

**A Mixed Methods Study of Oral Antibacterial
Prescribing in Primary Care Out-of-Hours Services in
Wales**

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Summary

The World Health Organization aims to combat antimicrobial resistance through strategies that include reducing unnecessary antimicrobial use. This global priority is reflected in the UK, including Wales, where national antimicrobial stewardship (AMS) plans guide efforts to optimise prescribing. Primary care accounts for approximately 80% of antibacterial prescriptions, with oral formulations representing the majority. Out-of-hours (OOH) services are an integral part of primary care that have gained momentum internationally; however, there is limited evidence on oral antibacterial prescribing practices within OOH services in Wales. Therefore, this thesis used mixed methods to explore oral antibacterial prescribing in OOH services through four studies. Study one conducted a scoping review to map current evidence on OOH antibacterial prescribing and identify knowledge gaps. Study two comprised two phases involving secondary analyses of prescribing and/or consultation data from primary care OOH services and the community pharmacy independent prescribing service (PIPS) during OOH periods to describe oral antibacterial prescribing over the available timeframe. Study three used interviews with key stakeholders to explore perspectives on oral antibacterial prescribing and factors influencing prescribing patterns. Study four also employed interviews to explore prescribers' experiences and decision-making when prescribing antibacterials in NHS 111, an OOH service model. The findings showed decreasing prescribing trends across primary care and OOH services, alongside rising PIPS prescribing driven by increased service use. Factors, including healthcare incidents and their consequences, influenced prescribing. The results also suggested limited awareness and oversight of OOH services among stakeholders, with challenges such as data availability and quality hindering identification of issues requiring targeted actions. Prescribing was context-dependent, shaped by access barriers, patient acuity, remote care challenges, and communication strategies adopted to optimise prescribing. Understanding determinants of prescribing is essential to inform feasible and effective interventions. Investment in integrated, efficient data infrastructure is crucial for enhancing evaluation, surveillance, and AMS.

Statement of Authorship

Chapter 2 of the thesis is based on the following published paper:

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SKA developed the methodology with the assistance of supervisors, KH and RD, and carried out the analysis and synthesis of findings. SKA led the writing of the paper, with input from KH, RD, and DE. The paper has been rewritten by SKA for its inclusion as a chapter in the thesis, which represents SKA's own work.

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List of Abbreviations

Abbreviation	Full
4Cs	Co-amoxiclav, cephalosporins, clindamycin, and ciprofloxacin/fluoroquinolones.
A&E	Accident and emergency
ABMUHB	Abertawe Bro Morgannwg University Health Board
ABUHB	Aneurin Bevan University Health Board
AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
APQI	Antibiotic prescribing quality indicator
(A/U)RTI	(Acute/upper) respiratory tract infection
AWAPG	All-Wales Antimicrobial Pharmacist Group
AWMSG	All-Wales Medicine Strategy Group
AWTTC	All-Wales Therapeutics and Toxicology Centre
BCUHB	Betsi Cadwaladr University Health Board
BNF	British National Formulary
C&C	Capacity and capability
CAP	Community-acquired pneumonia
CAS	Common Ailment Service
CASPA	Comparative Analysis System for Prescribing Audit
CDC	Centers for Disease Control and Prevention
CKS	Clinical Knowledge Summaries
COVID-19	Coronavirus disease 2019
CPD	Continuing professional development
(C)PIP	(Community) pharmacist independent prescriber
CRP	C-reactive protein
CSH	Clinical Support Hub
CSPPS	Cardiff School of Pharmacy and Pharmaceutical Sciences
CT(M)UHB	Cwm Taf (Morgannwg) University Health Board
CV	Curriculum Vitae
CVUHB	Cardiff and Vale University Health Board
DDD	Defined daily dose
DHCW	Digital Health and Care Wales
ESPAUR	English surveillance programme for antimicrobial utilisation and resistance
GAP	Global Action Plan
GAS	Group A Streptococcus
GCP	Good Clinical Practice
GDPR	General Data Protection Regulation
GMC	General Medical Council
GP	General practitioner
GPC	General practice cooperative
GPhC	General Pharmaceutical Council
HB	Health Board
HCAI	Healthcare associated infection
HCP	Healthcare professional
HCRW	Health and Care Research Wales
HDUHB	Hywel Dda University Health Board
HEIW	Health Education and Improvement Wales

Abbreviation	Full
HRA	Health Research Authority
ICE	Ideas, concerns, and expectations
IH	In-hours
(I/S)P	(Independent/Supplementary) prescribers
IPC	Infection prevention and control
IRAS	Integrated Research Application System
JB	Joanna Briggs Institute
JRO	Joint research office
LMICs	Low-and-middle income countries
LOA	Letter of Access
MDT	Multidisciplinary team
MMR	Mixed methods research
MSU	Midstream urine
NAP	National action plan
NHS	National Health Service
NICE	National Institutes for Health and Care Excellence
NIH	National Institutes of Health
NMIP	Non-medical independent prescriber
NP	Nurse prescriber
NPI	National prescribing indicator
NWSSP	NHS Wales Shared Services Partnership
OOH	Out-of-hours
PGDs	Patient Group Directions
PHW	Public Health Wales
PIPS	Pharmacy Independent Prescribing Service
PIS	Participant information sheet
POCT	Point-of-care test
PTHB	Powys Teaching Health Board
R&D	Research and development
REC	Research Ethics Committee
RPS	Royal Pharmaceutical Society
SBUHB	Swansea Bay University Health Board
SNOMED-CT	Systematised Nomenclature of Medicine Clinical Terms
SOP	Standard operating procedure
SSI	Skin and soft tissue infections
SSTF	Start Smart Then Focus
STAR-PU	Specific therapeutic group age-sex related prescribing units
STTT	Sore Throat Test and Treat
TARGET	Treat Antibiotics Responsibly, Guidance Education and Tools
UK	United Kingdom
UKHSA	UK Health Security Agency
USA	United States of America
UTI	Urinary tract infection
WAPSU	Welsh Analytical Prescribing Support Unit
WAST	Welsh Ambulance Services University NHS Trust
WG	Welsh Government
WHO	World Health Organization

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Chapter 1 Introduction

1.1 Thesis Conceptualisation: Personal Interest and Stakeholders Priority

My interest in antimicrobial drugs began early in my career as a pharmacist, where I saw their vital role in patient care and the growing problem of misuse and resistance. This interest deepened during my practice and MSc studies in Clinical Pharmacy, as I recognised the challenge of providing effective treatment while preserving antimicrobials for future use. Since then, I was determined to contribute to improving antimicrobial use in practice.

When the opportunity to pursue a PhD arose, I knew my research would focus on aspects of antimicrobial use. I began discussions with my supervisory team, and together we explored potential directions. We engaged with key stakeholders (Figure 1.1) to identify national antimicrobial stewardship (AMS) priorities and areas where evidence was needed. Among several ideas, one topic stood out during discussions with the Welsh Government (WG) representative: oral antibacterial prescribing in out-of-hours (OOH) services. Although it had received limited attention in Wales, stakeholders highlighted its importance. After further consultation, the focus was refined to prescribing in primary care OOH services. Since then, various stakeholders were involved throughout the research as needed, ensuring the research remained relevant to healthcare practice in Wales.

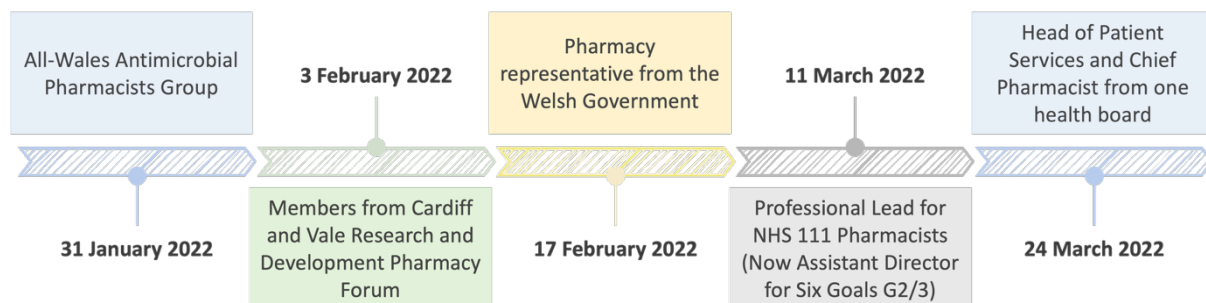


Figure 1.1: Early Engagement with Stakeholders

Key: NHS: National Health Service.

Stakeholder engagement has been advocated to improve healthcare research and ensure it addresses the needs of healthcare professionals (HCPs), patients, and decision-makers (Concannon et al. 2014). Involving them early helps refine research focus and enhance its relevance to align with actual needs (Concannon et al. 2014; Boaz et al. 2018). It also increases transparency throughout the research, fostering trust and collaboration (Mallery et al. 2012; Concannon et al. 2014; Boaz et al. 2018). Moreover, stakeholder engagement can accelerate the translation of findings into practice, thereby contributing to improved health outcomes (Concannon et al. 2014; Boaz et al. 2018).

1.2 Healthcare in Wales

The United Kingdom's (UK) health systems collectively form the National Health Service (NHS), including those of England, Wales, Scotland, and Northern Ireland. Since health became a devolved power in 1999, each nation has managed and regulated its own system (Institute for Government 2020), resulting in differences in the structure and delivery of healthcare services across the UK. In Wales, the WG oversees health policy and strategic planning, while NHS Wales delivers healthcare services through seven Health Boards (HBs), three Trusts, and two Special Health Authorities (Table 1.1) (NHS Wales n.d.-b). NHS Wales is also supported by affiliated organisations, such as NHS Wales Shared Services Partnership (NWSSP) (Welsh Government 2023c). These organisational arrangements reflect broader differences in healthcare models across the UK and internationally, including the abolition of prescription charges in Wales since 2007 (Groves et al. 2010).

Table 1.1: NHS Wales Organisation (Welsh Government 2023c; NHS Wales n.d.-b)

NHS Entity	Organisation Name	Role
Health Boards (HBs)	• Aneurin Bevan University (ABUHB). • Betsi Cadwaladr University (BCUHB). • Cardiff and Vale University (CVUHB). • Cwm Taf Morgannwg University (CTMUHB). • Hywel Dda University (HDUHB). • Powys Teaching (PTHB). • Swansea Bay University (SBUHB).	Plan, commission, and deliver health services in their geographical areas, including primary, secondary, and community care services.
Trusts	• Welsh Ambulance Services University NHS Trust (WAST).	Offers emergency/non-emergency ambulance services, handles 999, and manages NHS 111.
	• Velindre University NHS Trust.	Provides specialised cancer services and hosts the Welsh Blood Service.
	• Public Health Wales (PHW) NHS Trust.	National agency for protecting and improving health and wellbeing and reducing health inequalities.
Special Health Authorities	• Digital Health and Care Wales (DHCW).	Delivers digital services, support staff with systems, apps, and digital solutions to improve care.
	• Health Education and Improvement Wales (HEIW).	A strategic body for workforce in the NHS that leads on education, training, and development.
Other Health Agencies	• NHS Wales Shared Services Partnership (NWSSP).	Independent organisation; provides customer focused support functions and services to NHS Wales.

Key: NHS: National Health Service.

The NHS provides healthcare services at different levels, including primary care, secondary care, tertiary care, and community services (Welsh Government 2019c; Age Cymru 2024; NHS 111 Wales n.d.). Additional services also operate across these levels, with OOH services providing access to healthcare outside standard working hours (Figure 1.2). OOH services can be delivered in primary care (e.g., GP OOH) and secondary care (e.g., accident and emergency (A&E) and hospital admissions).

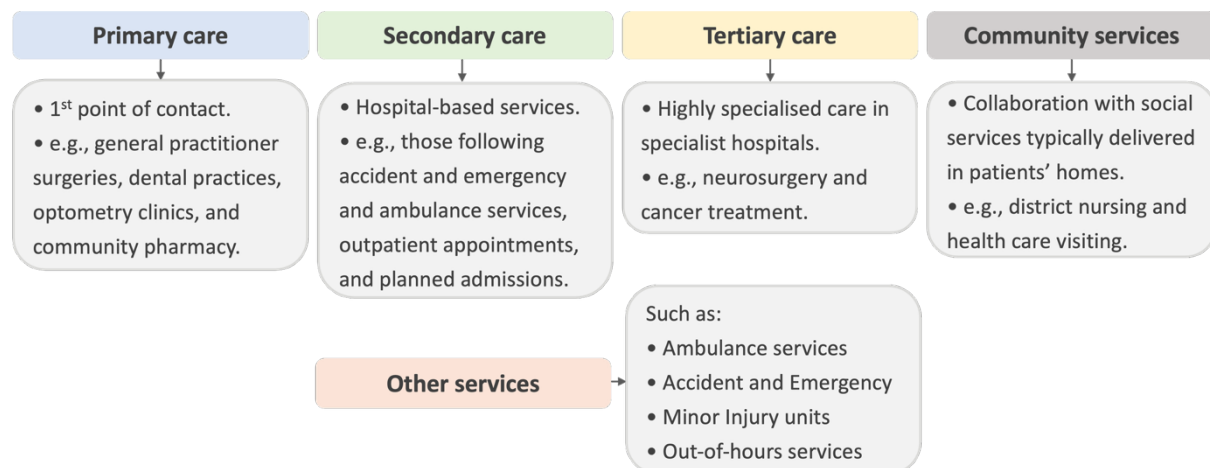


Figure 1.2: Levels of Care

1.3 Primary Care Out-of-Hours Services

Primary care OOH services offer care outside regular GP hours for urgent, non-emergency cases that cannot safely wait for in-hours (IH) services (National Audit Office 2014; Wales Audit Office 2018), reducing less-urgent emergency department use (Jones et al. 2020).

Organisational models of primary care OOH services vary within and between countries. Across 26 European countries, three to ten models exist per country, with GP cooperatives (GPCs)¹ being the most common (Steeman et al. 2020). Other existing models include individual GP practices, where GPs provide care for their own patients, and systems incorporating telephone triage (Steeman et al. 2020). These models also differ in their operational features. In the Netherlands, for example, OOH services are predominantly delivered by GPCs (van Uden et al. 2006; Steeman et al. 2020), operating from 17:00 to 08:00 on weekdays and from 17:00 Friday to 08:00 Monday, including holidays (den Boer-Wolters et al. 2010; Debets et al. 2017), and are mostly accessed via telephone triage (Smits

¹ GPCs are large-scale organisations of GPs sharing OOH duties for their combined patient population.

et al. 2019). The same model in Belgium operates from 19:00 Friday to 07:00 Monday and on holidays, without telephone triage (Smits et al. 2019). In the UK, OOH services run from 18:30 to 08:00 on weekdays and continuously over weekends and holidays (Royal College of General Practitioners [RCGP] 2019) with telephone triage as the primary access point (National Audit Office 2014; Wales Audit Office 2018).

Historically in the UK, GPs were obligated to provide 24-hour care for their patients until 2004, when a new contract was introduced allowing them to opt out of OOH care (House of Commons Health Committee 2004). In England, the responsibility for OOH services was shifted to Primary Care Trusts, and from 2013, to Clinical Commissioning Groups² known currently as Integrated Care Boards (National Audit Office 2014), while in Scotland it was assigned to HBs (NHS Scotland 2004). Patients accessed OOH services by calling local GP OOH services, which varied by region, or NHS Direct, a 24-hour nurse-led telephone and internet advice service (Department of Health [DH] 1997). This sometimes led to patients contacting both services for the same health episode.

In 2014, NHS 111 replaced NHS Direct nationally in England, offering a single point of access for urgent care (Pope et al. 2017). This free-to-call three-digit number operates 24 hours a day to provide advice to patients, and acts as the gateway to OOH services, allowing efficient and consistent access to care outside regular hours (NHS 2022). As the service in England is commissioned by Integrated Care Boards, this has resulted in a mixed-provider model in which services are delivered by various organisations, including private and non-profit providers (Evenstad 2014; Gibbins 2025). In Scotland, the service operates the same 111 number but is managed nationally by NHS 24 (NHS 24 2025), a national body established by the Scottish Government that function in a similar capacity to HBs (Evenstad 2014; Gibbins 2025).

1.3.1 Primary Care Out-of-Hours in Wales

In Wales, as in Scotland, HBs became responsible for ensuring their populations have access to OOH services when the 2004 contract was released (House of Commons Health Committee 2004), either by delivering care through their own staff via telephone or in-

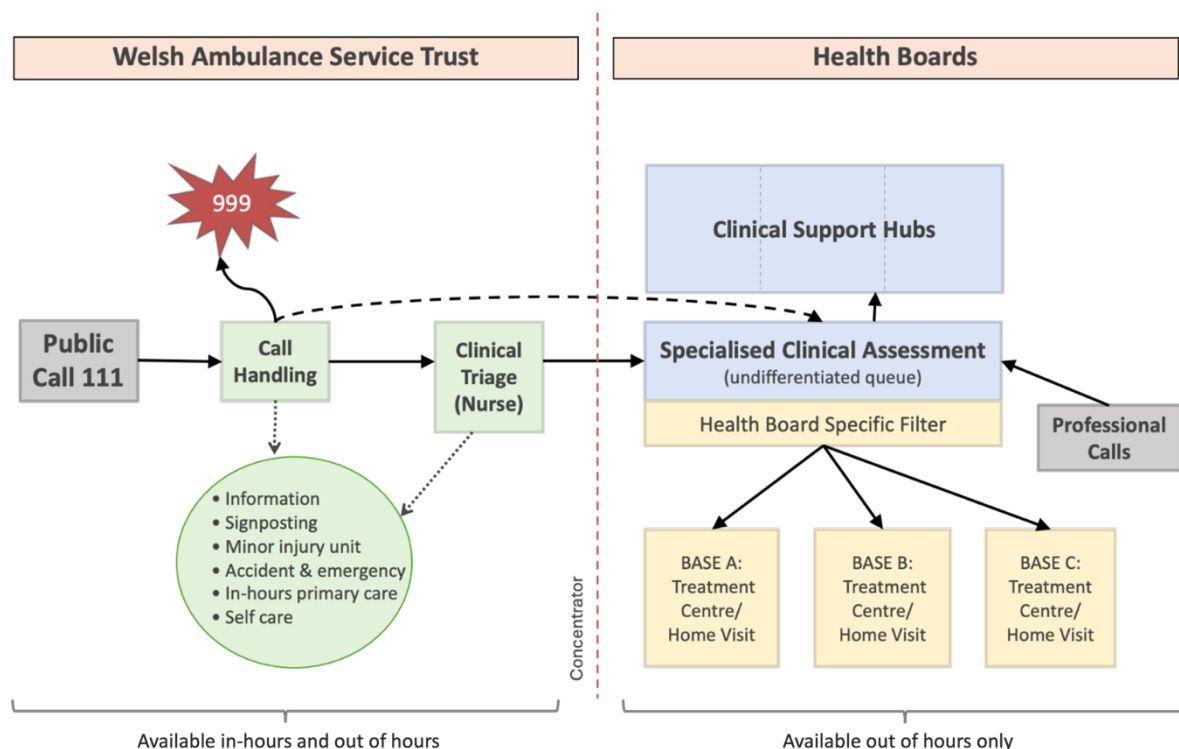
² Clinical Commissioning Groups are NHS organisations responsible for delivering healthcare services for their geographical area. These were replaced in 2022 by Integrated Care Boards as part of the NHS reorganisation.

person assessment, or by commissioning external providers (Wales Audit Office 2018). Although OOH services were originally GP-led, delivery has expanded to include other HCPs, including nurses, pharmacists, and paramedics (Wales Audit Office 2017,2018), reflecting challenges in recruiting and retaining GPs (Wales Audit Office 2013; Audit Wales Office 2017). In October 2016, the WG launched the NHS 111 pathfinder within specific HBs (Welsh Government 2018a), which was gradually expanded and implemented nationally by 2022 (Welsh Government 2023b), replacing GP OOH and NHS Direct numbers. NHS 111 Wales is managed by NHS WAST, and was developed as a distinct model tailored to the Welsh healthcare system (Robinson 2019).

1.3.2 How NHS 111 Service Operates in Wales

NHS 111 Wales operates via two integrated systems: a front-end system managed by WAST handling incoming calls, and a back-end system overseen by HBs supporting OOH services (Gibbins 2023b). When individuals call 111, an interactive voice response system directs them based on location, language preference, and inquiry type (e.g., new or worsening symptoms, dental advice, or medication queries). Calls concerning new or worsening symptoms are placed in a queue to speak with trained, non-clinical call handlers who use evidence-based algorithms and decision-support tools to guide safe and appropriate decisions. Each question asked during the assessment is underpinned by clinical rationale, enabling them to understand the purpose of each query and direct patients appropriately. Depending on the outcome, call handlers may offer self-care advice, signpost to alternative services (e.g., pharmacies), refer to a GP, minor injury units, A&E, or escalate to 999 where life-threatening emergencies are managed (Figure 1.3). Calls requiring clinical input are placed in a nurse-led clinical triage queue with a priority code (e.g., P1, P2) to indicate response urgency. Alternatively, call handlers may place the caller on hold and consult a nurse without queuing the case. The call handling and the nurse-clinical triage functions form the WAST-managed front-end system, which operate during IH and OOH periods.

The front- and back-end systems are connected via a software gateway, the concentrator, which is activated during OOH periods only to enable an additional output at the call handler and nurse triage stages. Its activation allows calls and patient information, such as demographics and triage responses, to flow into the back-end system for further assessment. Calls are also assigned to clinical advice queues with priority codes.



A key part of the back-end system is the three NHS 111 Clinical Support Hubs (CSHs), to which calls are routed. HCPs in these CSHs can pull calls into their hub queues based on their regional coverage (e.g., the West Hub covers calls from SBUHB, HDUHB, and CTMUHB), assess each case and determine the appropriate action. This may include offering self-care advice or prescriptions, making referrals, arranging home visits, or scheduling appointments with treatment centres (e.g., GP OOH) when an in-person consultation is needed (Figure 1.3). Prescriptions issued in these contacts are initially printed and electronically sent (via email or fax) to the patient's nominated pharmacy for collection. The original copies are then mailed to the pharmacy for compliance with regulatory requirements (Gibbins 2025).

A dedicated professional line also operates during OOH periods, allowing HCPs (e.g., district nurses, care home staff) to bypass the standard call handling. This facilitates timely discussions with HCPs in the hubs for advice or prescriptions for patients under their care.

In the UK, prescribing was historically restricted to medical prescribers (doctors and dentists); however, prescribing rights have expanded to other HCPs either as independent prescribers (IPs) or supplementary prescribers (SPs). A major milestone was the introduction

of non-medical independent prescribing in 2006 (England) and 2007 (Wales) (DH 2006; National Assembly for Wales 2007), enabling qualified pharmacists and nurses, to assess, diagnose, and prescribe independently (DH 2005; 2006). Currently, they have legal authority to prescribe any licensed, unlicensed, or controlled drugs (schedule 2–5) within their competence except diamorphine, cocaine, and dipipanone for addiction treatment (DH 2010,2012). These rights have expanded further to other professions (Figure 1.4), though each has specific prescribing limits (Human Medicines Regulations 2008,2013,2016,2018).

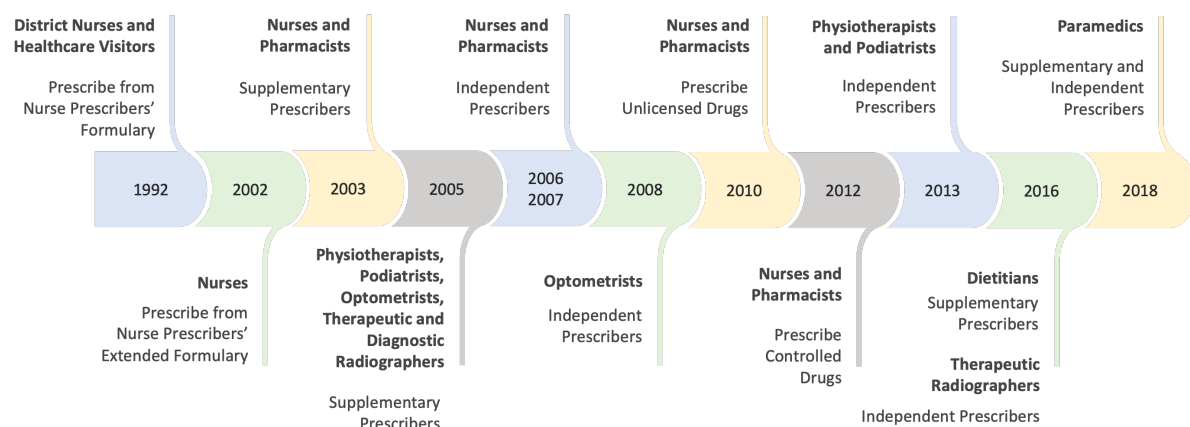


Figure 1.4: Non-Medical Prescribers in the United Kingdom

1.4.1 Pharmacist Independent Prescribers in Wales

Although non-medical independent prescribing has been implemented across healthcare sectors, the majority of those qualified in Wales were initially based in secondary care (Courtenay et al. 2017a). However, with the WG's commitment to strengthening and expanding the primary care workforce (Welsh Government 2018b), more pharmacists have taken roles in GP practices (Hodson et al. 2017). This was accompanied by a growing focus on managing acute conditions, particularly infections, where antibacterial treatment may be required (Hodson et al. 2017).

Pharmacists have also taken on roles as prescribers in OOH services (NHS 111 CSHs) since 2018 (Anon. 2018; Wickware 2019). These roles require advanced clinical skills, as pharmacists manage various acute presentations (e.g., urinary tract infections (UTIs), sore throat, skin conditions) and medicine-related queries, missed doses, and repeat prescriptions (Robinson 2019). To prepare for these responsibilities, NHS 111 pharmacists complete a transition programme supported by a training portfolio to ensure competence

and confidence (Robinson 2019). Participants have 12 months to complete their portfolio by reviewing learning outcomes, using self-directed resources, and participating in monthly moderated peer discussions. They demonstrate learning through practice-based assessments, receive feedback, and undertake an end-of-training assessment, with successful performance leading to a certificate of completion (Royal Pharmaceutical Society [RPS] n.d.-b).

The expanded role of pharmacists has also transformed community pharmacy services in line with Wales strategic vision of moving care closer to home (Welsh Government 2018b). Beyond their traditional dispensing role, community pharmacists now deliver more clinical services, such as the Common Ailments Service (CAS) introduced in 2013 (Welsh Government 2012). Additionally, the Pharmacy Independent Prescribing Service (PIPS) was piloted in 2020 and launched nationally in 2022, enabling community pharmacists qualified as IPs to manage specified conditions including infections (e.g., UTIs, skin, and upper respiratory infections) (Community Pharmacy Wales 2025a; NHS Wales Shared Services Partnership 2025). Many pharmacies deliver these services during OOH periods, enhancing access and reducing demands on other services.

1.5 Prescribing in Primary Care Out-of-Hours Services

Primary care is central to healthcare delivery, accounting for most patient encounters and antimicrobial prescriptions (Goossens et al. 2005; Song et al. 2025). Globally, an estimated 80–90% of antibiotics are prescribed in this sector (National Institute for Public Health and the Environment 2023; Norwegian Institute of Public Health 2025; World Health Organization [WHO] 2025b). In the UK, primary care accounts for around 80% and 83% of antibiotic prescriptions in England (UK Health Security Agency [UKHSA] 2024a; 2025) and Scotland, respectively (National Services Scotland 2022,2024), with at least 20% of these considered inappropriate (Public Health England 2018). While comparable data for Wales are not publicly available, a national audit has reported higher primary care antimicrobial use in Wales than in England (All Wales Medicines Strategy Group [AWMSG] 2022a), indicating a persistent AMS challenge.

According to earlier data from the English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR), ‘other community settings’ category beyond GP

practices, such as OOH services, walk-in centres, prisons, and care homes, accounted for 5.5% of prescribing (UKHSA 2021a). Notably, OOH services were estimated to represent 55.5% of this category (UKHSA 2021a), highlighting their contribution to overall prescribing. In the most recent ESPAUR report, however, OOH services represented 31.4% of community prescribing, largely due to the new inclusion of Pharmacy First³ data, which accounted for 34.5% of this category, alongside a 5% reduction in OOH prescribing between 2023 and 2024 (UKHSA 2025). Similar figures for OOH prescribing in Wales are currently lacking.

Infection-related consultations are common in OOH services, representing 26.2% of OOH consultations in the Netherlands and frequently leading to antimicrobial treatment (Giesen et al. 2006). Across Europe, between 15% and 33% of OOH encounters resulted in an antibiotic prescription, about 15% in England, Denmark, and Norway (Huibers et al. 2014; Hayward et al. 2016; Lindberg et al. 2017), 17% in Ireland (Shah et al. 2024), and 33% in Iceland (Palsdottir et al. 2020). Higher prescribing rates were also seen on weekends compared to weekdays (Huibers et al. 2014; Tandan et al. 2015), which may reflect differences in case mix and demands during these periods.

Studies have also reported proportionally higher antibiotic prescribing in OOH services compared with IH services (Debets et al. 2017; Edelstein et al. 2017), although this could be attributed to the acuity of patients accessing OOH services. However, prescribing in Norwegian OOH services for respiratory tract infections (RTIs) was found to be comparable to standard IH services (Lindberg et al. 2017). While this may suggest consistent clinical approaches across services, the narrow focus on RTIs may limit the generalisability to overall prescribing. Comparisons across countries should also be interpreted cautiously, considering the differences in OOH arrangements. Despite the clinical necessity in many cases, inappropriate prescribing remains a concern, with some claims that OOH services issue more irrational antibiotic prescriptions than IH care (Dyrkorn et al. 2016).

Following the onset of Coronavirus disease 2019 (COVID-19), a general reduction in antibiotic prescribing was observed across primary care IH and OOH services in several European countries (Colliers et al. 2021b; Hek et al. 2022; Krogh et al. 2024; Shah et al.

³ From 31 January 2024, pharmacies participating in the Pharmacy First service in England can supply prescription-only medicines (including antimicrobials) for 7 common conditions: earache, sore throat, sinusitis, impetigo, shingles, uncomplicated UTIs in women, and infected insect bites.

2024). This reduction was likely driven by many factors, such as fewer RTI encounters, altered health-seeking behaviours, and the impact of pandemic-related restrictions such as national lockdowns and social distancing.

Evidence on antibiotic prescribing specifically within primary care OOH services in the UK is limited, with only one identified study from England. Zhu et al. (2021b) found that while IH antibiotic prescribing declined before the first pandemic wave, OOH prescribing remained relatively stable, with a higher proportion of broad-spectrum antibiotics. However, following the pandemic, both services experienced a decline in overall antibiotic prescribing but an increase in broad-spectrum drug prescribing (Zhu et al. 2021b), reinforcing the impact of COVID-19 on prescribing practices.

In Wales, antibiotic dispensing in primary care during COVID-19 has been reviewed at the GP practice level. Findings showed an overall reduction in dispensing during the post-pandemic period (2020–2021) compared to the pre-pandemic levels (2018–2019), with monthly rates per 1,000 patients ranging from 39.3 to 49.1 items versus 48.5 to 67.4 previously. However, this analysis did not include OOH services (Wasag et al. 2021). Given the pandemic's impact on clinical practices and the absence of OOH-specific prescribing data in Wales, investigating antimicrobial prescribing in these settings has become an important area of inquiry.

1.5.1 Prescribing in Remote Consultations

Healthcare delivery has increasingly incorporated remote consultations, a shift that accelerated during the COVID-19 pandemic. In the UK, 90% of GP consultations were conducted remotely in April 2020 (first month of the lockdown) compared to 33% during the same period in 2019 (Murphy et al. 2020).

Although remote care could improve accessibility, it may also increase unnecessary prescribing. A systematic review of 12 studies could not conclude whether remote consultations significantly affected antibiotic prescribing (Han et al. 2020). However, many studies, though observational, have reported higher antibiotic prescribing rates during remote consultations than during face-to-face encounters (Mehrotra et al. 2013; Ray et al. 2019; Penza et al. 2020; Krogh et al. 2024). This could be attributed to increased clinical uncertainty, as the absence of face-to-face assessment limits the ability to observe visual

cues and perform and run thorough examinations and investigations (Stahl and Dixon 2010; Mehrotra et al. 2013; Gordon et al. 2017; Baillie et al. 2024). Consequently, HCPs may adopt a more cautious approach, prescribing antimicrobials when infection is suspected but not confirmed (Mehrotra et al. 2013).

OOH services in the UK have long relied on remote consultations, even before COVID-19, except when in-person assessment is clinically required. This reliance exacerbates the challenges observed during the pandemic, particularly around diagnostic uncertainties and its influence on prescribing decisions, where HCPs in these settings face additional pressures that may affect care quality and consistency. These include managing unfamiliar patients, high-pressure environments, and variable access to medical records (Al-Najjar 2016; Williams et al. 2018). Time constraints, limited diagnostic tools, and the lack of follow-up opportunities further complicate clinical decision-making (Colliers et al. 2018). Understanding how this care modality and associated pressures affect antimicrobial prescribing is critical to optimise practices in remote and urgent care settings.

1.6 Antimicrobial Therapy

Antimicrobial drugs are agents used to prevent or treat infections, either by killing microorganisms or inhibiting their growth (Purssell 2020). This category includes antibacterials, antivirals, antifungals, and antiparasitics (Adzitey 2015). When infection is strongly suspected, empirical antimicrobial treatment, guided by clinical judgement and likely pathogens prior to test or culture results, is recommended following evidence-based guidelines. The choice of antimicrobial drug is typically informed by the patient's clinical presentation, which helps infer the likely causative pathogen (Leekha et al. 2011). Therapy should then be adjusted (e.g., discontinued, de-escalated, or switched to a more appropriate drug) based on clinical response and culture results obtained before treatment, with susceptibility profile directing subsequent therapy. In addition to treating active infections, antimicrobials are used prophylactically in patients at risk of infection, such as those undergoing certain surgical procedures (Leekha et al. 2011).

Antimicrobials can be classified in several ways: by the microorganism targeted (e.g., antibacterial, antiviral, antifungal), mechanism of actions (e.g., cell wall or protein synthesis inhibitors), chemical structure (e.g., beta-lactams), spectrum of activity (narrow-, broad-, or

extended-spectrum), pharmacodynamic properties (bactericidal vs. bacteriostatic; time- vs. concentration-dependent), or origin (natural, semisynthetic, or synthetic) (Calderón and Sabundayo 2007; Giguère 2013; Adzitey 2015). The term antibiotics refers to drugs produced naturally from living organisms; however, for simplicity, it is often used broadly to include synthetic and semisynthetic antibacterial drugs (Nathwani 2018; Purssell 2020).

The discovery of antimicrobial drugs has shaped modern medicine. The first effective agent, salvarsan, was synthesised in 1909 by Paul Ehrlich for syphilis treatment (Hoel et al. 1997). In 1928, Alexander Fleming discovered penicillin, the world's first true antibiotic, when a mould contaminating a *Staphylococcus* culture inhibited bacterial growth (Hoel et al. 1997). These discoveries paved the way for the development of numerous others, particularly between the 1940s–1960s, known as the era of antibiotics (Bockstael and Aerschot 2009). These agents were considered wonder drugs at the time, capable of curing fatal infections and transforming outcomes (Zaman et al. 2017). However, their inappropriate use contributed to the rise of antimicrobial resistance (AMR) (Tang et al. 2023).

The development of new antimicrobials has slowed in the last decades (Gelband 2015; WHO 2020b). High development costs, high failure rates, and low returns on investment have deterred pharmaceutical companies from pursuing new drugs (Jackson et al. 2018). Only a few major companies (e.g., Novartis, GlaxoSmithKline, Merck and Roche) were reported to remain active in antibiotic research and development (R&D) (Jackson et al. 2018). These tend to focus on improving existing drugs (e.g., developing formulations that require less frequent dosing) rather than investing in novel ones (Jackson et al. 2018). As innovation declines and AMR rises, the pool of effective treatments has been reduced, emphasising a need to preserve their efficacy (WHO 2020b).

1.7 Antimicrobial Resistance

AMR is increasing rapidly worldwide, posing a major global health threat (Murray et al. 2022; WHO 2023a). It occurs when microorganisms develop mechanisms to survive exposure to antimicrobial drugs developed to eliminate them (Nelson et al. 2019), leaving patients vulnerable to serious, difficult-to-treat infections with limited treatment options (National Institute for Health and Care Excellence [NICE] 2018a; WHO 2023a). These mechanisms vary among bacterial species (Table 1.2).

Table 1.2: Examples of Mechanisms of Antimicrobial Resistance (Reygaert 2018)

Mechanisms	Examples / Explanation	Drug Affected (Examples)
Limiting drug uptake	- Decreased or changed selectivity of porin (protein on the outer cell membrane). - Loss or modification of outer cell wall.	β -lactams, tetracyclines.
Modification of drug targets	Mutations at the binding site (e.g., altered penicillin-binding protein, ribosomal methylation).	β -lactams, fluoroquinolones.
Drug inactivation	Production of enzymes that destroy or modify the drug (e.g., β-lactamase, aminoglycoside-modifying).	β -lactams, aminoglycosides.
Efflux pumps	Multi-drug resistance pumps expel the drug from the cell, lowering intracellular drug concentration.	Macrolides, fluoroquinolones.

AMR has serious clinical consequences, including prolonged illness, extended hospitalisation, delayed treatment, reduced ability to prevent infections during medical or surgical procedures, treatment failure, and increased mortality (Friedman et al. 2016). It also imposes a significant economic burden, including direct (e.g., cost of care) and indirect costs (e.g., reduced productivity due to sickness) (WHO 2015; Friedman et al. 2016).

AMR causes an estimated 700,000 deaths each year, a number projected to reach 10 million deaths annually by 2050 without effective action, alongside a predicted global economic loss of \$100 trillion (O'Neill 2016). A more recent estimate from 2021 recorded 1.14 million deaths (Naghavi et al. 2024), indicating that the global burden of AMR is greater than previously suggested. High-income countries reported 124,722 deaths directly attributable to AMR, including 41,872 deaths in North America and 46,068 in Western Europe (Institute for Health Metrics and Evaluation [IHME] 2024). The impact is substantially greater in low- and middle-income countries (LMICs), where infectious diseases are more prevalent and access to newer, effective, and typically expensive drugs is limited (Klein et al. 2019). South Asia recorded 334,671 deaths and Sub-Saharan Africa 209,245 deaths, with *Mycobacterium tuberculosis* responsible for 25% and 23% of deaths in these regions, respectively. Southeast Asia, East Asia, and Oceania reported 270,278 deaths, with *Staphylococcus aureus* causing 18% of them (IHME 2024).

In the UK, 5,841 deaths were attributable to AMR in 2021 (IHME 2024). Within England alone, severe resistant infection rose by 12.8%, from 59,171 in 2018 to 66,730 in 2023, with a decline during the COVID-19 pandemic (UKHSA 2024a). This reduction was likely due to changes in guidelines and antimicrobial use, testing capacity, patient behaviour, and

pandemic restrictions, including lockdowns, limited travel, social distancing, concerns about accessing healthcare services, which reduced infections and transmission (UKHSA 2021a). From 2019 to 2024, resistant infections increased by 13.1%, reaching 20,484 episodes in 2024, with a 9.3% increase occurring between 2023 to 2024 alone (UKHSA 2025). While specific figures for Wales are not published, available data from PHW highlight the increasing burden of AMR and resistant infections in the country (Public Health Wales 2025). These trends highlight the urgent need for coordinated efforts to counteract AMR and mitigate its impact.

1.8 Antimicrobial Stewardship

The term antimicrobial stewardship (AMS) was first introduced in the literature in 1996, emphasising the need to determine how to control AMR and ensure antimicrobial-use stewardship (McGowan and Gerding 1996). The Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) released guidelines the following year, highlighting that preventing AMR requires optimal AMS through appropriate drug selection, dosing, and duration, alongside strong infection control measures to limit the spread of resistant organisms (Shlaes et al. 1997). Since then, hospitals worldwide have begun implementing AMS programmes, supported by individual national and international guidance on prudent antimicrobial use from agencies such as the World Health Organization (WHO) (WHO 2001), Centers for Disease Control and Prevention (Centers for Disease Control and Prevention [CDC] 2002), and IDSA/SHEA (Dellit et al. 2007).

Over time, AMS has evolved from a clinical concept into a central strategy for addressing AMR by promoting responsible antimicrobial use across healthcare settings (Charani and Holmes 2019; Department of Health and Social Care 2019b). Although definitions may slightly vary across health organisations, they consistently describe structured, systematic efforts to optimise antimicrobial use. The WHO defines AMS as *“a coherent set of integrated actions which promote the responsible and appropriate use of antimicrobials to help improve patient outcomes across the continuum of care”* (WHO 2023d). It involves *“coordinated interventions designed to promote the optimal use of antibiotic agents, including the decision to use them, drug choice, dosing, route, and duration of administration”* (WHO 2021a). Similarly, the National Institute for Health and Care

Excellence (NICE) defines it as “*an organisational or healthcare-system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness*” (NICE 2015a, p. 8).

According to Doron and Davidson (2011), AMS has three main goals:

- Ensuring patients receive optimal antimicrobial therapy (appropriate selection, dosing, and duration, and de-escalation to pathogen-targeted treatment).
- Preventing inappropriate or unnecessary antimicrobial use across care settings.
- Minimising the development of AMR.

1.8.1 AMS Implementation and Interventions

Effective AMS requires a structured framework to support implementation. The CDC offers stewardship guidance for healthcare settings (Table 1.3 provides a hospital example), highlighting that AMS is an ongoing, adaptive process (CDC 2019; 2024). Leadership support, defined accountability, and access to expertise are identified as key to its success.

Moreover, tracking AMS data and transparent reporting of these to stakeholders can help inform targeted stewardship education and drive evidence-based actions (CDC 2024).

Table 1.3: The Core Elements of Hospital Antimicrobial Stewardship Programmes (CDC 2019)

Core Element	Description
Hospital leadership	Dedicate necessary human, financial, and information technology resources.
Accountability	Appoint a leader or co-leaders (e.g., physician and pharmacists) responsible for programme management and outcomes.
Pharmacy expertise	Appoint a pharmacist, ideally as the co-leader of the stewardship programme, to help lead implementation efforts to improve antibiotic use.
Action	Implement intervention, such as prospective audit and feedback or preauthorisation, to improve antibiotic use.
Tracking	Monitor antibiotic prescribing, impact of interventions, and other important outcomes, like <i>Clostridium difficile</i> infections and resistance patterns.
Reporting	Regularly report information on antibiotic use and resistance to prescribers, pharmacists, nurses, and hospital leadership.
Education	Educate prescribers, pharmacists, nurses, and patients about adverse reactions from antibiotics, antimicrobial resistance, and optimal prescribing.

Various AMS interventions have been applied across healthcare settings (WHO 2021a).

These can generally be classified into four types (Davey et al. 2017):

- Structural (e.g. introducing new diagnostic or screening tools).

- Persuasive (e.g. conducting audits with feedback).
- Enabling (e.g. implementing clinical guidance or delivering education).
- Restrictive (e.g. requiring specialist approval for certain antimicrobial drugs).

Some interventions may be implemented before or during prescribing, such as developing organisation-specific guidelines, establishing local antibiograms (periodic summaries of antimicrobial susceptibility patterns from patient isolates within an institution or region (Truong et al. 2021)), restricting antimicrobial authorisation, conducting allergy de-labelling (reviewing allergy history and testing to remove inaccurate allergy records), and delivering education for HCPs, patients, and the public (e.g., training or awareness campaigns) (WHO 2021a). Interventions may also be conducted after prescribing, including audits and feedback, antimicrobial review and reassessment, and optimisation of dose and duration (WHO 2021a).

1.8.2 Global Policy and Action

With limited progress in addressing AMR, the WHO introduced the first Global Action Plan on AMR (GAP-AMR) in May 2015 (Figure 1.5; the UK and Wales elements of the timeline will be discussed below), elevating AMR from a local concern to a global public health priority. The plan promoted a One Health approach, a coordinated, multisectoral framework that acknowledges the interconnection between human, animal, and environmental health (WHO 2023a), and sought to unite countries around a common strategy. The GAP-AMR outlined five strategic objectives (WHO 2015, p. 1):

1. *“Improve awareness and understanding of AMR through effective communication, education and training.”*
2. *“Strengthen the knowledge and evidence base through surveillance and research.”*
3. *“Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures.”*
4. *“Optimise the use of antimicrobial medicines in human and animal health.”*
5. *“Develop the economic case for sustainable investment that takes account of the needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines and other interventions.”*

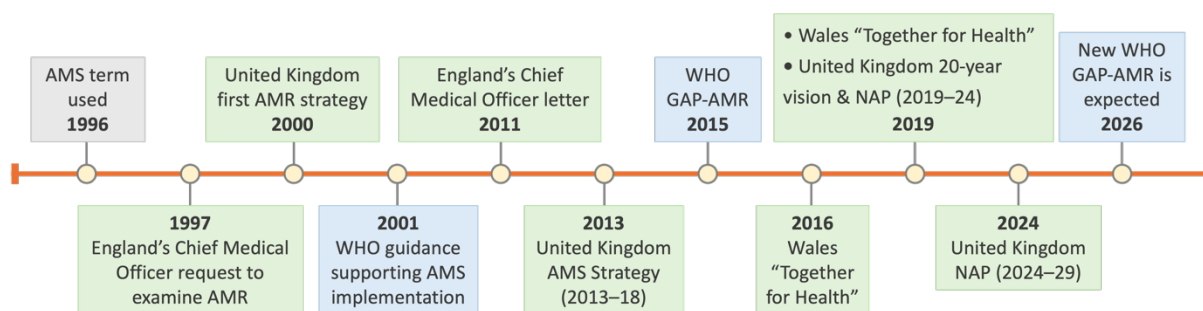


Figure 1.5: Key Policy and Plan to Tackle AMR

Key: AMR: antimicrobial resistance; AMS: antimicrobial stewardship; GAP: global action plan; NAP: national action plan; WHO: World Health Organization.

Member States were urged to develop national action plans (NAPs) based on GAP-AMR. To support surveillance, the WHO launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) in 2016, representing the first standardised international system to collect, analyse, and report national data on AMR in humans (WHO 2018a). Antimicrobial use data, previously reported independently, were added into the GLASS in 2019, with the first integrated report published in 2020 (WHO 2018b; 2020a).

By the end of 2023, 178 countries had developed NAPs aligned with the GAP-AMR. Of these, 68% had begun implementation, and 25% had progressed further by undertaking costing and budgeting and establishing monitoring and evaluation frameworks. Information on the remaining countries was not reported, though these may still be in the early stages of development or implementation planning. Notably, only 10% of countries had allocated specific financial resources for implementation (Quadrupartite Joint Secretariat on Antimicrobial Resistance 2025). Drawing on lessons learned and identified gaps, a revised GAP-AMR is expected to be adopted in 2026 to strengthen the One Health response (Quadrupartite Joint Secretariat on Antimicrobial Resistance 2025; WHO 2025a).

1.8.3 AMS Efforts in the United Kingdom

The UK began addressing AMR early, with England's Chief Medical Officer requesting a Standing Medical Advisory Committee to examine AMR in relation to prescribing practice (Standing Medical Advisory Committee 1998). The first national AMR strategy was published in 2000 (DH 2000) responding to the Committee's report, which identified AMR as a major public health issue. This three-year plan aimed to reduce morbidity and mortality from

resistant infections and preserve antimicrobial effectiveness in humans and animals, through surveillance, infection control, and prudent antimicrobial use (DH 2000).

The escalating AMR risk was further emphasised in England's Chief Medical Officer's 2011 report, which described rising resistance as a major threat and called for urgent action (Davies 2013). Guided by this report, the UK launched its 5-year AMR strategy in 2013, with a primary goal of slowing AMR progression. The strategy centred on enhancing AMR knowledge, stewarding available antimicrobial effectiveness, and encouraging the development of new treatments and diagnostics (Department of Health and Social Care [DHSC] 2013).

In January 2019, the UK Government released its 20-year vision to contain and control AMR by 2040, aligning with the global initiatives (DHSC 2019a). It also warned that, by 2030, global antimicrobial use is expected to rise by over 30%, and up to 200% if current increasing rates continue (DHSC 2019a). To support progress towards this long-term vision, the 2019–24 NAP (the first in a series of four) was published in the same month, focusing on reducing the burden of infections, optimising antimicrobial use, and investing in novel interventions, including vaccines, therapies, and diagnostics (DHSC 2019b). The plan set ambitious targets: a 15% reduction in human antimicrobial use by 2024, a 10% decrease in human resistant infections by 2025, and a 25% reduction in antimicrobial use in food-producing animals by 2020 (DHSC 2019b). Progress to these targets was mixed, with only the animal use reduction target achieved, while human resistant infections increased by 15% since 2018 (National Audit Office 2025a).

The second 5-year NAP (2024–29) has been developed building on lessons learned and gaps identified. It focuses on nine outcomes under four main themes (UK Government 2024):

1. Reducing the need for, and unintended exposure of antimicrobials.
2. Optimising antimicrobial use.
3. Investing in innovation, supply, and access.
4. Being a good global partner.

The new plan set more achievable targets (National Audit Office 2025a), including a 5% reduction in the total antimicrobial use by 2029 from 2019 levels (UK Government 2024).

At the UK level, national AMS initiatives have been implemented across the different nations to promote responsible antimicrobial use and strengthen AMS (UKHSA 2021a), a

crucial component of national action and strategic plans (DHSC 2013; 2019b). A key example is the Start Smart Then Focus (SSTF) toolkit which was introduced in 2011 and updated in 2015 for secondary care use (Public Health England 2015). It advises HCPs to have action plans and conduct routine audits, at least annually, to evaluate their compliance with AMS principles. This includes documenting indications and treatment duration, reviewing antimicrobial use 48–72 hours post-initiation, and ensuring prompt therapy aligns with local guidelines and resistance patterns. The Antibiotic Review Kit is another UK-wide hospital-based intervention, informed by SSTF, to support HCPs to review and revise decisions through a decision aid, audit resources, and information for HCPs and patients (Roy-Bentley et al. 2022). While for primary care, the TARGET (Treat Antibiotics Responsibly, Guidance Education and Tools) toolkit was launched in 2012. TARGET is designed for use in GP surgeries, OOH settings, and pharmacies (RCGP 2012; UKHSA 2021b). It provides HCPs and patients with access to AMS resources, such as treatment guidelines, educational materials, and audit tools to support judicious prescribing (RCGP 2012).

Regional initiatives have further supported reduced unnecessary prescribing. In England, examples include the Quality Premium, which provides financial incentives to Clinical Commissioning Groups for meeting prescribing targets and improving service quality (NICE 2018a). The Point-of-Care Antimicrobial Stewardship Tool (POCAST) integrates national antimicrobial guidelines into GP workflow, including OOH services, to provide clinicians with quick access to relevant, up-to-date guidance at the point of care (Davenport 2016; Imperial College London n.d.). Additionally, the Prescribing and Quality Innovation Programme (PrescQIPP) hub is another initiative that offers tools, guidance, and training across clinical areas, including AMS, to support HCPs (PrescQIPP 2025). In Scotland, the Scottish Reduction in Antimicrobial Prescribing (ScRAP) toolkit supports primary care prescribing improvement through educational resources, audit tools, and decision aids (Scottish Antimicrobial Prescribing Group 2021; NHS Education for Scotland n.d.). Moreover, the Scottish Management of AMR action plans (ScotMARAP1 and 2) were developed by the Scottish Government to slow the emergence and spread of AMR (Scottish Government 2014).

1.8.4 AMS Efforts in Wales

As a devolved nation, Wales also aligns its actions with the UK-wide AMR strategies, including the 20-vision and 5-years plans (Welsh Government 2024d). Together for Health

(2016) was the first AMR delivery plan in Wales. It established a human health-focused framework built around key priorities: optimising antimicrobial use, infection prevention and control (IPC), surveillance, education and training, and research (Welsh Government 2016). PHW also launched the healthcare-associated infection (HCAI), AMR, and Prescribing (HARP) programme in 2017 to strengthen surveillance and monitoring, although data are not publicly available (Welsh Parliament 2023). In 2019, a new plan was introduced extending the Together for Health (2016) approach to address AMR in animals and the environment (Welsh Government 2019a).

The WG has issued guidance and improvement goals to support the UK NAP, promoting prudent prescribing across primary and secondary care. One key goal was to reduce community antimicrobial usage by at least 25% from the 2013–14 baseline by 2024 (Welsh Government 2022a,2023a). Data from 2016–17 to 2020–21 indicated that all HBs have met or exceeded this goal (Welsh Government 2022a). However, a more recent report showed a reversal in this trend, largely influenced by the Group A Streptococcus (GAS) incident in 2022 (Welsh Government 2023a). By the end of the ten-year period, a 19.8% reduction was achieved, demonstrating a good progress. The new primary care goal targets a minimum of 10% reduction by 2029–30, using 2019–20 as the baseline (Welsh Government 2024a).

National Prescribing Indicators (NPIs) have been established to drive further improvements, with AMS prioritised over the years. These indicators provide measurable targets to promote rational use, comparing prescribing across HBs and GP practices against agreed standards (Table 1.4) (AWMSG 2022b,2024a). Alongside the overall antibacterial target, the NPIs set a specific target for the 4C antibacterials: co-amoxiclav (amoxicillin-clavulanate), cephalosporins, clindamycin, and ciprofloxacin (and other fluoroquinolones). Reducing the use of these drugs is a key AMS focus due to their broad-spectrum activity and association with *Clostridium difficile* infections as they disrupt the gut microbiota (NICE 2015b; Tydeman et al. 2021). Their use is therefore restricted to cases where narrow-spectrum alternatives are ineffective or inappropriate (NICE 2015b).

Data from December 2022 showed an increase in total antibacterial prescribing by 14.7% but a 12.5% reduction in 4Cs compared with the 2019-20 baseline (All Wales Therapeutics and Toxicology Centre [AWTTC] 2022). By June 2025, total antibacterial prescribing

decreased by 14.1% from 2019-20 baseline and 4C prescribing by 13.6% compared to the previous year, in line with the indicators (AWTTC 2025).

Table 1.4: Antimicrobial Stewardship National Prescribing Indicators for 2022–25 (AWMSG 2024a)

Applied to	Unit(s) of Measure	Target	Source
Primary care	Total antibacterial items per 1,000 STAR-PUs (a measure that adjusts prescribing data for differences in patient age and sex).	Health Board target: a quarterly reduction of 10% against a baseline of April 2019–March 2020†. GP Practice target: Maintain performance levels within the lower quartile, or show a reduction towards the quartile below.	NWSSP
	Number of 4C antimicrobial items per 1,000 patients§.	GP Practice target: Maintain performance levels within the lower quartile, or show a reduction towards the quartile below.	NWSSP

† Updated. Target for 2022–23 was a 5% reduction.

§ 2022–23 health board target was a quarterly reduction of 10% against 2019–20 baseline.

4C: co-amoxiclav, cephalosporins, fluoroquinolones, clindamycin; GP: general practitioner; NWSSP: NHS Wales Shared Services Partnership; STAR-PUs: specific therapeutic group age-sex related prescribing units.

Significant outcomes have been achieved guided by the NAP. These include collecting the first antibiotic usage data for the dairy, beef, and sheep sectors, and collaborating through the Arwain DGC project⁴ which earned UK and international recognition, to reduce antibiotic use in food-producing animals (Welsh Government 2024d). Wales, in partnership with NHS Wales pharmacists, also introduced antimicrobial prescribing guidance for primary and secondary care and developed ‘Antibiotic Eye’, an interactive antimicrobial library providing NHS staff with access to antimicrobial use and resistance data across both settings (Public Health Wales 2023a; Welsh Government 2024d). The efforts continue under the second NAP, with ongoing commitment to tackling AMR.

1.9 Antimicrobial Pharmacists in the United Kingdom

The development of antimicrobial pharmacist roles in the UK was driven by the Hospital Pharmacy Initiative. In 2003, the Department of Health allocated £12 million over three

⁴ The Arwain DGC (Defnydd Gwrthfoteg Cyfrifol - Responsible Antimicrobial Use) project is a Welsh Government-supported partnership initiative aimed at reducing AMR in livestock and horses across Wales. It is delivered in partnership by multiple organisations including: Menter a Busnes (lead organisation), Aberystwyth Veterinary School, Welsh Lamb and Beef Producers, Iechyd Da, and University of Bristol.

years to support clinical pharmacy services and expand pharmacists' responsibilities (DH 2003). Chief pharmacists were tasked with overseeing antimicrobial use within their trusts to reduce HCAs. These efforts led to key advancements, including updating local guidelines, enhancing collaboration between microbiology, infectious diseases, and pharmacy teams, attending ward rounds in high-use specialities (e.g., intensive care and infectious diseases), and educating HCPs on prudent antimicrobial use (Wickens and Jacklin 2006; Gilchrist et al. 2015). These interventions have been associated with improved antimicrobial utilisation, reduced hospital stays, and enhanced clinical outcomes (e.g., lower methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile* infections) (Gilchrist et al. 2015).

Since then, antimicrobial pharmacists have become integral, especially in secondary and tertiary care. Their importance was reinforced by the Department of Health's recommendation that all trusts establish an antimicrobial management team that includes an antimicrobial pharmacist (DH 2008). Their responsibilities expanded to include developing antimicrobial policies, conducting prescription reviews, audits, and feedback. By 2011, the number of antimicrobial pharmacists in England had increased by about 1.5-fold since 2005, reaching 175 posts (Wickens et al. 2013; Liaskou et al. 2018). All surveyed hospitals employed at least one; 35% employed two or more; and 13% employed three or more, with each dedicating part of their time to AMS, while 16% held full-time roles (Wickens et al. 2013). However, publicly updated data on these posts are unavailable.

In primary care, antimicrobial pharmacist posts have been limited, with a survey conducted in 2014 showing that 66% of primary care organisations relied on generalist prescribing advisors or medicines management pharmacists for AMS activities (Ashiru-Oredope 2015; Gilchrist et al. 2015). As many of the pharmacists' AMS functions in primary care are similar to those in secondary care (e.g., guideline development, audits, education, monitoring, and feedback), with frequent consultation of hospital microbiology laboratories for advice (Gilchrist et al. 2015), cross-sector collaboration has emerged. Specialists across care settings have started working together to optimise regional prescribing. In Scotland, for instance, antimicrobial pharmacists cover both hospital and community sectors, collaborating with prescribing advisors to influence GP prescribing (Gilchrist et al. 2015).

In Wales, antimicrobial pharmacist roles also began in secondary care, where infection risk and complexity are higher. The WG introduced 'A Strategy for Hospitals in Wales' in 2004, a

national plan emphasising shared responsibility for IPC and the Government's commitment to reducing HCAs (The National Assembly for Wales Audit Committee 2008). In 2008, the National Assembly for Wales Audit Committee recommended evaluating antimicrobial expertise's impact on IPC. This review aimed to demonstrate the benefits of employing antimicrobial pharmacists, given shortages in infection control teams, which consisted of nurses and microbiologists. The WG accepted these recommendations, noting that some trusts already had antimicrobial pharmacists and advising all to employ or have access to such expertise (Welsh Ministers 2008). National improvement goals have further promoted this role, emphasising adequate antimicrobial pharmacist provision and the establishment of AMS teams across all HBs and trusts, comprising an antimicrobial pharmacist, consultant microbiologist, and senior medical clinicians (Welsh Government 2023a).

In primary care, the establishment of antimicrobial pharmacist posts in Wales is increasing but inconsistent, with PHW supporting the expansion of AMS roles across sectors (Welsh Government 2016). Most HBs now employ at least one dedicated antimicrobial pharmacist, while larger HBs employ multiple pharmacists with defined roles in primary care, secondary care, or both. Some HBs also have senior AMS roles, such as ABUHB, where a consultant antimicrobial pharmacist oversees the HB AMS and leads a cross-sector team (RPS n.d.-a).

A key example of primary care involvement is the AMR Pacesetter project, launched under the WG's Pacesetter Fund (National Assembly for Wales 2017; NHS Wales 2021b). The project aimed to reduce antimicrobial prescribing, improve public awareness, and support GPs in AMS (NHS Wales 2021a). Within one cluster⁵ of the former Abertawe Bro Morgannwg University Health Board (ABMUHB; now SBUHB), a primary care antimicrobial pharmacist led AMS activities, including audits, action planning with GPs, and patient education. This initiative achieved a 6.8% reduction in prescribing (items per 1,000 population) between January and March 2016 within the cluster, compared with the same period in the previous year, exceeding reductions across the HB (2.54%) and Wales (3.84%) (RPS 2017). From November 2015 to the end of 2016–17, a 16.09% reduction was achieved, alongside improved public knowledge and stronger GP engagement with the AMR agenda (RPS 2017).

⁵ Clusters are groups of neighbouring GP practices that offer services to the populations in their area.

Antimicrobial pharmacists have also taken on HB and national leadership roles. The Welsh Antimicrobial Pharmacy Group, also known as the All-Wales Antimicrobial Pharmacist Group (AWAPG), brings together antimicrobial pharmacists from all HBs and key stakeholders, such as representatives from PHW. With a shared goal of optimising antimicrobial use, improving patient outcomes, and minimising AMR (Welsh Antimicrobial Pharmacy Group 2022), the group adopts a collaborative approach, sharing best practices, and working with national bodies, such as All Wales Medicines Strategy Group (AWMSG), to produce prescribing guidelines (AWMSG 2023; RPS n.d.-a). AWAPG has also demonstrated international leadership through partnerships, including with the Pharmaceutical Society of Malawi (Nyoloka et al. 2024).

1.10 Defining the Scope of the Thesis

Given the growing AMR threat and the need to optimise prescribing practices, particularly in OOH services, understanding current OOH prescribing patterns and practices and their influencing factors is essential for effective stewardship. While this area has received some attention in the UK, particularly in England, little seems to be known about Wales OOH services, despite national priorities to strengthen AMS in line with the UK-wide vision and NAP goals. Addressing this gap is crucial to inform policy efforts to mitigate AMR.

This thesis focuses on oral antibacterial prescribing in primary care OOH services. While antimicrobials comprise different categories and administration routes, this focus was guided by stakeholder input identifying oral antibacterials as a key concern, and the lack of OOH prescribing data from Wales. Antibacterials are the most commonly prescribed antimicrobial category in the UK and globally (Leekha et al. 2011; WHO 2023c), with oral formulations accounting for 94.8% of antibacterials prescribed in the UK (WHO 2023c). Evidence also suggests that oral formulations contribute more to AMR than other routes, such as topical treatments (Gray 2021). Primary care OOH settings were further highlighted as a priority area with limited data, alongside evidence of ineffective management, inconsistent adherence to national standards, and the need for improved workforce planning, funding, integration, and governance (Wales Audit Office 2018). Optometry and dental practices were not considered due to their distinct scope. For consistency, the term ‘antibacterials’ is used in this thesis instead of antimicrobials or antibiotics.

To address these gaps and priorities, this thesis explored two key questions: how primary care OOH services have contributed to oral antibacterial prescribing in Wales, and how stakeholders and HCPs understand, experience, and make decisions about oral antibacterial prescribing in primary care OOH services.

1.10.1 Thesis Aim and Objectives

The aim was to explore oral antibacterial prescribing in primary care OOH services in Wales to provide an evidence-based understanding of current prescribing practices and identify opportunities for improvement. The findings could inform the development of prescribing indicators or targeted interventions specific to OOH services.

The objectives were as follows:

- **Objective 1:** Identify existing evidence on oral antibacterial prescribing in primary care OOH services.
- **Objective 2:** Examine oral antibacterial prescribing trends in primary care OOH services in Wales.
- **Objective 3:** Describe oral antibacterial prescribing trends in Wales within primary care IH and OOH services, different HBs, and among HCP groups when feasible.
- **Objective 4:** Describe the utilisation of PIPS and the patterns of oral antibacterial prescribing within the service during OOH periods.
- **Objective 5:** Explore stakeholders' views and perceptions about oral antibacterial prescribing in primary care OOH services.
- **Objective 6:** Explore the experiences and decision-making process of HCPs regarding oral antibacterial prescribing in NHS 111 CSHs during OOH periods.

The first phase of the thesis involved undertaking a scoping review. It aimed to map existing international and UK literature and determine what is known about oral antibacterial prescribing in primary care OOH services, identify current prescribing trends, and explore the perspectives of those involved (HCPs and patients) in these settings.

Chapter 2 Scoping Review

2.1 Overview of the Chapter

Given the evidence gap noted in Chapter 1, this chapter presents a scoping review that identifies and maps the available literature on oral antibacterial prescribing in primary care OOH services.

2.2 Introduction

Out-of-hours services have gained increasing momentum globally as an important setting for delivering urgent and unscheduled care (Hong et al. 2020; Phiri et al. 2024). These services have some role in alleviating pressure on emergency departments (Hong et al. 2020; Allen et al. 2021) by offering an alternative first point of contact for patients with acute symptoms, particularly when primary care IH services are unavailable. Such presentations may result in antibacterial prescribing when infections are suspected.

As described in Chapter 1, there are various OOH service models developed internationally, with ongoing reforms to improve accessibility, efficiency, and integration within healthcare systems. These include GPCs, dedicated GP OOH services, telephone triage (e.g., NHS 111), and the involvement of other HCPs, such as pharmacists and nurse prescribers (NPs).

Recent years have seen growing attention toward antibacterial prescribing in OOH services, considering the global urgency around AMR and the potential impact of prescribing practices. While research on antibacterial prescribing, resistance, and stewardship has substantially grown, much of it has focused on primary care IH services, leaving the scope of evidence in primary care OOH services unclear. Although Hart and Phillips (2020) published a literature review on antimicrobial prescribing in OOH contexts, their review had methodological ambiguities. Their search strategy, conducted in 2017, relied on only five broad terms described as: ‘antibiotic prescribing’, ‘antimicrobial prescribing’, ‘out-of-hours’, ‘pre-hospital’, and ‘after-hours care’. Additionally, their eligibility criteria lacked clarity, particularly regarding the inclusion of primary research versus secondary analyses. For instance, one secondary analysis of a randomised control trial was included, while another secondary analysis study was excluded because it was not primary research.

Given these limitations and the time since their search (i.e., 2017), an updated review with a more comprehensive search strategy and clearly defined eligibility criteria was warranted to capture current evidence accurately. By systematically mapping existing evidence on the

topic, the review could identify key gaps and refine subsequent empirical chapters of this thesis. Therefore, establishing this evidence was a critical first step in understanding and exploring oral antibacterial prescribing in primary care OOH services.

2.2.1 Aim and Objectives

This review aimed to explore and synthesise existing literature on oral antibacterial prescribing in human primary care OOH services in the UK and Internationally, addressing the first objective of the thesis and highlighting knowledge gaps in Wales. The review was guided by the question: what is currently known about oral antibacterial prescribing in primary care OOH services? To address this, the review focused on the following objectives:

- Identify the types of oral antibacterial drugs that are prescribed in primary care OOH services and the clinical conditions for which they are used.
- Examine oral antibacterial prescribing trends in primary care OOH services.
- Explore factors influencing oral antibacterial prescribing in primary care OOH services.
- Explore AMS interventions implemented in primary care OOH services.
- Investigate the views and behaviours of HCPs and/or patients regarding oral antibacterial prescribing in primary care OOH services.

2.3 Methods

2.3.1 Review Approach

Various types of reviews exist, with systematic, literature, and scoping reviews among the most common. Systematic reviews address a specific, narrowly-defined question, and are often used to assess the feasibility, appropriateness, and effectiveness of an intervention (Munn et al. 2018; Sargeant and O'Connor 2020). As the aim was to explore a broad topic, different outcomes, and potentially varied study designs, a systematic review was deemed inappropriate. Narrative reviews are useful for summarising existing research and highlighting gaps; however, they may unintentionally omit relevant studies due to less systematic searches. Furthermore, they may not prioritise comprehensive coverage or include data analysis, limiting their validity (Grant and Booth 2009). For these reasons, narrative reviews were not considered suitable.

Given the review's broad research question, and the anticipated diversity of study designs, a scoping review was deemed the most appropriate approach. Scoping reviews are suitable for exploring broad topics that include different designs and methodologies (Arksey and O'Malley 2005; Munn et al. 2018; Sargeant and O'Connor 2020). Unlike systematic reviews, they do not aim to deliver new evidence to inform policy and practice but instead provide a descriptive synthesis of literature (Munn et al. 2018). For the PhD, a scoping review would provide an overview of the type and scope of evidence available, map research and key concepts on oral antibacterial prescribing in primary care OOH services, and highlight areas where further research is needed (Sargeant and O'Connor 2020). Table 2.1 illustrates key differences between the three review types.

This scoping review followed Arksey and O'Malley's methodological framework (Arksey and O'Malley 2005), enhanced by Levac et al. (Levac et al. 2010), and the Joanna Briggs Institute (JBI) guidance (Peters et al. 2020a). The adopted framework consisted of six stages: 1. identifying the research question, 2. identifying relevant studies, 3. study selection, 4. data charting, 5. collating, summarising, and reporting the results, and 6. an optional consultation stage. Reporting adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al. 2018), and the protocol was registered with the Open Science Framework (Al Hussain et al. 2024).

Table 2.1: Characteristics of the Narrative, Scoping, and Systematic Reviews – Adapted from Grant and Booth (2009)

Review	Description	Search	Appraisal	Synthesis	Analysis
Narrative review	Generic term: examination of recent or current literature that can cover a range of subjects with varying levels of completeness and comprehensiveness and may present research findings.	Searching may or may not be comprehensive.	Quality assessment may or may not be conducted.	Typically presented as a narrative.	Analysis may be chronological, conceptual, thematic, or other approaches.
Scoping review	Preliminary assessment of the size and scope of research literature to identify the nature and extent of evidence, often including ongoing studies.	Search completeness depends on time and scope constraints and may include in progress research.	No formal quality assessment.	Often presented in tables with some narrative commentary.	Describes the quantity and quality of the literature (e.g., study design, methods) and identifies what could be explored further.
Systematic review	A systematic approach to identifying, appraising, and synthesising research evidence, usually following established methodological guidelines.	Comprehensive and exhaustive searching is the goal.	Quality assessment may be used to determine the inclusion or exclusion of studies.	Typically combines narrative with tables.	Explains what is well established, provides recommendations to guide policy and practice, highlights gaps and uncertainties, and identifies questions for future research.

2.3.2 Stage I: Identifying the Research Question

The review question (Section 2.2.1) was formulated using the Population, Concept, and Context (PCC) framework (Table 2.2) recommended by JBI (Peters et al. 2020a). This framework is more suitable for scoping reviews than the systematic review's PICO model (Population, Intervention, Comparison, and Outcome), as it accommodates broader questions without requiring prespecified interventions or outcomes (Peters et al. 2020a). The research question informed the search strategy and the eligibility criteria.

Table 2.2: Scoping Review PCC Framework (Peters et al. 2020a)

PCC Framework	Definition Based on the Review Question
Population	• Those prescribing or receiving oral antibacterial prescriptions (e.g., HCPs, including GPs and NMIPs, patients or their carers).
Concept	• Any aspects related to oral antibacterial prescribing (e.g., views, behaviour, interventions and trends).
Context	• Primary care OOH services in any geographical location.

GPs: general practitioners; HCPs: healthcare professionals; NMIPs: non-medical independent prescribers; OOH: out-of-hours.

2.3.3 Stage II: Identifying Relevant Studies

In an attempt to address potential limitations of previous searches by Hart and Phillips (2020), which may have restricted the retrieval of relevant studies (Section 2.2), this scoping review followed a three-step approach suggested by JBI (Peters et al. 2020a). The search strategy was developed systematically and expanded to include additional synonyms and controlled terms, where available. A pilot search was first conducted on 24 April 2022, to identify studies containing 'after-hours' OR 'out-of-hours' AND 'antimicrobial prescribing' OR 'antibacterial prescribing' in two electronic databases (Medline and Embase via OVID). Titles, abstracts, and index terms of the identified articles were reviewed to determine the search terms, which were subsequently grouped into three main concepts: antimicrobial drugs, prescribing, and out of hours (Table 2.3).

A comprehensive second search was conducted to identify relevant articles from inception to 9 May 2022 (when the search was completed) across seven health-related databases: MEDLINE (OVID), Embase (OVID), Emcare (OVID), CINAHL complete (EBSCOhost), Web of Science Core Collection, Scopus, and the Cochrane library. The search combined synonyms of the three concepts in database-specific subject heading terms (e.g. MeSH, Emtree) and

free-text forms. Boolean operators (AND, OR) and truncations were used as appropriate (Table 2.3). The strategy was reviewed and refined with guidance from an experienced subject librarian and the project supervisors (KH, RD) to ensure appropriateness and comprehensiveness. To capture all available literature, the search was not initially limited by date or language. The search strategy and results are presented in Appendix 2.1.

Table 2.3: Search Terms

Concept 1: Out of Hours	Searched with AND	Concept 2: Antimicrobials	Searched with AND	Concept 3: Prescribing
Searched with OR		Searched with OR		Searched with OR
Pre-hospital*		Antimicrobial*		Prescrip*
Prehospital*		Antibiotic*		Prescrib*
After-hours care/		Anti-Bacterial Agents/		
Out of hours¶				
After hours¶				
Outside of normal working hours				

The highlighted terms are based on, or adapted from, the terms used by Hart and Phillips (2020).

*: Captures all word variations; /: Indicates terms from a database's-controlled index; ¶: Running the searches with hyphens did not affect the results unlike pre-hospital and prehospital across all databases.

Search results from each database were imported into EndNote 20 (Clarivate 2020), where duplicate citations were automatically removed. Any duplicates not detected by the software were manually removed by the researcher. The third stage involved reviewing the reference lists of full-text articles meeting the inclusion criteria (Table 2.4) to identify potentially relevant studies other than those already located via the database search.

Although review articles were excluded (see exclusion criteria below), their reference lists were scanned to ensure no eligible studies were missed by the database search.

Additionally, a Google Scholar search was conducted on 9 May 2022 using the following combined terms: antimicrobial prescribing and out-of-hours, antibacterial prescribing and out-of-hours, antibiotic prescribing and out-of-hours, antimicrobial prescribing and after-hours, antibacterial prescribing and after-hours, and antibiotic prescribing and after-hours. The first 50 results were reviewed for relevance. Although this approach is arbitrary and not necessarily evidence-based (Haddaway et al. 2015), it has been used in previous reviews (Hughes et al. 2014; Savilaakso et al. 2014). It was adopted due to the large volume of results, the absence of a systematic method to sort them by relevance, and its perceived

value within the constraints of the PhD timeline. Potentially relevant studies were considered for the subsequent stage only if not already retrieved from the database search, with duplicates excluded immediately. The final set of citations was exported into Microsoft Excel® spreadsheet for screening against the eligibility criteria.

Grey literature was not explored due to challenges that can reduce search reproducibility, such as inefficient processes to locate unpublished work and lack of integrated databases or repositories (Benzies et al. 2006; Adams et al. 2016). The review was hence limited to published, peer-reviewed studies.

2.3.4 Stage III: Study Selection

2.3.4.1 Eligibility Criteria

Eligibility criteria were defined to select studies relevant to the review's aim. The inclusion and exclusion criteria, with their rationale, are summarised in Table 2.4.

Table 2.4: Eligibility Criteria

Inclusion Criteria	Rationale
Primary care OOH studies reporting oral antibacterial drug prescribing (e.g., data, trends, interventions, behaviours, or views).	The review focuses on oral antibacterial drug prescribing practice specifically within primary care OOH services.
Data on/from HCPs within primary care OOH services (GP, NMIP) and/or patients of any age or their carers using these services.	To capture data and/or views on different experiences of HCPs working within primary care OOH services, and the service users.
Any published primary research (qualitative, quantitative, or mixed methods) and secondary analysis studies.	To gain as much information as necessary for the purpose of the review, allowing for comprehensive data synthesis.
Studies published in English.	English is the common language among the research team.
Any geographical location.	To present a complete picture of what is happening around the world.
Exclusion Criteria	Rationale
Studies not related to oral antibacterial drugs, such as those on other drug classes, (e.g., to treat non-infectious conditions), or on other antibacterial dosage forms (e.g., ophthalmic or topical preparations).	These studies are beyond the scope of the review (oral antibacterial in primary care OOH services) and do not meet the inclusion criteria.
Non-human studies: animal studies.	These studies are beyond the review's scope and do not align with its aim, as they do not examine oral antibacterial prescribing in human patients within primary care OOH services.

Table 2.4: Eligibility Criteria (continued)

Exclusion Criteria	Rationale
Studies in other settings (e.g., undertaken in secondary or tertiary care, or specialised centres, care homes, hospital departments, such as intensive care units, wards, and emergency departments) or those in primary care solely focusing on IH services or data on OOH services are not separately reported.	These studies are beyond the review's scope and do not align with its aim, as they either contradict the reviews' definition of primary care OOH services or report OOH prescribing data collectively with IH data, making it impossible to isolate and synthesise findings specific to OOH services.
Laboratory-based, sample-testing, and microbiology-focused studies where antibacterial prescribing was not reported.	These studies are beyond the review's scope and do not align with its aim, as they do not examine oral antibacterial prescribing in primary care OOH services.
Grey literature, non-original, or incomplete studies, including all types of reviews, meta-analyses, commentaries, editorials, protocols, opinions, newsletters, conference abstracts, posters, guidelines, and reports.	Although some were included in the thesis introduction, grey literature is difficult to locate and varies in quality and detail, reducing the reliability and reproducibility of the search. Reviews, meta-analyses, and guidelines summarise existing evidence rather than providing original data. Others e.g., abstracts, posters, and protocols typically contain incomplete/preliminary results and lack sufficient details to assess eligibility or extract data.
Non-English studies.	Translation constraints considering that English is the common language among the research team. While avoiding language restrictions is desirable, including non-English studies can introduce additional costs and time to complete the review (Kugley et al. 2017).
The full text cannot be accessed.	Eligibility assessment and relevant data extraction is not possible without accessing the full text.

2.3.4.2 Screening

The screening process followed a two-step approach recommended by PRISMA-ScR and JBI guidance (Tricco et al. 2018; Peters et al. 2020b). First, titles and abstracts of the resulting citations were independently screened against the predefined eligibility criteria. The researcher screened all records, while the project supervisors (KH, RD) each screened half. Records were considered for full-text screening if they met the inclusion criteria or if screening the title and abstract was insufficient for a clear decision on whether to include. Citations clearly meeting one or more exclusion criteria were excluded. If multiple exclusion reasons were noted, the most relevant one was reported. Articles were labelled as '1' for inclusion and '0' for exclusion, with exclusion reasons coded accordingly. Inter-rater

reliability was assessed between the researcher and each supervisor at this stage (i.e., the title and abstract screening) using Cohen's kappa. Kappa values of 0.93 (SA and KH) and 0.91 (SA and RD) were obtained, indicating almost perfect agreement (McHugh 2012). Any disagreement between the research team was resolved through discussion to reach consensus.

In the second step, the researcher conducted full-text screening of the selected articles using the same eligibility criteria. Any queries at this stage were discussed with the project supervisors (KH, RD), and final inclusion decisions were made by consensus.

2.3.5 Stage IV: Data Charting

A data charting form was adapted from the JBI (Peters et al. 2020a), and relevant data from the included studies were extracted into a Microsoft Excel® spreadsheet by the researcher (Appendix 2.2). The form was first piloted on 10% of included studies, a proportion used in other reviews (Büchter et al. 2023), and was reviewed by the project supervisors (KH, RD). Revisions were made as needed, ensuring pertinent data we extracted.

Data charting was completed by the researcher, with 10% of records (a different subset from the pilot) jointly reviewed by the project supervisors (KH, RD). Evidence suggests partial (20%) checks of data charting produce comparable findings to a full review (Taylor-Phillips et al. 2017), making this approach a valid and efficient alternative. However, 20% was not possible within the limitations of a doctoral study (single investigator), and a 10% was therefore agreed as a pragmatic compromise. To address potential errors, any queries or uncertainties from the full set were discussed and resolved with the supervisors.

Contacting corresponding authors was initially planned for missing or unclear data but was not needed. Extracted data included:

- Study characteristics: first author, publication year, title, aim, country, study type (e.g., primary, secondary analysis, qualitative, quantitative, or mixed methods), study design (e.g., observational, interview), settings (IH and OOH vs OOH).
- Population characteristics: participant types (e.g., HCPs, patients), age when relevant (e.g., patient), and number.
- Key findings: based on the study aim, their relevance, and measured outcomes.
- Study limitations: as reported by the study authors or identified by the researcher.

2.3.6 Stage V: Collating, Summarising, and Reporting the Results

Different approaches exist for synthesising evidence; however, most were established for either quantitative or qualitative findings specifically (Mays et al. 2005b). The synthesis approach varies depending on the type of extracted data. Given the methodological diversity of the included studies, a narrative synthesis was deemed an appropriate option. Narrative synthesis has been criticised for its perceived lack of methodological transparency (Dixon-Woods et al. 2005) and the absence of formal guidance for the synthesis (Mays et al. 2005a). However, Popay et al. (2006) addressed these concerns by developing guidance to support systematic and transparent synthesis using various tools and techniques.

Unlike many other approaches, Popay et al.'s framework (2006) is acknowledged for its flexibility, allowing the inclusion of different study designs and subsequently producing qualitative and/or quantitative evidence (Popay et al. 2006), without data transformation (Mays et al. 2005a). For these reasons and given the predicted diversity of studies in this review, their four-stage synthesis approach was followed. Although originally developed for systematic reviews, this framework has been frequently used in scoping reviews (Alehagen et al. 2024; Bölte et al. 2025).

Popay et al.'s framework (2006) consists of four elements that are not necessarily linear. The first element involves developing a theory to explain how, why, and for whom an intervention works (Popay et al. 2006). However, this step was not addressed in this review, as no intervention was being evaluated (common with systematic reviews). Instead, the focus was on identifying available literature on the topic. The second element involves developing a preliminary synthesis to describe the findings. This was completed by reading the studies to provide a textual description of each and organising them into categories within a table (e.g., by design: qualitative vs quantitative, outcomes: prescribing trends vs prescribing challenges). The third element involves exploring relationships in the data by identifying common themes and how these interact or diverge across studies and exploring potential attributable factors (e.g., variations in design, timeframe, population, and settings to understand or explain differences). These processes were conducted by the researcher using Microsoft Excel® and reviewed by the project supervisors. The last element entails assessing the robustness of the synthesis, which refers to the methodological quality of included studies and the synthesis produced. This depends on the quality and quantity of

included studies and the methods used, e.g., providing detailed information and steps taken to minimise bias (i.e., consulting the project supervisors) (Popay et al. 2006). As scoping reviews are not intended to assess the quality of evidence (see Table 2.1), but rather to report the scope of research available in a particular area, included studies were not evaluated for quality. Nonetheless, study limitations noted by the authors and/or identified by the researcher were reported. Given this, techniques outlined by Popay et al. (2006) for evaluating synthesis robustness (e.g., validity assessment tools, checking synthesis with study authors) were not applicable or feasible. Instead, the synthesis produced was reviewed by the project supervisors, and revisions were made until consensus was achieved. Additionally, a reflective summary is provided in the discussion section, outlining methodological limitations and their impact on the results. Figure 2.1 illustrates the process guiding the synthesis.

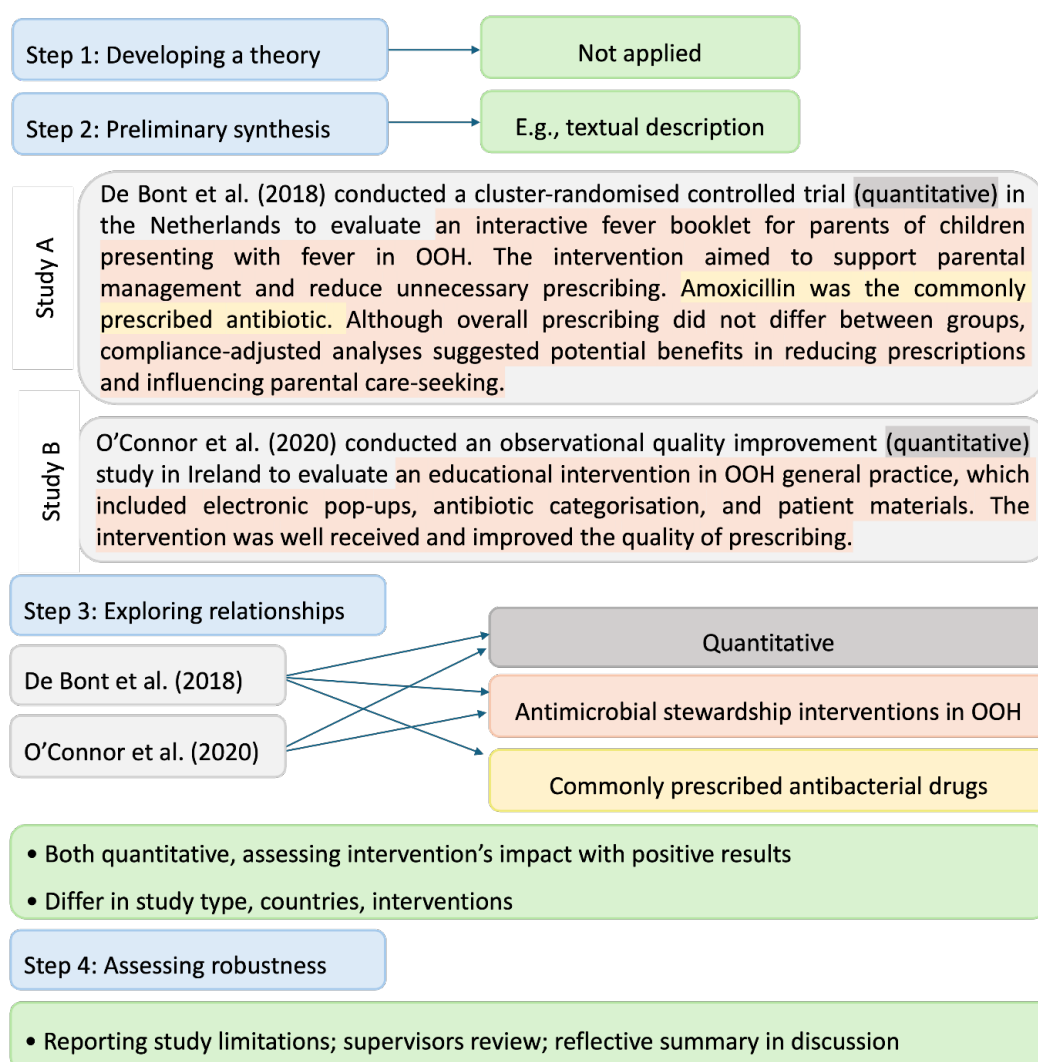


Figure 2.1: An illustration of the Synthesis Process

Terminology was standardised in the narrative synthesis to ensure consistency. In the literature, the terms ‘antibiotics’ and ‘antibacterial drugs’ are often used interchangeably; however, ‘antibiotics’ does not necessarily involve synthetic or semisynthetic agents (see Chapter 1) (Nathwani 2018). Therefore, this review adopted ‘antibacterial drugs’ throughout, even when ‘antibiotics’ was used in the original studies. Furthermore, ‘antibacterial drug(s)’ in this review referred specifically to oral formulations, distinguishing them from other routes (e.g., topical). Accordingly, ‘antibacterial drug’ was consistently used when summarising results to refer to oral formulations.

2.3.7 Stage VI: Consultation

This optional step involves consulting stakeholders to identify additional references to include and obtain feedback on the findings (Arksey and O'Malley 2005). However, guidance on conducting consultations and integrating their results into the review was not provided. Therefore, this step was limited to consulting the expert librarian (Section 2.3.3) to ensure the search strategy was relevant and comprehensive. A faculty member experienced in scoping reviews from the School of Healthcare Sciences, who also serves as Director of the JBI Wales Centre for Evidence-Based Care, was consulted to review the methodological approach and reporting for publication. The review was also shared with the Divisional Director of Primary Care, Community Services, and Complex Care in Wales, who endorsed that it addressed all key areas and required no further additions on their part.

2.3.8 Ethical Considerations

As this review involved only published literature on the topic, ethical approval was not required.

2.4 Results

2.4.1 Search Results

Overall, 834 citations were retrieved from the database searches, of which 510 duplicates were removed (Figure 2.2). The titles and abstracts of the remaining 324 records were screened independently, leaving 75 articles eligible for full-text screening.

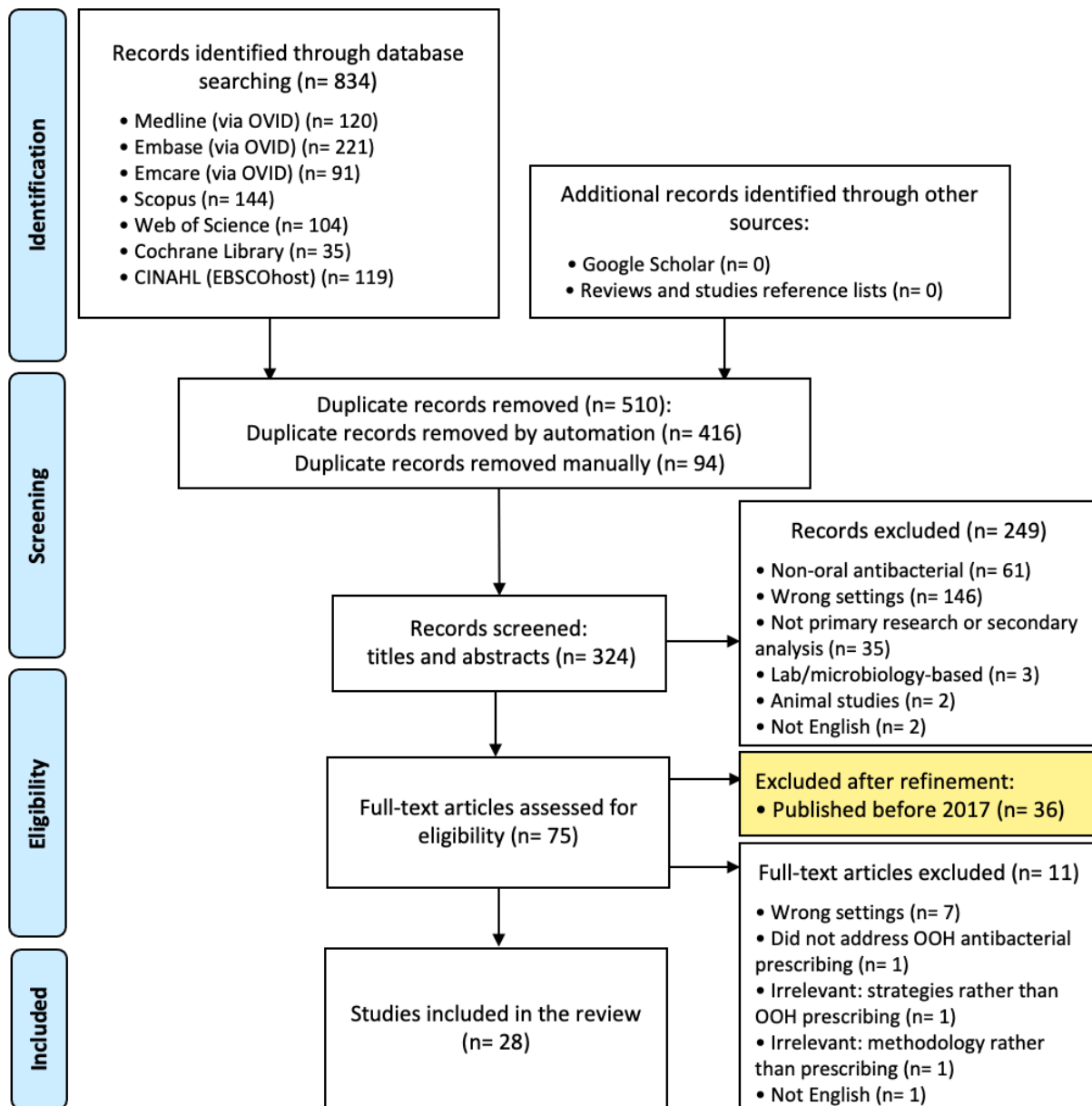


Figure 2.2: Flowchart for Search, Screening, and Study Selection

As scoping reviews are iterative and exploratory, the breadth of relevant studies is not always clear at the beginning and may require refinement of the search strategy as the review progresses (Alexander et al. 2024). To maximise search comprehensiveness, no publication date limits were applied initially given the uncertainty about the volume of literature. However, the unexpectedly large number of studies led to a reassessment of the scope and feasibility. Reflecting on the volume and potential added value of these studies, the review was limited to publications from 2017 onwards. This cutoff was based on the previous review's search year (Hart and Phillips 2020). While this prevented gaps in the

search, some overlap with studies from that year was expected as the earlier review's search month was not reported. Although this restriction could be seen as a limitation, it aligns with guidance for adapting scoping review protocols when necessary, suggesting that narrowing the date is acceptable when supported by clear rationale and documentation. In this review, introducing a date restriction was a justified methodological decision to prioritise manageability, timeliness, and relevance (Alexander et al. 2024). Following this refinement, 47 of the 75 records identified were excluded as 36 were published before 2017, and a further 11 were excluded at the full-text screening for various reasons (Figure 2.2). The remaining 28 studies met the inclusion criteria and were included.

2.4.2 Study Characteristics

In this section, each study was assigned a number to ease interpretation, with references summarised in Table 2.5. The included studies originated from nine high-income countries. The UK accounted for the majority (six studies, 21%) (2,6,9,10,23,28), followed by Belgium (five studies, 18%) (3,4,24,25,26). Norway (11,12,14,20), Ireland (16,17,18,27) and the Netherlands (7,8,13,21), each contributed four studies (14%). Australia contributed two studies (7%) (1,22), while Iceland (19), Sweden (5), and Denmark (15) each contributed one study (4%). Publication years ranged from 2017 to 2022, with the highest publication frequency in 2020 (eight studies, 29%) (1,2,5,10,18,19,21,25).

Most studies were quantitative (23 studies, 82%) (1–23), with only five adopting qualitative designs (18%) (24–28). Of the quantitative studies, five focused on paediatrics (7,10,15,16,20), one on adults (21), and the remaining studies did not specify an age group. The qualitative studies explored HCPs' views and antibacterial prescribing practices in OOH settings, such as their decision-making and the challenges encountered (24–28).

Several studies focused on specific conditions only, such as respiratory conditions (seven studies, 25%) (14,16,17,20,28,27,26), UTIs (two studies, 7%) (12,21), gastroenteritis (one study, 4%) (11), and fever (one study, 4%) (7). Four overlapped with those identified in Hart and Phillips's (2020) review (8,14,20,28).

- **Table 2.5:** Study Characteristics

Study Characteristic	Studies (n=28)	References
Country		
United Kingdom	6 (21%)	Edelstein et al. (2017); Curtis et al. (2018); Williams et al. (2018); Brettell et al. (2020); Edwards et al. (2020); Zhu et al. (2021).
Belgium	5 (18%)	Colliers et al. (2018); Colliers et al. (2019); Colliers et al. (2020); Colliers et al. (2021a); Colliers et al. (2021b).
Norway	4 (14%)	Lindberg et al. (2017); Rebnord et al. (2017); Haugom et al. (2021); Emberland et al. (2022).
Ireland	4 (14%)	Maguire et al. (2018); O'Connor et al. (2019); O'Doherty et al. (2019); O'Connor et al. (2020).
The Netherlands	4 (14%)	Debets et al. (2017); De Bont et al. (2018); Spek et al. (2020); Hek et al. (2022).
Australia	2 (7%)	Turner et al. (2017); Baker et al. (2020).
Denmark	1 (4%)	Lous et al. (2019).
Sweden	1 (4%)	Cronberg et al. (2020).
Iceland	1 (4%)	Palsdottir et al. (2020).
Population		
Adults only	1 (4%)	Spek et al. (2020).
Paediatrics only	5 (18%)	Rebnord et al. (2017); De Bont et al. (2018); Maguire et al. (2018); Lous et al. (2019); Edwards et al. (2020).
No age criteria	22 (79%)	Debets et al. (2017); Edelstein et al. (2017); Lindberg et al. (2017); Turner et al. (2017); Colliers et al. (2018); Curtis et al. (2018); Williams et al. (2018); Colliers et al. (2019); O'Connor et al. (2019); O'Doherty et al. (2019); Baker et al. (2020); Brettell et al. (2020); Colliers et al. (2020); Cronberg et al. (2020); Palsdottir et al. (2020); Colliers et al. (2021a); Colliers et al. (2021b); Haugom et al. (2021); Zhu et al. (2021); Emberland et al. (2022); Hek et al. (2022).
Publication date		
2017	5 (18%)	Debets et al. (2017); Edelstein et al. (2017); Lindberg et al. (2017); Rebnord et al. (2017); Turner et al. (2017).
2018	5 (18%)	Colliers et al. (2018); Curtis et al. (2018); De Bont et al. (2018); Maguire et al. (2018); Williams et al. (2018).
2019	4 (14%)	Colliers et al. (2019); O'Connor et al. (2019); O'Doherty et al. (2019); Lous et al. (2019).
2020	8 (29%)	Baker et al. (2020); Brettell et al. (2020); Colliers et al. (2020); Cronberg et al. (2020); Edwards et al. (2020); O'Connor et al. (2020); Palsdottir et al. (2020); Spek et al. (2020).
2021	4 (14%)	Colliers et al. (2021a); Colliers et al. (2021b); Haugom et al. (2021); Zhu et al. (2021).
2022	2 (7%)	Emberland et al. (2022); Hek et al. (2022).

Table 2.5: Study Characteristics (continued)

Study Characteristic	Studies (n=28)	References
Methodology		
Quantitative	23 (82%)	Debets et al. (2017); Edelstein et al. (2017); Lindberg et al. (2017); Rebnord et al. (2017); Turner et al. (2017); Curtis et al. (2018); De Bont et al. (2018); Maguire et al. (2018); Colliers et al. (2019); Lous et al. (2019); O'Connor et al. (2019); Baker et al. (2020); Brettell et al. (2020); Cronberg et al. (2020); Edwards et al. (2020); O'Connor et al. (2020); Palsdottir et al. (2020); Spek et al. (2020); Colliers et al. (2021b); Haugom et al. (2021); Zhu et al. (2021); Emberland et al. (2022); Hek et al. (2022).
Qualitative	5 (18%)	Colliers et al. (2018); Williams et al. (2018); O'Doherty et al. (2019); Colliers et al. (2020); Colliers et al. (2021a).
Focus		
Respiratory tract infections	7 (25%)	Lindberg et al. (2017); Rebnord et al. (2017); Maguire et al. (2018); Williams et al. (2018); O'Connor et al. (2019); O'Doherty et al. (2019); Colliers et al. (2021a).
Urinary tract infections	2 (7%)	Spek et al. (2020); Haugom et al. (2021).
Fever	1 (4%)	De Bont et al. (2018).
Gastroenteritis	1 (4%)	Emberland et al. (2022).
Not specific	17 (61%)	Debets et al. (2017); Edelstein et al. (2017); Turner et al. (2017); Colliers et al. (2018); Curtis et al. (2018); Colliers et al. (2019); Lous et al. (2019); Baker et al. (2020); Brettell et al. (2020); Colliers et al. (2020); Cronberg et al. (2020); Edwards et al. (2020); O'Connor et al. (2020); Palsdottir et al. (2020); Colliers et al. (2021b); Zhu et al. (2021); Hek et al. (2022).
Overlapping with Hart and Phillips' (2020) review	4 (14.3%)	Debets et al. (2017); Lindberg et al. (2017); Rebnord et al. (2017); Williams et al. (2018).

Table 2.6 provides an overview of the included studies and their limitations. Studies are grouped by type (quantitative first, then qualitative) and ordered alphabetically by first author within each group. Although all studies addressed oral antibacterial prescribing and practice, this was not the primary focus in five studies, which examined broader prescribing across different drug classes and patient encounters (1,2,10,15,22). These studies are highlighted in yellow in Table 2.6. The main findings are reported narratively in the text to maintain the table's readability.

Table 2.6: Descriptions of Included Studies

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
Quantitative Studies				
1	Baker et al. (2020) GP services in Australia: presentation profiles during usual practice hours and after-hours periods.	Identify differences in the most common patient reasons for encounter and problems managed in usual hours and after-hours consultations.	Method: Collected data from a national, cross-sectional bettering the evaluation and care of health (BEACH) study. Country: Australia. Duration/year: April 2014–March 2015. Settings: Usual GP hours and after-hours. Population: Patients of all ages/genders. Size: 38,275 encounters: 36,529 (95.4%) in usual GP hours and 1,746 (4.6%) in after-hours.	Study authors - Old data (2014–15) - Weekend encounters may be underrepresented due to the study’s recording schedule starting on Tuesday and may end before the weekend, and the possibility that some GPs providing after-hours care may not record these encounters due to factors such as fatigue. The researcher - Based on BEACH study with 29% response rate, which may limit representation
2	Brettell et al. (2020) Out-of-hours primary care end of life prescribing: a data linkage study.	- Explore volume and type of prescriptions issued at the end of life. - Explore OOH role in prescribing syringe driver medications.	Method: A population-based study using OOH electronic record data from AdastrA. Country: England (Oxfordshire). Duration/year: December 2014–November 2015. Settings: OOH services. Population: Palliative patients who had contact with OOH service in the 30 days prior to death. Size: 1,530 patients in 2,661 encounters, of which 1,310 contacts were documented as palliative.	Study authors - None mentioned. The researcher - Classification of palliative patients was based on palliative code assigned to patient records by OOH clinicians or action relevant to palliative care which could lead to misclassification (those not truly at the end of life).

Key: GP: general practitioner; OOH: out-of-hours.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
3	Colliers et al. (2019) Antibiotic prescribing quality in out-of-hours primary care and critical appraisal of disease-specific quality indicators.	• Assess the quality of antibiotic prescribing in primary care OOH. • Describe antibiotic prescribing OOH by indication, assess its quality by updating values for European Surveillance of Antimicrobial Consumption (ESAC) disease-specific APQI, and critically appraise these APQIs.	• Method: Collected data from Improving Care and Research Electronic Data Trust Antwerp database (iCAREdata), a research database of linked data on OOH primary care. • Country: Belgium. • Duration/year: 1 July 2016–30 June 2018. • Settings: OOH services in 5 GPCs. • Population: Patients of all ages/genders. • Size: 111,600 encounters (all OOH patient visits); 26,436 antibiotic prescriptions.	Study authors • The used APQI values were not specific for OOH. • Data quality depends on registration quality by GPs. • Incomplete picture of prescriptions: prescriptions linked to symptom diagnoses were not included in APQI values. • Handwritten prescriptions are possible and may have been missed. • Inability to differentiate between immediate and delayed prescriptions. The researcher • Only consultations at GPC were used, as OOH home visits were not recorded. • Covered 11% of Flemish population - may limit representation and generalisability.
4	Colliers et al. (2021b) Antibiotic prescribing trends in Belgian out-of-hours primary care during the COVID-19 pandemic: observational study using routinely collected health data.	• Describe trends in the antibiotic prescribing of GPs for RTIs, before and after the start of the COVID-19 lockdown in Belgian OOH care.	• Method: An observational study using routinely collected health data. • Country: Belgium. • Duration/year: 2019–2020. • Settings: OOH services. • Population: Patients of all ages/genders. • Size: 388,293 contacts and 268,430 prescriptions.	Study authors • Appropriateness of prescribing was not assessed. • Possible under- or incorrect data registration by GPs. • It was not possible to detect a shift in prescribing from OOH to IH services. • Age groups differed pre-and post-COVID-19. Unknown percentage of the difference observed was caused by this. • Inability to control for potential seasonality. The researcher • Home visits were excluded due to the lack of data. • Data from one weekend (668 contacts) was excluded due to collection issues, underrepresenting OOH contacts.

Key: APQI: antibiotic prescribing quality indicators; COVID-19: coronavirus disease 2019; GPs: general practitioners; GPC: general practice cooperative; IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
5	Cronberg et al. (2020) Diagnosis-linked antibiotic prescribing in Swedish primary care - a comparison between in-hours and out-of-hours.	• Describe the trends in antibiotic prescribing over time. • Compare diagnosis-linked prescribing in general and in detail between IH and OOH in the same population.	• Method: A retrospective, descriptive study based on data from KIDPC database, which contains information on all visits with an infection diagnosis and all antibiotic prescriptions with or without a visit in primary care in Kronoberg County. • Country: Sweden. • Duration/year: 2006–2014 • Settings: IH and OOH services • Population: Patients of all ages/genders. • Size: On average, 434 visits (IH: 382; OOH: 51.4 ‘as noted’), 242 prescriptions (IH: 209; OOH: 33)/1,000 inhabitant/year.	Study authors • No validation of the diagnoses was done. • No investigation into the reason antibiotics were prescribed without infection diagnoses. • Lower prescribing threshold cannot be ruled out. • Antibiotics other than oral and parenteral are missing. • Antibiotic rate for elderly patients might be underestimated due to missing data. • Inability to measure delayed prescribing rate. The researcher • Diagnoses were not recorded for phone, mail or e-mail consultations; hence, prescriptions could not be linked. • Limited national extrapolation (Kronoberg covers only 2% of Sweden population). • 3% of visits had more than one diagnosis recorded.
6	Curtis et al. (2018) Time trends and geographical variation in prescribing of antibiotics in England 1998–2017.	• To describe antibiotic prescribing trends in NHS England primary care for the years 1998–2017 using various measures, investigating trends and variation between practices and geographical areas, OOH prescribing, and seasonality.	• Method: Using 2 sources of publicly available, routinely collected NHS data: monthly practice-level prescribing data and annual Prescription Cost Analysis data. • Country: England. • Duration/year: For OOH: October 2010–December 2017. • Settings: 8,052 GP practices and 260 OOH services. • Population: Patients of all ages/genders. • Size: Not reported.	Study authors • Includes only dispensed items; excludes non-dispensed. • Use of practice-level data; as individual data could allow the separation of indications for each prescription. • No appropriate denominators for OOH. • OOH data may omit prescriptions given directly to patients. The researcher • Practices with <1,000 registered patients or prescribing <100 antibacterial items a month were excluded. • No registered population size for OOH.

Key: IH: in-hours; GP: general practitioner; KIDPC: Kronoberg infection database in primary care; NHS: National Health Service; OOH: out-of-hours.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
7	De Bont et al. (2018) Booklet for childhood fever in out-of-hours primary care: a cluster-randomized controlled trial.	• Develop and assess the effectiveness of an illness-focused interactive fever booklet for parents on managing children with fever at family physician OOH care.	• Method: A cluster-randomised controlled trial with 2 arms: an illness-focused interactive booklet arm or a care-as-usual arm. • Country: The Netherlands. • Duration/year: November 2015–June 2016. • Settings: 20 OOH services. • Population: Children aged 3 months to 12 years with family physician recording the encounter as a fever-related consultation. • Size: 25,355 children Intervention group: 11,945 Control group: 13,410.	Study authors • Physicians were provided with brief e-mail instructions about the intervention use without training or meeting. • Blinding of physicians regarding the intervention was not possible but they were blinded to the outcome. • Lack of comparable data to inform actual compliance, and the estimation of complier analysis CACE is dependent on assumptions that cannot be tested. • Statistical models/software do not allow for cluster effect correction in a CACE with a dichotomous outcome. • Risk of post-randomisation recruitment bias. • Differences in the percentage of children with fever and acute upper RTIs across booklet users and non-users. The researcher • Surveyed parents subsample (n=553) limit representation
8	Debets et al. (2017) Antibiotic prescribing during office hours and out-of-hours: a comparison of quality and quantity in primary care in the Netherlands.	• Provide insight into quantity and quality differences in office hours and OOH antibiotic prescribing.	• Method: Using national, routinely collected Dutch data. • Country: The Netherlands. • Duration/year: 2012. • Settings: Office hours and OOH services. • Population: Patients of all ages and genders. • Size: 6,434,640 antibiotic courses (of which 8.4% in OOH).	Study authors: • Information from patient files was used to determine overprescribing in OOH (prone to missing relevant data). • Information that was not provided was considered absent and may have overestimated OOH overprescribing. • OOH overprescribing data analysed 1–2 years after IH. • ICPC codes were used to retrieve the data. The researcher • Prescriptions in extended-hour GP practices were counted as office hours, even after 5pm when OOH opens. • Appropriateness of OOH prescribing was assessed only for the first 100 files per ICPC code, which may overlook variation in quality beyond these records.

Key: CACE: complier average causal effect; GP: general practitioner; ICPC: international classification of primary care; IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
9	Edelstein et al. (2017) Trends and patterns in antibiotic prescribing among out-of-hours primary care providers in England, 2010-14.	Describe trends and patterns of antibiotic prescribing among OOH providers in England to inform future stewardship interventions.	Method: Using national primary care prescribing data from NHS BSA. Country: England. Duration/year: 2010–14. Settings: GP IH and OOH services. Population: Patients of all ages and genders. Size: Between 1,055,000 and 1,205,000 antibiotic items each year in OOH.	Study authors - It was not possible to calculate prescription volume per population or estimate each OOH population size. - Due to the heterogeneous nature of OOH providers, rapid turnover, and lack of reliable information on who provides OOH services, sample representativeness could not be determined. Therefore, data were analysed at a national level without multilevel analysis. - Prescription indications were not available, making it difficult to determine their appropriateness The researcher - Centres prescribed <100 items per year were excluded. - Findings may lack relevance to current practice (old data)
10	Edwards et al. (2020) Paediatric contacts with the UK out-of-hours primary care service and contact outcomes: a regional service evaluation.	Characterise the nature, timing, and outcomes of paediatric contacts with OOH GP.	Method: Using a database created from OOH electronic record system Adastra, clinical patient management software used by clinicians. Country: England (Oxfordshire). Duration/year: December 2014–November 2015. Settings: OOH services Population: Paediatric patients Size: 27,455 encounters (26.69%) made by 18,987 individuals (29.95%).	Study authors - Less deprived area. The results may not be generalisable to the whole UK with different population and care models. - The data predate recent extended access schemes which may change how people use health services. The researcher - Although limited, small number of contacts (1%) had ‘Null’ as clinical code were removed from the dataset, affecting completeness. - Old data – may not reflect current situation.

Key: GP: general practitioner; IH: in-hours; NHS BSA: National Health Service Business Services Authority; OOH: out-of-hours; UK: United Kingdom.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
11	Emberland et al. (2022) Antibiotics for gastroenteritis in general practice and out-of-hour services in Norway 2006–15.	Investigate time trends and patient characteristics associated with antibiotic treatment for GE in Norwegian primary care from 2006 to 2015.	Method: Using data collected from 2 nationwide registries: KUHR, the national registry of reimbursement claims data from IH GP and OOH, and NorPD, a complete registry of all prescription drugs dispensed from pharmacies in Norway. Country: Norway. Duration/year: 2006–2015. Settings: IH GP and OOH services. Population: Patients with GE of all ages and genders. Size: 1,279,867 consultations. IH GP: 1,081,162 (84.5%). OOH: 198,705 (15.5%).	Study authors - Underreporting of OOH services consultations. - Claims from electronic/telephone consultations or home visits were not included. - Possible GE misclassification challenges internal validity. - Possible underestimation of treatment proportion as the calculation was based on GE consultations not cases. - Possible misclassification of antibiotics as treatment for GE since data on antibiotics were based on courses dispensed from pharmacies and not prescriptions. - If consultations were misclassified as GE, antibiotics may have been incorrectly defined as GE treatment. The researcher - Linked only antibiotics dispensed the same or next day – may miss those given later. - Possible data linkage errors.
12	Haugom et al. (2021) Consultations and antibiotic treatment for urinary tract infections in Norwegian primary care 2006-2015, a registry-based study.	Investigate time trends in antibiotic treatment following consultations for UTI in primary care in Norway.	Method: Observational study using national data from 2 registries: KUH and NorPD (see above) Country: Norway. Duration/year: 2006–2015. Settings: IH GP and OOH services. Population: Patients with UTI of all ages and genders. Size: 2,426,643 UTI consultations. IH GP: 1,927,615 (79.4%). OOH: 499,028 (20.6%).	Study authors - Potential misclassification due to differences in coding behaviour by individual GPs (no validation of UTI diagnoses in the database) may impact internal validity. - Reimbursement claims from contacts by telephone or at the reception were not included. - E-consultations were not included as they were introduced at the end of the study period. - Possible prescribing underestimation as the NorPD contains data on all prescription drugs ‘dispensed’. The researcher - Possibility that some consultations relate to the same episode, including follow-up after initiating treatment.

Key: GE: gastroenteritis; GPs: general practitioner; IH: in-hours; KUHR: control and payment of health reimbursement database; NorPD: Norwegian prescription database; OOH: out-of-hours; UTIs: urinary tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
13	Hek et al. (2022) Antibiotic prescribing in Dutch daytime and out-of-hours general practice during the COVID-19 pandemic: a retrospective database study.	• Describe changes in antibiotic prescribing in the different phases of COVID-19 in 2020 and 2021 compared to 2019 in IH GPs and at OOH. • Describe antibiotic prescribing for the two diagnoses for which antibiotics are most frequently prescribed, RTIs and UTIs.	• Method: A retrospective database study using routine care data. • Country: The Netherlands. • Duration/year: 2019–2021. • Settings: IH GP and OOH services. • Population: Patients of all ages and genders. • Size: Not reported.	Study authors • Unknown disease severity. • Possible underestimation of RTI contact rate during the first months of the pandemic. • Inability to correct for seasonal changes in prescribing in the analysis leading possibly to underestimation of COVID-19 impact, especially during winters. The researcher • No description of how consultations were conducted and how this may influence prescribing, particularly during the pandemic.
14	Lindberg et al. (2017) Antibiotic prescribing for acute respiratory tract infections in Norwegian primary care out-of-hours service.	• Explore factors that predict antibiotic prescribing and broad-spectrum prescribing for ARTIs in primary care OOH. • Explore if the activity level (both per session and per doctor) was correlated with antibiotic prescribing.	• Method: A retrospective data analysis from 2 units' electronic record systems. • Country: Norway. • Duration/year: 2014. • Settings: 2 OOH services. • Population: Patients with ARTIs of all ages and genders. • Size: 6,757 ARTI consultations (16.8% of all consultations), 2,310 (34.2%) resulted in antibiotic prescription.	Study authors • Possible inaccurate diagnoses as doctors were unaware of the research plan. • Small number of children received antibiotic mixture at the unit, and those were recorded like paper prescriptions and therefore not captured by data retrieval. • Inability to detect patients who presented at OOH for antibiotic failure or follow-up visits. • Possible underestimation of antibiotic prescribing rate of upper RTIs because of the way diagnoses were grouped. • Median duration of consultations per session variable was based on all diagnoses and not specific for ARTIs. The researcher • Lack of information on conditions' severity and duration.

Key: ARTIs: acute respiratory tract infections; COVID-19: coronavirus disease 2019; GP: general practitioner; IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections; UTIs: urinary tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
15	Lous et al. (2019) Preschool children in Danish out-of-hours primary care: a one-year descriptive study of face-to-face consultations.	Describe face-to-face consultations for children aged 0–5 years in OOH primary care, specifically reason for encounters, diagnoses recorded by the triaging and treating GPs, and provided care (dispensed prescriptions, reason for referral, and parental satisfaction with the contact).	Method: A population-based cross-sectional study based on collected data and postal questionnaire sent to parents. Country: Denmark. Duration/year: June 2010–May 2011. Settings: OOH services. Population: Preschool children (0–5 years) with face-to-face contact. Size: 2,363 contacts: Clinic: 1,875; Home visit: 488. Parents: 1,220 (51.5%) returned the questionnaire.	Study authors - Number of contacts was used and not children. - Diagnoses were mainly based on GP evaluation and information from parents. - Low questionnaire response rate could have implied selection bias; hence, parental perceptions should be assessed with caution. - Risk of misclassification when coding GP text. - Outdated data (2010–11). The researcher - Restricted age group – may not apply to older children. - Parental satisfaction reflects only respondents (51.5%). Non-respondents may have had different experiences.
16	Maguire et al. (2018) A cross-sectional study of antibiotic prescribing for childhood upper respiratory tract infections in Irish general practice.	- Quantify antibiotic prescription rates and guideline compliance for upper RTIs. - Analyse factors linked to antibiotic prescribing in under 6 children attending IH and OOH. - Examine changes which may be related to new for free-of-charge service eligibility.	Method: A cross-sectional study of anonymised consultation data. Country: Ireland. Duration/year: 2 weeks from January 2015, 2016, and 2017. Settings: 4 IH GPs and 2 OOH services. Population: Children under 6 years presenting with upper RTIs. Size: 1,007 children: IH: 385 (38.2%). OOH: 622 (61.8%).	Study authors - Data collection was for a short period (14 days) which may not reflect general prescribing trends. - Inability to assess illness severity or treatment decisions based on chart review. - Certain findings were weakened by wide confidence intervals. The researcher - Consultation notes were reviewed to determine inclusion for all children in IH but only for a random sample (about 50%) of OOH presentations, which may have reduced accuracy due to potential errors in the unreviewed notes.

Key: GPs: general practitioners; IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
17	O'Connor et al. (2019) Medical management of acute upper respiratory infections in an urban primary care out-of-hours facility: cross-sectional study of patient presentations and expectations.	Examine patients presenting with acute upper RTI in an OOH setting expectation of clinical examination, symptom management, information on their condition, reassurance, antibiotic treatment and other possible options including referral.	Method: A cross-sectional, single-centre study using paper-based questionnaires. Country: Ireland. Duration/year: October 2017–February 2018. Settings: 1 urban OOH service. Population: Patients with acute upper RTIs of all ages and genders. Size: 435 questionnaires filled by patients or their parents/guardians if age <18 years.	Study authors - Single-centre study does not reflect all OOH patients. - Sample was not randomly selected sample and with possible skewed results as some groups (e.g., older patients) were underrepresented. - As 34% of OOH patients expected antibiotics, there is a possibility that patients who declined participation (5%) were sicker than those who did and were more likely to look for antibiotics (i.e., underestimate demands). - Illness duration and severity were not assessed. - Patients' expectations for antibiotics were not assessed against clinician evaluation. - Chance of missing ARTI patients as non-trained staff was in charge of questionnaire distribution. The researcher - Questionnaires were filled in waiting room – responses may be influenced by social desirability.
18	O'Connor et al. (2020) Improving the quality of antibiotic prescribing through an educational intervention delivered through the out-of-hours general practice service in Ireland.	Analyse the change in the quality of antibiotic prescribing after the introduction of an educational intervention for GPs and patients using the OOH setting categorising antibiotics into a red (avoid) and green (preferred) panel.	Method: An observational quality improvement study, baseline data based on retrospective electronic notes analysis. Country: Ireland. Duration/year: Week 47 – 7 in 2016/2017 and 2017/2018. Settings: 2 OOH services. Population: Patients of all ages and genders. Size: Not reported; 240 GPs participate in providing OOH service.	Study authors - Lack of actual volume of prescribing to assess the quantity. - Intervention impact cannot be assessed outside this setting or on the level of resistance. The researcher - Only two out of 11 OOH centres included, which limit generalisability.

Key: ARTI: acute respiratory tract infections; GP: general practitioner; OOH: out-of-hours; RTI: respiratory tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
19	Palsdottir et al. (2020) Prescriptions of antibiotics in out-of-hours primary care setting in Reykjavik capital area.	Describe antibiotic prescriptions in OOH primary care in Reykjavik capital area over a one-year period and analyse them by patient age, gender, and diagnosis.	Method: A population-based retrospective study using electronic data from the OOH medical registration system. Country: Iceland. Duration/year: 1 January 2014–31 December 2014. Settings: OOH services. Population: Patients of all ages and genders who received oral antibiotics at OOH. Size: 25,059 contacts resulted in an oral antibiotic prescription (33% of all contacts).	Study authors - Studied diagnoses accounted for only about 50% of all prescriptions. - Possible lack of diagnoses accuracy. - Inability to distinguish those presented due to antibiotic failure, follow-up, or those who were told to wait and see. - Guidelines assessment requires data recorded in plain text such as severity, symptoms, and whether first-line antibiotic has failed. The researcher - Reykjavik population represented 61.3% of Iceland population limiting the generalisability of the results. - Old data – may be less applicable to current healthcare settings.
20	Rebnord et al. (2017) Factors predicting antibiotic prescription and referral to hospital for children with respiratory symptoms: secondary analysis of a randomised controlled study at out-of-hours services in primary care.	Identify predictors for antibiotic prescription and referral to hospital in a primary care setting.	Method: A secondary analysis of a randomised controlled study. Country: Norway. Duration/year: Winter seasons from January 2013–May 2015. Settings: 4 OOH services and 1 paediatric emergency clinic. Population: Children aged 0–6 years with respiratory symptoms and/or fever. Size: 397 children.	Study authors - Doctors were informed of the research plan which may have affected the findings. - No information about the experience of OOH doctors. - Weak diagnoses validity/ inability to verify. - Observational study based on a randomised trial, which may have increased CRP use and therefore could have affected prescription rate. The researcher - Limited age group. - Data may be outdated limiting relevance.

Key: CRP: C-reactive protein; OOH: out-of-hours.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
21	Spek et al. (2020) Workload, diagnostic work-up and treatment of urinary tract infections in adults during out-of-hours primary care: a retrospective cohort study.	Examine the workload, diagnostic work-up and treatment of UTIs in healthy adults during OOH primary care.	Method: A retrospective observational cohort study using data from electronic patient reports. Country: The Netherlands. Duration/year: 2018–full year. Settings: 2 OOH services. Population: Adult patients with UTI symptoms. Size: 5,657 patients.	Study authors - Risk of bias due to missing data in observational studies. - Possible misclassification of some patients based on the quality of medical reports which could have led to comparing prescription choice with the wrong guidelines. The researcher - Retrospective observational studies are prone to selection bias and confounding factors.
22	Turner et al. (2017) Characteristics of patients presenting to an after-hours clinic: results of a MAGNET analysis.	Characterise a typical inner metropolitan after-hours patient cohort in Australia.	Method: Analysis of data from the MAGNET database, which contains both demographic and clinical information extracted from the computerised medical records for patients that have attended any of the 50 participating GP clinics in the inner east Melbourne metropolitan region. Country: Australia. Duration/year: 1 January 2005–31 December 2014. Settings: After-hour GP. Population: Patients of all ages and genders. Size: 46,074 patients; 64,800 encounters.	Study authors - None mentioned. The researcher - Findings are limited by the quality and coverage of MAGNET data.

Key: GP: general practitioner; MAGNET: Melbourne East Monash general practice database; OOH: out-of-hours; UTIs: urinary tract infections.

Table 2.6: Descriptions of Included Studies (continued)

	Author and Title	Aim(s)/Objective(s)	Design	Limitations
23	Zhu et al. (2021b) Trends in antibiotic prescribing in out-of-hours primary care in England from January 2016 to June 2020 to understand behaviours during the first wave of COVID-19.	Investigate any changes in OOH antibiotic use prior to and during England's first wave of the COVID-19 pandemic.	Method: Analysis of electronic-based prescribing data from NHS BSA. Country: England. Duration/year: January 2016–June 2020. Settings: IH and OOH services. Population: Patients of all ages and genders. Size: Not reported.	Study authors - Prescribing records were excluded if the setting could not be assigned (0.04% of all prescribing records). - No analysis of how OOH consultations were carried out, especially during COVID-19. The researcher - Limited to first wave of COVID-19 and did not examine long-term effects.
Qualitative studies				
24	Colliers et al. (2018) How do general practitioners and pharmacists experience antibiotic use in out-of-hours primary care? an exploratory qualitative interview study to inform a participatory action research project.	- Assess antibiotics prescribing and dispensing challenges in OOH primary care for GPs and pharmacists. - Identify context-specific elements to help the implementation of behaviour change interventions.	Method: An exploratory study using semi-structured interviews. Thematic analysis was undertaken. Country: Belgium. Duration/year: Not mentioned. Settings: OOH services (GPCs). Population: 17 GPs, 5 pharmacists, and 1 GPC manager. Size: 23 interviews.	Study authors - Some findings must be viewed within the context of Belgian OOH care. - The interviewer was a former colleague of several participants, which may have caused reticence in responding to some questions. - Use of purposeful sampling. The researcher - Although saturation was achieved, the possibility of missing perspectives cannot be ruled out. - Data collected pre-2018 and thus may not represent current practices.

Key: COVID-19: coronavirus disease 2019; GPs: general practitioners; GPCs: general practice cooperatives; NHS BSA: National Health Service Business Services Authority; OOH: out-of-hours.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
25	Colliers et al. (2020) Understanding general practitioners' antibiotic prescribing decisions in out-of-hours primary care: a video-elicitation interview study.	• Unravel GPs' decision-making during consultations about infections in OOH primary care, focusing on (non) antibiotic prescribing, using a video consultation as a prompt to explore tacit knowledge, beliefs, attitudes, social influences, and communication that drove their behaviour.	• Method: An elicitation interviews after video-recording consultations. Part of the better antibiotic prescribing through Action Research (BAbAR) project, which uses participatory action research. Inductive thematic analysis was used. • Country: Belgium. • Duration/year: August 2018–November 2018. • Settings: OOH services. • Population: GPs in OOH services. • Size: 160 consultations were videos-recorded from 21 GPs.	Study authors • A single OOH centre study. • The described perspectives reflect consultations at a particular point in time and in a particular setting. • Possible differences between GPs who agreed to be video-recorded and those refused. • Potential recall bias because of the time delay between the videorecording and the interview. • The interviewer is a former colleague of the participants. The researcher • GPs were able to start and stop the camera themselves and choose which recordings the reviewers analysed. This could introduce selection bias and may alter their behaviour and spontaneity, i.e., the Hawthorne effect.
26	Colliers et al. (2021a) Antibiotic prescribing and doctor-patient communication during consultations for respiratory tract infections: a video observation study in out-of-hours primary care.	• Describe how patients present their problem and how GPs interact with this and elicit the ICE of patients, and in what possible ways this doctor-patient communication relates to antibiotic prescribing for RTIs in OOH care.	• Method: Recorded consultation videos were used. Part of the better antibiotic prescribing through Action Research (BAbAR) project, which uses participatory action research. Deductive and inductive analysis was used. • Country: Belgium. • Duration/year: Weekends during the day; end of August to November 2018. • Settings: OOH services. • Population: Patients with RTIs and GPs managing them. • Size: 77 videos on RTIs from 19 GPs.	Study authors • GPs and patients were aware of the study, which could influence the behaviour (Hawthorne effect). • Inability to judge if prescribing decisions were justified. • Inability to analyse patients' non-verbal communication. • Concerns about not getting antibiotics may have led some patients to refuse to participate. • Pre-COVID-19 study, where some phrases used, e.g., "just a viral infection", could have different influences on patients nowadays. • More explorative analysis could yield deeper knowledge. The researcher • GPs had control of the camera themselves (as above).

Key: COVID-19 coronavirus disease 2019; GPs: general practitioners; ICE: ideas, concerns and expectations; OOH: out-of-hours; RTIs: respiratory tract infections.

Table 2.6: Descriptions of Included Studies (continued)

#	Author and Title	Aim(s)/Objective(s)	Design	Limitations
27	O'Doherty et al. (2019) Over prescribing of antibiotics for acute respiratory tract infections; a qualitative study to explore Irish general practitioners' perspectives.	Investigate why GPs in Ireland continue to prescribe antibiotics for ARTIs, despite widely publicised guidelines and evidence of their ineffectiveness.	Method: An explorative study using semi-structured face-to-face interviews that were digitally audio-recorded and transcribed. Thematic analysis was used. Country: Ireland. Duration/year: June–August 2017. Settings: General practices. Population: GPs. Size: 13 GPs – all have experience in GP practices and worked in OOH setting – [Not specific to OOH].	Study authors - Possible selection bias as authors and participants were affiliated to the same institution. - GPs who did not participate may have different opinions. The researcher - Potential bias due to purposive sampling. - Findings may be less reflective of current practices (data collected in 2017)
28	Williams et al. (2018) General practitioner and nurse prescriber experiences of prescribing antibiotics for respiratory tract infections in UK primary care out-of-hours services (the UNITE study).	- Explore antibiotic prescribing practices of GPs and NPs. - Identify GP and NP experiences of prescribing antibiotics for RTIs in OOH, to explore facilitators and barriers to reducing antibiotic prescribing. - Identify similarities and differences between GP and NP antibiotic prescribing.	Method: Semi-structured telephone interviews that were audio recorded. An inductive thematic analysis was used. Country: England. Duration/year: Interviews between November 2015–April 2016. Settings: OOH services. Population: GPs and NPs. Size: 30 (15 GPs and 15 NPs).	Study authors - Unavailability of individual- and service-level prescribing data to ensure maximum variability. - Purposive sampling is prone to bias. - Small response rate (8.94%). The researcher - Telephone interviews may result in the loss of visual and nonverbal cues. - As interviews were conducted between 2015–16, possible changes in practice and OOH organisation may limit current relevance.

Key: ARTIs: acute respiratory tract infections; GPs: general practitioner; NPs: nurse prescribers; OOH: out-of-hours; RTIs: respiratory tract infections; UK: United Kingdom.

2.4.3 Antibacterial Prescribing in OOH Services

2.4.3.1 Most Frequently Prescribed Drugs

Eleven studies examined oral antibacterial prescribing in OOH services, although the extent and methods of investigation varied. Of these, four found that antibacterials were overall the most prescribed class in OOH contacts (Turner et al. 2017; Lous et al. 2019; Brettell et al. 2020; Edwards et al. 2020), accounting for over half (53% and 58.3%) of total prescriptions in two (Turner et al. 2017; Edwards et al. 2020). Seven studies reported on the most frequently prescribed antibacterials (Lindberg et al. 2017; Rebnord et al. 2017; De Bont et al. 2018; Lous et al. 2019; Brettell et al. 2020; Palsdottir et al. 2020; Zhu et al. 2021b). Penicillins were the predominant group, though the specific drug varied across countries (Table 2.7).

Table 2.7: Most Prescribed Antibacterial Drugs in OOH Services

Country	Most Prescribed Antibacterial Drugs in Out-of-Hours Services	Reference
The Netherlands	Amoxicillin (76.1% in children).	De Bont et al. (2018)
England	Amoxicillin (30.9%), followed by trimethoprim (25.4%) and amoxicillin-clavulanate (17.4%) among end-of-life patients.	Brettell et al. (2020)
	Penicillins (61.6%) followed by tetracyclines (11.2%) and macrolides (10.3%); similar pattern to in-hours services.	Zhu et al. (2021b)
Norway	Penicillin V (preferred for RTIs): 69.9% of all antibacterial prescriptions.	Lindberg et al. (2017)
	Penicillin V (66.7%) followed by amoxicillin (20.4%).	Rebnord et al. (2017)
Denmark	Penicillin and amoxicillin were prescribed in 47% and 46% of cases, respectively.	Lous et al. (2019)
Iceland	33.1% of OOH contacts resulted in antibacterial prescription: amoxicillin-clavulanate (22.7%), amoxicillin (18.4%), penicillin V (16.9%). Diagnosis-specific patterns: amoxicillin-clavulanate for otitis media (50.3%) and pneumonia (40%), amoxicillin for sinusitis (48%), pivmecillinam for cystitis.	Palsdottir et al. (2020)

2.4.3.2 Comparison with In-Hours Services

Seven studies explored OOH antibacterial prescribing in relation to IH services, with different approaches to reporting. Five studies found that patients seen in OOH were more likely to receive antibacterial prescriptions (Debets et al. 2017; Turner et al. 2017; Baker et al. 2020; Cronberg et al. 2020; Haugom et al. 2021), especially for sinusitis, tonsillitis, and

cystitis (Debets et al. 2017). One study revealed a higher proportion of broad-spectrum drugs in OOH compared to IH services (Curtis et al. 2018).

In the Netherlands, Debets et al. (2017) reported drug-specific patterns, with OOH encounters more frequently involving prescriptions of amoxicillin, nitrofurantoin, and amoxicillin-clavulanate, whereas tetracyclines and macrolides were prescribed less often. Prescribing for cystitis was similar across services, and at least 80% of prescriptions for acute otitis media, bronchitis, and sinusitis used the recommended antibacterial drug. Differences between services were observed for other conditions, such as impetigo and tonsillitis, with more amoxicillin-clavulanate prescribed in OOH services (Debets et al. 2017).

Findings from a qualitative interview study suggested that, although GPs in OOH settings had a lower prescribing threshold, their choice of antibacterial drugs was similar to that in IH settings (Colliers et al. 2018). This aligns with quantitative evidence by Cronberg et al. (2020), who found that while OOH antibacterial prescribing rate was higher than IH services, the drug choice for each diagnosis was comparable across services (Cronberg et al. 2020).

2.4.4 OOH Services Presentations and Conditions Related to Antibacterial Prescribing

Eight studies identified common presenting symptoms and conditions in OOH services, including respiratory, urinary, ear, and skin-related infections, with varied prevalence across countries (Debets et al. 2017; Turner et al. 2017; Lous et al. 2019; O'Connor et al. 2019; Baker et al. 2020; Cronberg et al. 2020; Edwards et al. 2020; Haugom et al. 2021). Nonetheless, these studies explored prescribing for different clinical areas, examining a wide range of conditions or focusing on specific ones, such as UTIs (Haugom et al. 2021) or respiratory-related ailments (O'Connor et al. 2019). Table 2.8 summarises these findings.

Table 2.8: Presenting Conditions in OOH Services

Country	Most Common Conditions / Presenting Symptoms	References
Australia	Significantly higher rates of acute upper RTIs, fever, laceration, infection, injury management in OOH than in-hours services.	Baker et al. (2020)
	Respiratory diseases (13.4%; 71.2% of which RTIs) were the most common, followed by gastrointestinal diseases (12.6%; 48.5% of which throat infections*), and eye/ear problems (11.6%; 77.9% of which otitis media and 9.9% conjunctivitis).	Turner et al. (2017)
The Netherlands	Cystitis and acute otitis media most frequent in both services; more acute otitis media and tonsillitis in OOH.	Debets et al. (2017)

Key: OOH: out-of-hours; RTIs: respiratory tract infections; *Throat was classed as gastrointestinal.

Table 2.8: Presenting conditions in OOH services (continued)

Country	Most Common Conditions / Presenting Symptoms	References
Sweden	RTIs most prevalent in both services; more otitis media, pharyngotonsillitis, and lower UTIs in OOH.	Cronberg et al. (2020)
Denmark	In preschool children: respiratory tract diseases (41.4%; 36.8% of which upper RTIs), followed by general complaints, such as fever and viral infections (18.5%), and ear diseases (15.7%; 78.6% of which acute otitis media).	Lous et al. (2019)
England	52% of patients consulted OOH regarding an infection; upper RTIs most frequent recorded diagnosis (14.3%).	Edwards et al. (2020)
Ireland	In acute upper RTI cases: cough (72%) and sore throat (46%) were most reported presenting symptoms, while earache/discharge (15%), nasal or sinus complaints (24.1%) were least reported.	O'Connor et al. (2019)
Norway	Most UTI consultations were in IH services compared to OOH, with an annual increase of 32.7%: cystitis by 33.9% (IH: 38.9% vs. OOH: 13.7%); pyelonephritis by 14% (IH: 28.4% vs. OOH: 16.4%). Unlike IH services, the percentage of pyelonephritis consultations (30.1%) handled in OOH was higher than cystitis (20%).	Haugom et al. (2021)

Key: IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections; UTIs: urinary tract infections.

Eight studies revealed variability in antibacterial prescribing patterns across settings and medical conditions (Lindberg et al. 2017; Rebnord et al. 2017; Colliers et al. 2019; Lous et al. 2019; Brettell et al. 2020; Cronberg et al. 2020; Edwards et al. 2020; Palsdottir et al. 2020). Certain diagnoses were associated with higher prescribing compared to others (Table 2.9).

Table 2.9: Conditions Associated with Antibacterial Prescribing in OOH

Country	Infections Associated with Antibacterial Prescribing	Reference
Sweden	Higher prescribing in OOH vs IH for pneumonia, otitis media, pharyngotonsillitis; after adjusting for age and gender, skin and soft tissue infections (SSIs) and UTIs also had significantly higher relative risks of prescribing in OOH.	Cronberg et al. (2020)
Iceland	Five infections were studied (sinusitis, cystitis, pneumonia, acute otitis media, and bronchitis) accounting for 51.3% of OOH antibacterial prescriptions; of these, most frequent infections for antibacterial prescriptions: sinusitis (27.4%) and bronchitis (24.9%). Antibacterials were also prescribed for unstudied conditions: other RTIs, including tonsillitis (20.3%), skin infections (11.2%), UTIs and gastrointestinal infections (2%).	Palsdottir et al. (2020)
Belgium	44% of antibacterial prescriptions for respiratory infections, UTIs (13%), skin (12%), ear (11%), and digestive infections (6%).	Colliers et al. (2019)

Key: IH: in-hours; OOH: out-of-hours; RTIs: respiratory tract infections; UTIs: urinary tract infections.

Table 2.9: Conditions Associated with Antibacterial Prescribing in OOH (continued)

Country	Infections Associated with Antibacterial Prescribing	References
England	UTIs accounted for 39.7% of antibacterial prescriptions, respiratory conditions (31.7%), skin infections (2.4%); a relatively high percentage of prescriptions lacked clinical codes.	Brettell et al. (2020)
	Paediatric contacts resulting in antibacterial prescriptions: respiratory-related (42%), ear conditions (22.4%), skin conditions (14.4%).	Edwards et al. (2020)
Denmark	About 70% of preschool children with acute otitis media and 25% with fever received an antibacterial prescription.	Lous et al. (2019)
Norway	All children with respiratory symptoms found to have pneumonia received an antibacterial drug if a hospital referral was not made.	Rebnord et al. (2017)
	Upper RTIs and respiratory symptoms represented 31.9% and 20.5% of acute RTIs, respectively; 18.9% of patients with these two diagnoses received antibacterials, mostly penicillin V (74.8%). Among acute RTIs, tonsillitis (OR 24.11) and sinusitis (OR 12.39) were associated with higher prescribing.	Lindberg et al. (2017)

Key: OR: odds ratio; RTIs: respiratory tract infections; UTIs: urinary tract infections.

2.4.5 Factors and Predictors Correlated with Antibacterial Prescribing in OOH

Four studies examined factors and predictors of antibacterial prescribing in OOH services. Three focused on respiratory-related conditions (Lindberg et al. 2017; Rebnord et al. 2017; Spek et al. 2020), and one investigated UTIs (Maguire et al. 2018). Overall, these studies identified different prescribing predictors related to patients' presenting symptoms and diagnoses, laboratory test results, and the consultation length.

Rebnord et al. (2017) reported that children with respiratory symptoms were significantly more likely to receive an antibacterial prescription if they had positive ear examination findings (OR 4.62; 95% CI 2.35 to 9.10), C-reactive protein (CRP) levels above 20 mg/L (OR 3.57; 95% CI 1.43 to 8.83), or parents perceived the illness as bacterial and required antibacterial drugs (OR 2.45; 95% CI 1.17 to 5.13). Vomiting in the past 24 hours was negatively associated with prescriptions (OR 0.26; 95% CI 0.13 to 0.53) (Rebnord et al. 2017). Lindberg et al. (2017) found that short consultations and diagnoses of tonsillitis or sinusitis were linked to higher antibacterial prescribing in patients with ARTIs. Additionally, bronchitis, pneumonia, and other ARTIs were often associated with non-penicillin V prescriptions. Older patients and those younger than six had a lower prescribing prediction; however, elderly patients with bronchitis or pneumonia were more likely to receive broad-spectrum drugs. Maguire et al. (2018), who studied children with URTIs in both services,

concluded that those presenting to OOH settings were more likely to receive an antibacterial drug (odds ratio 1.42) and to have an immediate prescription. Spek et al. (2020) explored prescribing predictors in adults with UTIs, noting that nitrites, leukocytes, or erythrocytes in dipsticks were correlated with antibacterial prescribing, whereas male sex and pregnancy were associated with fewer prescriptions, possibly due to less specific symptoms in males. Prophylactic antibacterial use in patients with recurrent UTIs and those with diabetes mellitus did not affect prescribing (Spek et al. 2020).

2.4.6 Appropriateness of Prescribing in OOH Services

Four studies investigated the quality of antibacterial prescribing in OOH services, examining either adherence to guidelines (Debets et al. 2017; Maguire et al. 2018; Spek et al. 2020) or antibiotic prescribing quality indicators (APQIs) (Colliers et al. 2019). These studies revealed variations in prescribing appropriateness, with some conditions demonstrating higher adherence than others.

Using disease-specific APQIs in Belgium, Colliers et al. (2019) found that antibacterial prescribing exceeded the upper limit for all conditions studied. Antibacterials were given to 30% of patients with URTIs and 77% of those with tonsillitis, yet only a small proportion received the recommended treatment (3% and 6%, respectively). Adherence ranged from 40–46% for sinusitis, bronchitis, pneumonia, teeth/gum diseases, and erysipelas, and was highest for cystitis (69%) and otitis media (74%). None of the conditions met the target range of 80%–100%. Quinolones use exceeded the recommended limits in four infections, including sinusitis (7%), bronchitis (11%), pneumonia (15%), and cystitis (25%). In the Netherlands, Debets et al. (2017) reported over 80% adherence to guidelines for acute otitis media, tonsillitis, cystitis, and impetigo, with overprescribing of 20%, 23%, 3%, and 13%, respectively. Lower adherence was found for sinusitis (65%) and bronchitis (71%), with respective overprescribing of 49% and 40% (Debets et al. 2017).

According to Spek et al. (2020), over 20% of UTI patients received an antibacterial drug not aligned with guidelines. Prescribing via OOH telephone consultations was more compliant with guidelines than in GP visits (73.4% versus 54.5%). Furthermore, more than 20% of patients visiting a GP and 13.5% of those receiving telephone consultations during OOH services had prescriptions not in line with the recommended duration. For both service types, Maguire et al. (2018) reported that antibacterials were mostly prescribed for

immediate use (IH: 64.7%; OOH: 77.6%), with delayed prescriptions complying more often than immediate ones both in OOH (70.5% vs 64.3%) and IH services (76.8% vs 63.3%).

2.4.7 Impact of Interventions on Antibacterial Prescribing in OOH Services

Only two studies developed and evaluated OOH-specific AMS interventions to improve prescribing (De Bont et al. 2018; O'Connor et al. 2020). Both studies demonstrated that such interventions could have a positive impact on OOH antibacterial prescribing, resulting in more appropriate and guideline-concordant prescribing practices in these settings.

De Bont et al. (2018) conducted a cluster-randomised control trial investigating the impact of an interactive booklet designed to support HCPs in managing childhood fever during OOH consultations. The booklet served as an educational guide to be used during the final stages of consultations to facilitate discussions with parents. Intervention centres were provided with the booklet, while others served as control groups, and HCPs at the intervention centres had the option to choose whether to use the booklet. Although overall prescribing did not significantly differ between groups, analysis limited to consultations where the booklet was actually used (28.5% of cases) showed a substantial decrease in prescribing for all treatment, including antibacterials. Moreover, parents who had access to the booklet expressed a significant lower intention to seek further consultations for similar illnesses.

In Ireland, an educational intervention was provided to GPs, along with an electronic pop-up messages in OOH at the end of each consultation, classifying antibacterial drugs into red (to avoid) and green (preferred) ones, with other supporting materials (O'Connor et al. 2020). The intervention was well accepted and led to improved prescribing, with increased use of preferred agents and reductions in amoxicillin-clavulanate and other red category drugs.

2.4.8 Trends of Antibacterial Prescribing

Six studies investigated antibacterial prescribing trends in OOH services across multiple countries (Edelstein et al. 2017; Curtis et al. 2018; Maguire et al. 2018; Cronberg et al. 2020; Haugom et al. 2021; Zhu et al. 2021b), examining overall patterns, seasonal variations, and condition-specific prescribing.

In Sweden, antibacterial prescribing fell from 43 to 26 prescriptions per 1,000 inhabitants between 2006 and 2014, alongside a decline in infection visits from 65 to 43 per 1,000 inhabitants, representing 12% of all visits (Cronberg et al. 2020). Whereas in England, OOH

consultations represented only 1% of IH consultation volume, but accounted for 5%–5.4% of all GP antibacterial prescribing between 2010 and 2013, decreasing to 4.5% in 2014 (Edelstein et al. 2017), and further to 3.3%–3.6% between 2016 and 2020 (Curtis et al. 2018; Zhu et al. 2021b). Antibacterial prescribing in both IH and OOH services peaked each December (Edelstein et al. 2017; Zhu et al. 2021b) and was lowest in July (Edelstein et al. 2017). However, the number of items did not change significantly on an annual basis in both services (Edelstein et al. 2017) or monthly in OOH prior to COVID-19 (Zhu et al. 2021b). Though, over the same period, IH prescribing had a significant monthly declining trend (Zhu et al. 2021b). The proportion of broad-spectrum prescribing to the total volume was highest each year in July, according to Edelstein et al. (2017) and in August, according to Zhu et al. (2021b) for both IH and OOH services. Both settings observed a reduction in the proportions of broad-spectrum drugs and a dramatic decline in cephalosporin prescribing (Curtis et al. 2018). Despite this reduction, OOH services consistently contributed to higher broad-spectrum prescribing than IH services (Edelstein et al. 2017; Curtis et al. 2018; Zhu et al. 2021b), though this contribution was decreasing before COVID-19 across both settings (Edelstein et al. 2017; Zhu et al. 2021b).

Condition-specific analyses further illustrated important trends. In Norway primary care, Haugom et al. (2021) identified that about 52% of UTI cases resulted in an antibacterial prescription, and the proportion increased over the study period (2006–15). Cystitis prescribing rose from 36.6% to 65.7% in IH and from 47% to 69.7% in OOH services, while pyelonephritis prescribing increased from 28% to 46.6% in IH and 50.6% to 64% in OOH services. In England, a consistent decline in trimethoprim prescribing was found in OOH services, with the trimethoprim-to-nitrofurantoin ratio dropping from 1.9 to 0.3 between January 2016 and June 2020 (Zhu et al. 2021b). Additionally, based on Curtis et al.'s (2018) study, the duration for antibacterial courses for UTIs in OOH was consistently shorter than IH services, decreasing from a median of 5.5 to 5 days (Curtis et al. 2018).

For respiratory and chest infections in England, Zhu et al. (2021b) found that cephalosporins and ciprofloxacin prescribing remained stable throughout each year. However, amoxicillin, amoxicillin-clavulanate, and doxycycline prescribing peaked every year in December, with the seasonality indicating the highest use of amoxicillin to treat RTIs in winter. In Ireland, Maguire et al. (2018) observed that antibacterial prescribing for children with URTIs

decreased following the introduction of free GP services in July 2015 (Maguire et al. 2018). In OOH care, prescriptions fell from 72.3% pre-introduction to 57.7% in 2016 and 60.6% in 2017. A similar pattern was seen within IH prescribing (69.6% pre-introduction to 46.2% and 49.5% in 2016 and 2017, respectively).

2.4.8.1 Prescribing in the COVID-19 Context

Three studies explored changes in antibacterial prescribing in OOH services during COVID-19 in terms of overall trends, specific drugs, and consultation modes, with a common trend of reduced prescribing (Colliers et al. 2021b; Zhu et al. 2021b; Hek et al. 2022).

England: Prescribing in OOH services remained stable from January 2016 to February 2020 (Zhu et al. 2021b). From March 2020, however, there was a monthly decrease of 5,088 items prescribed, with increasing proportions of broad-spectrum prescribing in IH (0.7% per month) and OOH services (1.4% per month). Use of amoxicillin-clavulanate and doxycycline peaked between March and May 2020, unlike previous seasonal trends (Zhu et al. 2021b).

Belgium: OOH antibacterial prescribing dropped by 42.9% (Colliers et al. 2021b), with reductions in amoxicillin and amoxicillin-clavulanate prescribing (commonly prescribed for RTIs), while nitrofurantoin trend (first-line drug for UTIs) remained stable. The reduction in amoxicillin (65.2%) prescribing exceeded that for amoxicillin-clavulanate (38.1%). Both telephone and face-to-face prescribing decreased by 56.5%. The reduction in face-to-face prescribing might be attributed to the drop in antibacterial prescribing and, to a greater extent, the number of contacts. Although face-to-face contacts decreased by about a third after the lockdown, the overall contacts increased due to a rise in telephone consultations.

The Netherlands: IH and OOH antibacterial prescribing fell drastically during COVID-19 due to government restrictions and reduced patient encounters (Hek et al. 2022). However, OOH prescribing returned to pre-pandemic levels in 2021 when restrictions were lifted. Prescribing rates changed considerably for RTIs and in children under 11, while UTI prescribing did not. Overall, the drop in prescribing in both services during the first pandemic year did not have a lasting impact on antibacterial prescribing.

2.4.9 Patients Satisfaction and Expectations when Visiting OOH Services

Two studies mentioned satisfaction with OOH care (De Bont et al. 2018; Lous et al. 2019). Parents generally reported feeling positive, reassured, and satisfied with the care their

children received (De Bont et al. 2018; Lous et al. 2019). However, one of these studies noted that dissatisfaction was linked to low antibacterial prescribing rate (Lous et al. 2019).

In terms of expectations, one study on ARTIs in OOH care found that patients mainly expected further examination (53%), reassurance (51%), information (49%), and cough medications (47%) (O'Connor et al. 2019). Regarding antibacterials, over half of those surveyed were unsure about needing a prescription, 34% expected one, and 10% did not. Patients presented with earache or sore throat were more likely to anticipate antibacterials (44% and 39%, respectively). While not significant, patients attending subsequent consultations and those eligible for free care were more likely to expect antibacterials, whereas males were significantly more likely not to expect one (O'Connor et al. 2019).

2.4.10 Challenges in OOH Services

2.4.10.1 Factors Influencing Antibacterial Prescribing in OOH Services

Four qualitative studies explored factors influencing antibacterial prescribing in OOH services (Colliers et al. 2018; Williams et al. 2018; O'Doherty et al. 2019; Colliers et al. 2020), highlighting how organisational and patient-related factors create complexity in prescribing within these settings.

In OOH services, HCPs often face pressure with limited consultation time, especially with unknown patients, limiting opportunities to have adequate discussion to fully assess their expectations and actual needs for antibacterial drugs (Colliers et al. 2018; Williams et al. 2018; O'Doherty et al. 2019). O'Doherty et al. (2019) found that GPs may issue antibacterial prescriptions despite knowing they are unnecessary, while Williams et al. (2018) identified that prescriptions were sometimes used to end consultations to see the next patient, especially during busy shifts and long waiting periods.

Several factors were also reported as contributing to clinical uncertainty, such as inability or limited access to patient medical records, lack of OOH re-access or follow-up, patient-perceived anxiety, fear of missing critical conditions or poor prognosis, particularly for vulnerable patients, and loyalty to the patient's regular GP (Colliers et al. 2018; Williams et al. 2018). Additionally, patients' knowledge and understanding contributed to this uncertainty (Colliers et al. 2018) and influenced the decision to prescribe, primarily for delayed prescribing (Williams et al. 2018). Williams et al. (2018) also reported mixed views

on the lack of patient rapport in OOH services, with some indicating it affected their prescribing, while others reported no effect.

It was also identified that patients attending OOH differ from those in IH services in being sicker individuals, increasing the likelihood of prescribing (Colliers et al. 2018; Williams et al. 2018). Moreover, GPs felt pressured to prescribe in OOH services to provide a consultation exchange that would please patients and meet their expectations (Colliers et al. 2018; O'Doherty et al. 2019), particularly for private patients who pay for the service (O'Doherty et al. 2019). Other barriers may also impact OOH prescribing, especially for patients for whom further explanation and education requires more time and effort, such as those with different languages, cultural views and beliefs, or patients less reliant on self-care (Colliers et al. 2018). When patients had already consulted their regular GP, OOH GPs may find it difficult to use watchful waiting; hence they issue a prescription (Colliers et al. 2018).

GPs felt they had different duties working OOH in a GPC (Colliers et al. 2018; Colliers et al. 2020), describing it as a stressful environment with extra burden and limited diagnostics. They reported feeling less connected and accountable, and more pressured by time, attending patients, or faster-working peers (Colliers et al. 2018). Furthermore, they believed that the high turnover and varying shifts within the workforce in OOH services made consistent training and education difficult, contributing to antibacterial prescribing complexities and practices that may contradict local guidelines (Williams et al. 2018).

2.4.10.2 Communication and Managing Expectations

Three studies discussed aspects related to communication, managing patient expectations, and aligning prescribing with appropriate assessments in OOH services (Williams et al. 2018; Colliers et al. 2020; Colliers et al. 2021a), supporting informed decisions and improving patient satisfaction and outcomes.

Williams et al. (2018) explored OOH prescribing practices of 15 GPs and 15 NPs in England through semi-structured telephone interviews, focusing on patients with RTIs. HCPs followed an iterative three-stage approach when communicating management decisions. Initially, they managed patient expectations, with most reporting that patients either seemed to expect or explicitly expressed expectations for antibacterials, while a minority noted fewer instances of requesting antibacterials compared to previous years. The second stage involved discussing and negotiating the management plan with patients by explaining

the illness's course and severity. Delivering safety-netting advice was the last stage, highlighting alarming signs, alternative care pathways, and possible side effects if a decision to prescribe was made.

In Belgium, Colliers et al. (2020) showed that work settings affected GPs' communication and decision-making. GPs often based decisions on unconfirmed assumptions about patients' expectations. Their thinking process was influenced by the way patients framed their concerns rather than the actual details and contents of the complaints, which created pressure to prescribe antibacterial drugs.

In a related study, Colliers et al. (2021a) analysed 77 video-recorded consultations involving 19 GPs to examine how patients presented their problems, how GPs interacted, and how these factors related to antibacterial prescribing, particularly for RTIs in OOH settings. GPs demonstrated different communication styles: open communication or faster, close-ended questioning, which might impact the extent to which they understood patients' ideas, concerns, and expectations (ICEs) and, consequently, their prescribing decisions (Colliers et al. 2021a). Patients did not routinely express their concerns or expectations directly, and GPs rarely explored them. Although accepted among GPs, only a few applied the communication probing tool to explore ICEs (Colliers et al. 2020). From the beginning of the consultation, their attention was on deciding whether an antibacterial was required. In some instances, however, GPs addressed patients' expectations about receiving prescriptions, either during care plan discussions or before prescribing, and explained their decisions (Colliers et al. 2021a). If expectations remained unmet or had not been discussed, patients would raise them. Generally, clarifying expectations led to smoother consultations, e.g., when prescribing was not expected but a sick note was needed (Colliers et al. 2021a).

Differences were also observed in how GPs communicated their management plans. Generally, non-antibacterial decisions were well accepted among patients (Colliers et al. 2021a). Delayed prescriptions were occasionally offered when patients doubted the GPs' non-prescribing decisions. It was common for GPs to diagnose patients following clinical examination and indicate that antibacterials were not needed. A few GPs addressed patients' concerns by summarising examination findings and used that to defend their (non)-antibacterial prescribing plan. They also communicated non-prescribing decisions by providing reassurance and emphasising that there was no indication. Some GPs explained to

patients whether they had a viral illness to educate them and counter any expectation of prescriptions (Colliers et al. 2020). GPs would also acknowledge the seriousness of symptoms while using assertive phrases (e.g., “conquering infections”) to encourage patients to act appropriately or avoid antibacterials; however, many reflected that simpler language might have been more appropriate. When antibacterials were not prescribed, some GPs were assured of offering care advice only, while others provided symptomatic treatments to meet patients’ expectations and acknowledge their illnesses.

2.4.10.3 Approaches to Safety Netting

Two studies identified approaches used to ensure that safety netting is in place (Williams et al. 2018; Colliers et al. 2020). Colliers et al. (2020) found that GPs engage in conversations with patients about safety netting, adopt a watchful waiting approach, use communication strategies to highlight red flags and support safety netting. However, determining the safety of this approach can be difficult in OOH services, especially with language barriers, new patients with unfamiliar history and behaviour, or those who do not have a regular GP (Colliers et al. 2020). Delayed prescribing was identified as a useful safeguarding tool (Colliers et al. 2020), supporting treatment and shared decision-making (Williams et al. 2018). Nonetheless, the lack of feedback on delayed prescribing and the perceived expectations of getting it dispensed against advice might hinder HCPs from issuing such prescriptions (Williams et al. 2018). Furthermore, HCPs may increase prescribing during weekends as an additional measure, anticipating limitations in medical coverage the next day (Williams et al. 2018). Some may also refer patients to their regular GPs to ensure continuity of care (Colliers et al. 2020).

2.4.10.4 Differences in OOH Practices Among HCPs

One study showed variations in prescribing practices between OOH GPs and NPs. Williams et al. (2018) found that NPs tended to spend more time with patients, felt more accountable, and were more likely to follow guidelines. In contrast, GPs reported that time constraints and pressures to end consultations impacted the likelihood of antibacterial prescribing, and they frequently deviated from guidelines. Their view of accountability was shaped by the need to act in the patient’s best interest and the inability to follow up. While both HCPs acknowledged that GPs typically manage more complex cases, NPs felt that inconsistent prescribing practices between HCPs influenced patient expectations, as some

patients associated not receiving antibacterial prescriptions with being treated by a nurse rather than a GP (Williams et al. 2018).

2.4.10.5 HCPs' Perspectives on OOH Antibacterial Prescribing and Proposed Solutions

Two studies explored OOH HCPs' perspectives on their prescribing and responsibilities toward AMR (Colliers et al. 2018; Williams et al. 2018). Colliers et al. (2018) found that while GPs were familiar with local guidelines, their approaches to using them varied. Although they acknowledged the AMR threat and the importance of limiting antibacterial use, they did not see themselves as personally responsible, attributing the problem to their peers' prescribing habits. Many GPs did not fully understand their own prescribing profiles and expressed a need for feedback on their prescribing to compare with others. Additionally, evaluating prescribing necessity in OOH services was seen as difficult, particularly because weekend GPs frequently provide incomplete records, possibly exaggerate diagnoses to justify prescriptions, and some do not use computers (Colliers et al. 2018).

Some OOH HCPs suggested developing GPC-specific prescribing guidelines (Colliers et al. 2018), believing it could positively influence prescribing as they prefer to use common standards to refrain from unnecessary prescribing. They also highlighted auditing, feedback, and supervision as key strategies to support prescribing practices (Williams et al. 2018).

2.5 Discussion

2.5.1 Main Findings

This scoping review aimed to map and synthesise current evidence on oral antibacterial prescribing in primary care OOH services. Hart and Phillips (2020) previously summarised evidence in this area; however, their review was limited by a narrow search conducted in 2017 and unclear inclusion criteria. The present review builds on that work by using a more comprehensive search strategy with clearly defined criteria and including studies published since 2017. Research beyond this date has contributed to key understanding in several areas, such as changes in OOH antibacterial prescribing and care delivery, particularly during COVID-19, AMS interventions, and challenges in OOH services. Overall, this scoping review provides an updated overview of the literature, mapping current evidence, highlighting key aspects of prescribing practices, and thereby fulfilling its stated aim.

2.5.1.1 Most Prescribed Drugs and Associated Conditions in OOH Services

Penicillins were the most frequently prescribed oral antibacterial class across countries, consistent with Hart and Phillips' (2020) review based on four studies, two of which overlap with this scoping review (Debets et al. 2017; Lindberg et al. 2017). Among these studies, Huibers et al. (2014) noted beta-lactam-sensitive penicillins as the most commonly prescribed drugs, and Hayward et al. (2016) further reported penicillins as the top prescribed class, with amoxicillin accounting for over 28% of UK primary care prescriptions in IH and OOH settings. Alignment of findings highlights that penicillins remain the dominant class used across different OOH services.

Since the completion of this scoping review, further studies have also reinforced such finding. In Ireland OOH services, penicillins were the most commonly prescribed class, with amoxicillin predominating (Shah et al. 2024). In Australian primary care, URTIs were more likely to result in immediate antibacterial prescriptions on weekends and holidays than on weekdays, with narrow-spectrum penicillins most commonly used (Peng et al. 2023). Additionally, in England, two-thirds of patients presenting with insect bites in OOH services, accounting for less than 1% of encounters, received antibacterial drugs, with flucloxacillin representing 82.1% of antibacterial prescriptions (Finnikin et al. 2023).

The persistence of this trend is possibly attributed to the high prevalence of RTI contacts in OOH and primary care more broadly, where penicillins are widely used as first-line treatments (NICE 2024; Plejdrup Hansen et al. 2024). Most studies, both in this review and the previous one (Hart and Phillips 2020), identified RTIs as among the most common conditions encountered, with varying contributions from other conditions (e.g., SSIs). A high proportion of penicillins were issued for these infections, as also seen in Ireland's OOH consultations (Shah et al. 2024). This aligns with other systematic reviews, which reported RTIs among the leading infectious conditions for consulting primary care (Finley et al. 2018; Khan et al. 2022). However, these reviews did not focus specifically on OOH contexts.

2.5.1.2 Prescribing Trends and the Impact of COVID-19

Prescribing trends and, particularly the impact of COVID-19 on antibacterial prescribing practices, including prescription volumes, number of encounters, and consultation modes, was an important theme highlighted in this scoping review. Hart and Phillips (2020) did not address prescribing trends generally, including during COVID-19 as their review preceded

the pandemic. This emphasises the importance of capturing current evidence and gaps through an updated review. Variations exist across countries and between IH and OOH services in terms of prescribing before COVID-19. However, included studies consistently reported an overall decline in antibacterial prescribing during COVID-19 across both IH and OOH services in England, Belgium, and the Netherlands (Colliers et al. 2021b; Zhu et al. 2021b; Hek et al. 2022), with a significant shift from face-to-face to remote consultations (Zhu et al. 2021b). This aligns with a study in Ireland published after completing this review covering the period between December 2019 and 2021, where OOH prescribing substantially reduced during the early pandemic stages but rebounded in 2021 (Shah et al. 2024). In contrast, Danish OOH antibacterial prescribing remained relatively stable, with only a 3% reduction compared to pre-pandemic levels (Krogh et al. 2024). Both studies, however, reported a decrease in face-to-face consultations, coinciding with a rise in those conducted remotely (Krogh et al. 2024; Shah et al. 2024).

The decline in antibacterial prescribing during the pandemic could likely be linked to multiple interacting factors, including altered prescribing and health-seeking behaviour, lockdown measures, social distancing, and reduced infection transmission. This reduction was particularly notable for infections transmitted via respiratory routes (i.e., RTIs), which commonly present and drive prescribing. In contrast, prescribing for UTIs remained stable, reflecting the consistent clinical need for treatment of non-respiratory infections. Although some studies have reported a rebound in prescribing after the early stages of COVID-19 when restrictions were lifted, these analyses were limited to data up to 2021 (Hek et al. 2022; Shah et al. 2024). Therefore, it remains unclear whether these changes have persisted, warranting further investigation to assess their long-term implications.

2.5.1.3 Challenges and Factors Influencing Prescribing

The scoping review identified several factors influencing antibacterial prescribing among HCPs in OOH settings. Many of these mirror those described previously in a systematic review by HCPs in IH services, such as diagnostic uncertainty, working under stress, and patient expectations (Tonkin-Crine et al. 2011). However, the present review revealed additional challenges specific to OOH care, including the absence of established patient-clinician relationships, perceived patient anxiety and awareness, parental assessment, limited access to shared medical records, and managing sicker individuals during busy shifts.

These factors, along with limited diagnostics, lack of follow-up, and the pressure to meet patient expectations, may increase the likelihood of unnecessary prescribing.

Hart and Phillips' (2020) review reported similar findings, noting that parental opinion could influence prescribing, based on two studies (de Bont et al. 2015b; Rebnord et al. 2017), one of which was also included in the current review. This influence was attributed either to parents' perceived knowledge of their child's health or efforts to satisfy parental expectations (Hart and Phillips 2020). Time pressure was also identified in their review as a factor, with shorter consultations associated with higher antibacterial prescribing, especially during busy shifts (Hart and Phillips 2020), though this was based on two studies captured in the present review (Lindberg et al. 2017; Williams et al. 2018). Evidence published after the completion of this review further highlighted variation in antibacterial prescribing across OOH consultation modes (clinic, telephone, or home visits), suggesting that GPs' familiarity with the setting and their activity levels (e.g., number of patients seen) may contribute to the pressure experienced and influence prescribing tendency (Huibers et al. 2022). These results suggest that contextual and behavioural factors can drive antibacterial prescribing.

Addressing these factors may help promote appropriate antibacterial prescribing and advance AMS in OOH care. Strategies to mitigate unnecessary prescribing may include guideline-based educational outreach, as suggested by Hart and Phillips (2020), or using patient interactions as opportunities for education, as studied by Lawson and Flocke (2009), to promote long-term health behaviour change. Courtenay et al. (2017b) also identified that dedicating time to patient education is key and can help reduce the likelihood of future unnecessary consultations and antibacterial expectations. In this scoping review, a few OOH HCPs suggested that tailored guidance, audits, personalised feedback, and supervision could improve prescribing. Broader literature supported the effectiveness of interventions, such as training programmes, educational outreach, meetings, and lectures, in changing prescribing behaviour, though these have mostly been tested in non-OOH settings (Kamarudin et al. 2013; Köchling et al. 2018; Kunstler et al. 2019). For instance, a systematic review by Baker et al. (2015) found that tailored educational outreach, such as those addressing barriers to change, nearly doubled the likelihood of behaviour change. This suggests that tailoring interventions to the specific needs of OOH HCPs could enhance their

effectiveness. While promising, the applicability and acceptability of such approaches in OOH services should be explored.

This scoping review highlighted that uncertainty in OOH services, often driven by factors such as the lack of diagnostics and point-of-care tests (POCTs), further complicates antibacterial prescribing. This aligns with findings from daytime practice, where underuse or lack of tools such as CRP testing and urine cultures has been linked to higher prescribing (Aabenhus et al. 2017). However, evidence from Danish OOH settings conducted after the scoping review revealed variation in POCT use, including CRP, rapid antigen detection tests, and urine dipsticks, correlating higher usage with increased antibacterial prescribing (Christensen et al. 2024). Research also found that such tests support more informed decisions about antibacterial need (Aabenhus et al. 2014; Dixon et al. 2022). For example, evidence published beyond the review found that while reductions in antibacterial prescribing could not be conclusively demonstrated, more than half of OOH clinicians reported changing their prescribing decisions after CRP testing, with nearly two-thirds (64%) changing their decision in suspected lower RTI cases (Dixon et al. 2022). They also noted that CRP testing supported their decision-making and facilitated communication about non-prescribing decisions by providing an objective rationale (Dixon et al. 2022). The limited impact was attributed to low uptake and inconsistent use, suggesting that barriers could be addressed through flexible education and training, mentorship, and sharing positive experiences, and improving machine accessibility (Dixon et al. 2022).

In Wales, the NHS-funded POCT Sore Throat Test and Treat (STTT) service was implemented in several community pharmacies and has expanded nationally since November 2018 (Mantzourani et al. 2020; Mantzourani et al. 2022). This service helps pharmacists manage uncomplicated throat infections using rapid antigen detection tests, when necessary, based on the patient's FeverPAIN and Centor scores (NICE 2018c). It shifts management of those patients from GPs to community pharmacies, many of which operate beyond regular GP hours, contributing to OOH service provision while ensuring antibacterial drugs are given only when warranted. Studies have demonstrated the service's value in reducing unnecessary antibacterial prescribing and promoting AMS practices (Mantzourani et al. 2020; Mantzourani et al. 2022). Furthermore, the STTT service received high satisfaction and positive feedback from patients and pharmacists, highlighting its acceptability and feasibility

(Mantzourani et al. 2021; Mantzourani et al. 2023). These findings suggest that expanding access to POCT and diagnostic tools could help address some prescribing challenges in OOH settings. However, understanding the service needs and contexts is important to design tailored interventions to maximise the benefits of these tools.

2.5.1.4 Enhancing Prescribing Through Communication and OOH-Specific Interventions

This scoping review identified communication as a fundamental component of antibacterial prescribing. Effective communication enables HCPs to explore patients' ICEs, understand their perspectives, and deliver appropriate decisions, leading to improved consultation outcomes. Safety-netting advice represents a key part of this process, providing patients with guidance on self-management and on recognising signs of deterioration. However, evidence from Belgian OOH settings in this review found that such advice was frequently absent, unclear, or rarely documented in medical records (Colliers et al. 2022). Additionally, safety-netting was more commonly provided when a (delayed) antibacterial prescription was issued than when clinicians chose not to prescribe (Colliers et al. 2022). This suggests that communication quality and advice provision may be influenced by the prescribing decision, potentially limiting efforts to promote reassurance and AMS when no prescription is given.

Communication interventions could help address these gaps. For instance, an e-learning programme based on the results of the OPEN 'Out of Hours Prescribing: Enhancing Communication' project, was developed in England and published in 2021. It aims to improve communication with patients in OOH consultations for common infections (NHS England elearning for Healthcare 2021). The training is freely accessible to NHS HCPs, including GPs, nurses, pharmacists, and paramedics, and consists of four 20-minute modules on managing patient expectations, providing self-care advice, delayed prescribing, and offering safety netting advice. Although data on its uptake and impact could not be identified, initiatives of this kind could be shaped, evaluated, and implemented nationally and globally to strengthen communication and support better prescribing practices.

2.5.1.5 Appropriateness of Prescribing

Although studies from this review showed high antibacterial prescribing in OOH services, this does not necessarily imply inappropriate prescribing. For instance, one reviewed study revealed higher prescribing in OOH compared to IH services (Debets et al. 2017), yet the

quality of prescribing profiles was comparable. It must be noted, however, that comparing IH and OOH prescribing remain challenging due to fundamental differences in the clinical environments, available resources and diagnostics, and patient population in each setting. These differences suggest a need for prescribing quality evaluation in OOH contexts.

Opportunities to improve adherence to guidelines and prescribing quality indicators were noted in this review, although studies addressing these varied in population, methods, and outcomes. A study by De Man et al. (2023) published after completing the review further reported substantial variability in antibacterial prescribing for lower UTIs across OOH services and their trends over time. Their findings showed that 55% of antibacterial prescriptions adhered to the guidelines' recommended drugs, with improvement in adherence from 50.5% in 2016 to 59.8% in 2020. While some of the reviewed studies showed acceptable adherence for some diagnoses, concerns were raised about inappropriate drug selection and overprescribing for certain infections.

These issues are particularly relevant given that antibacterial prescribing is often influenced by infection type and severity. For instance, while acute RTIs were among the most common conditions for antibacterial prescriptions, most of these infections, such as sinusitis, sore throat, and otitis media, are typically viral, self-limiting, and only occasionally require antibacterial treatment (NICE 2017; 2018; 2022; Sur and Plesa 2022), as also noted by Hart and Phillips (2020). The need for timely care access may further drive overprescribing, as clinicians may feel compelled to issue antibacterials to avoid treatment delays, even in situations where such prescriptions are not warranted. This may also result in higher referral rates, especially in severe cases or where clinical uncertainty exists and further evaluation is needed. Moreover, most reviewed studies assessed prescribing appropriateness retrospectively using routinely collected data from primary care electronic records, which could limit insights into patient histories and examinations, making it difficult to judge whether prescriptions were urgent or justified.

Despite their critical role in maintaining continuity of care, OOH services have received less focus compared to routine primary care in efforts to improve antibacterial prescribing. Most AMS interventions and guidance have targeted primary care, with Alves et al. (2021) highlighting this gap. Additionally, the present review also showed a dearth of OOH interventions to support prudent antibacterial prescribing, with only two studies identified

that evaluated AMS intervention efficacy (De Bont et al. 2018; O'Connor et al. 2020). Both, an interactive prescribing booklet and a simplified educational intervention, were effective, although the booklet's impact was limited to those who actually used it (De Bont et al. 2018; O'Connor et al. 2020).

Studies published after the completion of this review provided evidence on the effectiveness of multifaceted AMS intervention in OOH care. In Belgium, a participatory action research on such intervention demonstrated promising outcomes (Colliers et al. 2023). The intervention included e-learning packages for GPs, patient leaflets, printed guideline summaries, electronic pop-ups to guide or withhold antibacterial prescriptions, interdisciplinary meetings with pharmacists, and CRP POCTs alongside usage guidance and prescribing posters (Colliers et al. 2023). This approach reduced total antibacterial prescribing and increased adherence to guideline-recommended treatments for RTIs (Colliers et al. 2023). Similarly, a two-year multifaceted intervention in Spanish primary care, including four OOH services, introduced leadership groups, educational sessions, feedback at individual and centre levels, infographics for HCPs and patients with cystitis, and updated local resistance data (Gallardo et al. 2022). While it did not reduce urine culture requests for uncomplicated UTIs, it improved cystitis management and increased the use of first-line antibacterials in OOH sites (Gallardo et al. 2022).

These findings highlight a clear need for AMS interventions and strategies for OOH care. Promoting and evaluating the uptake of such interventions is essential. While employing multiple interventions simultaneously may maximise overall benefits, examining each intervention individually may help determine the specific impact of each and identify which elements most effectively improve prescribing practices.

All studies identified in this review were from high-income countries, which may not reflect the challenges in LMICs, such as limited trained HCPs, insufficient infrastructure, and financial constraints that often restrict access to basic emergency services (Kironji et al. 2018). These challenges suggest that well-established OOH services are likely limited or unavailable in many healthcare systems. Enhancing access to emergency and OOH care should, therefore, be a key priority for countries aiming to improve healthcare delivery.

2.5.2 Implications for Research and Practice

Addressing the global concerns of antibacterial drug overprescribing and the rising resistance requires a deeper exploration of prescribing practices, particularly within OOH. Most research in OOH services has focused on the volume of prescribing. However, although examined by some, it is also essential to explore the quality of prescribing practices and the underlying behaviours of both HCPs and patients. Qualitative investigations across different countries can offer insight into potential factors affecting their daily practice.

OOH services present a challenging environment, where HCPs face increased clinical pressure which may contribute to high rates of antibacterial prescribing. These challenges suggest a need for support and resources to deliver the best care. Although many initiatives exist to optimise antibacterial drug use, such as the NPIs in Wales (AWMSG 2022b), to the researcher's knowledge, these have been primarily developed for general primary care settings and are not explicitly designed for OOH services. As such, their relevance and applicability in OOH services remain unclear. The unique nature of OOH services necessitates developing feasible and practical interventions for these environments.

This scoping review highlights the limited literature on AMS interventions in OOH services, their impact on prescribing practices and the sustainability of changes. The scarcity of evidence restricts definitive conclusions about their success. Future research should focus on improving OOH services, developing tailored interventions, and incorporating multifaceted strategies that support both patients and HCPs to promote appropriate prescribing. Interventions that are simple and easily integrated into busy environments and time-pressured consultations may encourage high uptake and adherence. Additionally, standardising methods and outcome reporting may enhance comparability and facilitate evaluation of intervention effectiveness.

This review identified a clear gap in the literature around prescribing oral antibacterial drugs in primary care OOH services in Wales. Although several studies have examined prescribing in the UK OOH services, none have explored Wales prescribing in these settings, where responsibility lies with the WG as a devolved nation. The studies in this thesis aim to address this gap by providing robust, data-driven understanding of current practices, moving beyond anecdotal observations.

2.5.3 Strengths and Limitations

This scoping review builds on an earlier review that identified how OOH prescribing contributes to AMR (Hart and Phillips 2020). By incorporating more recent literature, it extends existing knowledge and captures changes in healthcare systems and prescribing practices over the past few years. The review comprehensively explores the topic through an extensive database search and broad inclusion criteria, capturing diverse relevant peer-reviewed studies and ensuring thorough reporting. To enhance rigour, the search strategy was developed with input from an experienced subject librarian at Cardiff University. Additionally, scanning reference lists of included studies and identified reviews did not yield additional studies beyond those retrieved through the electronic search, indicating that the chosen search terms and strategy effectively captured relevant and current literature. Reproducibility, transparency, and methodological integrity were maintained by following JBI and PRISMA-ScR guidelines where possible throughout the search, screening, and reporting processes.

However, it has a few drawbacks, mainly in terms of the study design. The exclusion of non-English studies and those published before 2017 may have led to missing out on information relevant to the review's focus. Excluding these articles, however, was intended to narrow down the focus to more current literature and to ensure that the researcher could assess the eligibility of each study, understand the context, and effectively synthesise the results. Despite this, it is believed that key concepts around oral antibacterial prescribing within OOH services were still identified, particularly studies pertaining to AMS interventions.

One of the study's limitations is the exclusion of grey literature, as including them may have affected the reproducibility of the review. Grey literature, including non-peer-reviewed publications, academic reports, and governmental documents, was excluded due to the challenges in locating them, the lack of resources to assess their quality and the high volume of citations identified during initial screening. Considering the nature of scoping reviews, no formal quality evaluation was not conducted. However, since included publications were peer-reviewed, they were assumed to be of reasonable quality.

Ideally, scoping review stages are completed at least in duplicate to increase methodological rigour. However, in this review, data charting and synthesis stages were completed by the researcher only owing to the nature of PhD projects and the imposed time limits. To

mitigate this, the project supervisors reviewed 10% of the work during the data charting stage. Additionally, the results and any queries that arose during these stages were discussed throughout. Due to time restrictions as stated above, the sixth suggested step in the scoping review process, i.e., stakeholders' consultation, was not pursued extensively. Nevertheless, this step was only reported in roughly 40% of published scoping reviews (Pham et al. 2014).

Lastly, synthesising and comparing findings across studies to provide an objective overview of global antibacterial prescribing practice in OOH services presented several challenges. These included heterogeneity in patient populations, differences in how OOH services are implemented across healthcare systems, and inconsistencies in study methodologies and outcome reporting. Additionally, some studies did not solely focus on oral antibacterial prescribing or OOH; in such cases, only data relevant to the overall aim were extracted.

A few relevant studies were published after the search was completed. These were subsequently identified, by running the search again on 9 November 2024, and incorporated into the discussion, ensuring the review remains as current as possible.

2.6 Conclusion

This review provides an overview of research on primary care OOH services covering different aspects of oral antibacterial prescribing. Optimising prescribing practices to support the rational use of these drugs is important. The findings also reinforce the significance of establishing AMS programmes at national and international levels to reduce inappropriate prescribing in OOH care, which would positively impact healthcare systems and human health. Stakeholders and policymakers could develop multifaceted interventions to promote behavioural changes and mitigate inappropriate prescribing in these settings.

Although a satisfactory number of studies addressed OOH prescribing, differences in OOH service delivery across countries and heterogeneity in methods and outcomes limit comparisons. Future research could build upon this review to better understand current practice in these settings and their contribution to AMR and stewardship efforts. Given the lack of evidence from Wales and earlier input from local stakeholders (Chapter 1), this thesis explores OOH oral antibacterial prescribing in this context, with the following chapter outlining the methodological framework and key considerations to address this gap.

Chapter 3 Methodology

3.1 Overview of the Chapter

This chapter outlines the philosophical perspectives and methodological approaches adopted to address the thesis' aim and objectives. It begins with an overview of research paradigms and the researcher's positionality. The chapter then introduces the mixed methods approach and presents descriptions of the specific methods, principles, and considerations to set the foundation for those used in subsequent chapters.

3.2 Research Paradigms

Research paradigms are sets of assumptions or beliefs about how the world operates that shape how researchers investigate a phenomenon (Guba 1990). They provide a framework that forms researchers' perspectives on the subject, guiding their approach and choice of data collection and analysis methods. Guba (1990) described a paradigm through three dimensions: ontology (views of reality and truth), epistemology (how they acquire knowledge), and methodology (methods used to gain knowledge). The choice of paradigm is driven by the research question. In healthcare research, the most common paradigms are positivism, constructivism, and pragmatism (Harvey and Land 2021) (Table 3.1).

Table 3.1: Philosophical and Methodological Views of Common Paradigms in Healthcare Research

Paradigms	Ontology	Epistemology	Methodology
Positivism	Realism (singular reality)	Objectivism	Quantitative
Constructivism	Relativism (multiple realities)	Subjectivism	Qualitative
Pragmatism	One or multiple realities	Objectivism/subjectivism	Mixed method

3.2.1 Positivism

Positivists, who adhere to realist ontology and objective epistemology, believe in a single objective reality that exists externally and independently of the researcher (Krauss 2005; Scotland 2012). The researcher remains detached from the research process to maintain neutrality, separating their values and experiences from the science they study (Scotland 2012). Positivists typically use controlled approaches and statistics (quantitative methods) to investigate phenomena (Krauss 2005).

3.2.2 Constructivism

Constructivists, with relativist ontology and subjective epistemology, reject the idea of singularity, assuming multiple co-existing realities (Scotland 2012; Creswell and Creswell 2018). They view reality as subjective and socially constructed through individuals as they interact with the world. Thus, constructivists often focus on interpreting meaning and typically use qualitative methods (Creswell and Creswell 2018).

3.2.3 Pragmatism

Pragmatists, positioned between positivism and constructivism, accept that reality can be singular or multiple. They acknowledge both an external world independent of the researcher and an internal world that is individually constructed (Creswell and Creswell 2018). Pragmatists prioritise understanding the research problem and the use of methods most effective for answering the research question (Creswell and Creswell 2018), often combining qualitative and quantitative methods (Harvey and Land 2021).

3.2.4 Researcher's Positionality

Pragmatism was identified as the most suitable paradigm for this thesis as it aligns with the descriptive (quantitative) and exploratory (qualitative) objectives aimed at understanding oral antibacterial prescribing in primary care OOH services in Wales. As such, a mixed-method approach was adopted, allowing the examination of both objective and subjective data. The philosophical framework guiding each study is outlined in the respective chapters.

3.3 Mixed Methods Research

Mixed methods research (MMR) integrates qualitative and quantitative methodologies to provide a complete understanding of the research question (Creswell and Creswell 2018), using at least one quantitative and one qualitative methodology within a single or related studies (Hesse-Biber and Johnson 2015). Greene et al. (1989) identified five main purposes for integrating these approaches: triangulation (seeking convergence and corroboration of findings from multiple methods), complementarity (using one method to elaborate, enhance, clarify the findings from the other), development (using results from one method to inform the design of the other), initiation (exploring contradictions or new insights by comparing methods), and expansion (broadening the scope of inquiry by addressing

different aspects through different methods) (Schoonenboom and Johnson 2017). For this thesis, complementarity, expansion, and triangulation were particularly relevant.

MMR provides significant benefits by enabling the use of both qualitative and quantitative approaches, combining the advantages of each while minimising their drawbacks (Creswell and Creswell 2018). It offers flexibility to address complex research questions when a single methodology may not provide sufficient depth. However, MMR also presents challenges, requiring substantial time, resources, and skills for integration (Creswell and Clark 2018). Some critics also argue that combining approaches based on different philosophies and methods is contradictory and cannot be effectively achieved (Bryman 2007). Pragmatism, however, addresses this challenge by promoting methodological diversity rather than viewing approaches as incompatible (Morgan 2014).

3.3.1 Mixed Methods Research Designs

Numerous typologies of MMR designs have been proposed, with Creswell and Clark (2018) outlining three core types: convergent, explanatory sequential, and exploratory sequential. In convergent designs, quantitative and qualitative data are collected concurrently, analysed separately, and then integrated during interpretation. Explanatory sequential designs start with quantitative data collection and analysis, followed by qualitative research to provide an in-depth explanation of the data. Conversely, exploratory sequential designs begin with qualitative research, followed by a quantitative phase to validate or expand initial findings.

This thesis adopted an explanatory sequential design. This design is useful for deeper explanations of quantitative results, especially when findings are unclear or unexpected (Creswell 2009; Creswell and Creswell 2018). While appreciated for its simplicity and ease of reporting, this design presents several challenges (Creswell 2009). Conducting separate phases requires considerable resources, time, and effort, particularly when both phases are given equal emphasis. Additionally, determining which quantitative findings to investigate further and selecting participants for the qualitative phase can be challenging (Creswell 2009; Creswell and Creswell 2018).

3.3.2 Point of Integration

The point of integration is the stage at which quantitative and qualitative data are combined, which can occur at a single or various points, including design, methods, and

interpretation and reporting (Fetters et al. 2013). Integration at the design takes place during study conceptualisation and may follow a convergent, explanatory sequential, or exploratory sequential design, as outlined in Section 3.3.1. At the methods level, integration occurs during data collection and analysis through four strategies: connecting (using results from one phase to guide sample or participant selection for the next), building (shaping subsequent data collection based on results from an earlier phase), merging (integrating data after analysis to allow for comparison), and embedding (combining data collection and analysis at multiple points) (Fetters et al. 2013).

Integration at the interpretation and reporting level occurs after quantitative and qualitative data have been collected and analysed separately (Fetters et al. 2013), and focuses on how findings are presented (Yaqoob and Barolia 2023; Knafl et al. 2025). One approach is narrative, which reports quantitative and qualitative findings either theme-by-theme (weaving), in different sections (contiguous), or in distinct stages (staged). Another approach is transformation, where findings from one phase are converted into the other data type and then mixed with the untransformed data. Joint displays are also used, employing visual tools, such as tables or figures, to combine data and generate new insights beyond those from separate analyses (Fetters et al. 2013).

3.3.3 Integration Techniques

O’Cathain et al. (2010) outlined three techniques that can be used at different levels of integration (Fetters et al. 2013) to standardise data integration (Moseholm and Fetters 2017; Gauly et al. 2022). At the analysis stage, ‘following a thread’ involves tracing a finding (e.g., a theme or concept) from one dataset across others (O’Cathain et al. 2010), though the steps involved are not clearly defined (Johnson et al. 2017). A mixed methods matrix, also used at this stage, organises data from both strands on the same cases (e.g., individual or group unit) into a matrix, with rows representing cases and columns representing data types. This enables analysis that reveals patterns and unexpected differences across cases rather than themes or variables (O’Cathain et al. 2010). The triangulation protocol, the most detailed technique, systematically compares findings side by side at the interpretation stage to assess relationships (agreement, partial agreement, dissonance, or silence), which are then displayed in a convergence coding matrix (Farmer et al. 2006; O’Cathain et al. 2010). Agreement signifies convergence, partial agreement indicates complementarity where

additional or supportive insights emerge, dissonance reflects contradictions, and silence represents results appearing in one dataset but absent in the other. This technique goes beyond separate analyses to identify overarching meta-themes across strands, requiring additional time and effort (O’Cathain et al. 2010). Farmer et al. (2006) recommended involving two researchers at this stage, especially if different individuals conducted the qualitative and quantitative phases (O’Cathain et al. 2010).

This thesis used the triangulation protocol, as it enhances validity by comparing insights across datasets. Although time-intensive, this technique ensures transparent integration. The triangulation protocol was originally designed to integrate multiple qualitative methods; however, O’Cathain et al. (2010) suggested its relevance for mixed methods integration. It has since been used in studies integrating quantitative and qualitative data, including by Tonkin-Crine et al. (2016), whose approach was adopted (details in Chapter 7).

3.4 Quantitative Research

Quantitative research investigates phenomena by measuring variables using objective tools and numerical data. It is commonly used to test hypotheses, make predictions, establish relationships, and describe patterns in data (Creswell and Creswell 2018; Lim 2024).

3.4.1 Quantitative Research Designs

Experimental design involves manipulating an independent variable (effect) in a controlled environment to assess its impact on a dependent variable (outcome). The data are then statistically analysed to identify cause-and-effect relationships (Khaldi 2017; Creswell and Creswell 2018). This design is highly replicable due to its controlled nature. In true experimental designs, participants are randomly selected and assigned to control or intervention groups (Khaldi 2017; Creswell and Creswell 2018). Quasi-experimental design is a variation used when experimental conditions, particularly randomisation and control groups, are not feasible (Khaldi 2017). It examines cause-and-effect relationships in real-world settings without random assignment or comparison groups. As this thesis does not aim to test a particular intervention or establish causality, an experimental/quasi-experimental design was not appropriate.

In non-experimental designs, researchers are unable to manipulate variables but instead observe and interpret available data (Khaldi 2017). Various types of research fall under non-

experimental design. Correlational research examines associations between variables, while causal-comparative research compares two or more groups based on a cause or variable that occurred without the researcher's involvement (Creswell and Creswell 2018).

Descriptive research focuses on describing data related to a phenomenon or situation (Creswell and Creswell 2018; Ranganathan and Aggarwal 2018). Given that the thesis quantitative objectives 2–4 centre around describing oral antibacterial prescribing in Wales OOH services, a non-experimental descriptive design was the most appropriate choice.

3.4.2 Quantitative Data Collection Methods

Research data can come from primary or secondary sources, depending on the study design, resources, and objectives. As quantitative research prioritises objectivity, replicability, and generalisability, it commonly uses standardised collection instruments (e.g., data collection forms, tests, surveys) to minimise personal bias and ensure precision and consistency (Conrad et al. 2011).

3.4.2.1 Primary Data

Primary data is collected directly by the researcher for specific research purposes (Kornegay and Segal 2013). It captures events as they occur, enabling tailored and relevant data collection to the phenomenon being researched (Roos et al. 1987). This typically results in more accurate, better-quality data (Roos et al., 1987; Dhudasia et al., 2023), reducing the risk of missing essential details (Dhudasia et al. 2023). However, collecting primary data can be time-consuming and resource-intensive (Roos et al. 1987; Dhudasia et al. 2023).

Primary data can be obtained from various approaches, such as conducting experiments (see Section 3.4.1) (Bowling 2014; Creswell and Creswell 2018). A common example is randomised controlled trials, where participants are randomised to control or intervention groups (Bowling 2014). Surveys or questionnaires are another method used to collect primary data from a sample of the population, either cross-sectionally (at one time point) or longitudinally (over multiple time points). Surveys can efficiently collect large amounts of data to describe samples and populations, but cannot establish cause-and-effect relationships (Watson 2015). Both methods enable statistical inference and can potentially produce generalisable findings, depending on factors such as sample size (Creswell and Creswell 2018).

3.4.2.2 Secondary Data

Secondary data are those collected by others or for purposes different from the current research, including administrative and routinely collected data (Hox and Boeijs 2005; Pederson et al. 2020). These data are useful for answering descriptive and analytical questions, such as describing trends or examining relationships (Pederson et al. 2020). One key advantage of secondary data is their availability, though the ease of access may vary, making them efficient for quick use (Cheng and Phillips 2014; Pederson et al. 2020). They allow researchers to address questions with minimal risk, often covering large samples size or entire populations at little or no cost. This is particularly advantageous in longitudinal studies, where primary data collection can be time-consuming and pose major constraints (Dunn et al. 2015).

However, using secondary data has limitations. Identifying a suitable dataset and tackling issues related to data quality and relevance can be difficult (Dunn et al. 2015). The data may lack key variables needed to address specific research questions, making the analysis more challenging (Vartanian 2010; Pederson et al. 2020). It may contain limitations (e.g., missing values, poorly measured variables, or outdated information), requiring researchers to have the expertise to assess data suitability and manage it appropriately (Dunn et al. 2015). Several techniques exist to enhance data quality (Taleb et al. 2015), and the specifics of relevant ones are provided in Chapter 4.

3.4.3 Choice of Quantitative Methods

For the thesis's quantitative objectives 2–4 (Chapter 4), analysing secondary data was selected as the most appropriate method. The availability of national prescribing datasets, which are described along with their advantages and disadvantages in the respective chapters, facilitated an efficient analysis within the PhD timeframe, avoiding the higher costs and time demands of primary and prospective designs (Song and Chung 2010). These datasets also provided longitudinal data, allowing for analysis of prescribing trends over time, an important aspect of the research objectives.

3.4.4 Rigour in Quantitative Research

Ensuring rigour in quantitative research involves enhancing quality measures, such as validity, i.e., accuracy in measuring a concept, and reliability, i.e., consistency or reproducibility of results (Fitzner 2007). While these can be assessed using various methods,

they are more feasible in primary research. Assessing secondary data quality is more challenging, as researchers have no control over its collection (Kumara 2022). However, secondary data are typically compiled by experienced professionals or organisations that follow strict quality control procedures (Bell et al. 2022). Their quality is generally assured if funded by governmental agencies and evaluated by impartial researchers (e.g., academics) who are neutral to the topic to ensure objectivity and minimise bias (Bell et al. 2022). Details on how quality was assured are provided in Chapter 4.

3.5 Qualitative Research

Qualitative research is exploratory in nature and aims to provide an in-depth understanding of a phenomenon through open-ended questions and non-numerical, textual data (Creswell and Creswell 2018).

3.5.1 Qualitative Research Design

Various qualitative research designs exist, each with distinct characteristics that help guide the selection of the most appropriate one for the study's aim. A brief overview of common qualitative designs is presented in Table 3.2.

Table 3.2: Description of Commonly Used Qualitative Research Designs

Qualitative Design	Description
Narrative research (Creswell and Creswell 2018)	• Researchers ask participants to share their personal stories. • Researcher may reorganise these stories chronologically and combine their perspectives with those of the other participants.
Grounded theory (Creswell and Creswell 2018)	• Researchers collect and organise data to generate a theory based on participants' perspectives about an action, process, or phenomenon – theory generation.
Ethnography (Creswell and Creswell 2018)	• Researchers immerse themselves over a time period in a specific cultural group in a natural everyday setting to study their behaviours or activities. • Usually involves the use of observations and interviews.
Case study (Creswell and Creswell 2018)	• Researchers aim to deeply examine a particular case or multiple cases in its actual setting(s) over time using multiple data collection methods.
Phenomenology (Creswell and Creswell 2018)	• Researchers gather descriptions of lived experiences from individuals who have experienced a particular phenomenon, often using interviews. • These descriptions are then combined to identify important aspects.
Generic qualitative approaches (Caelli et al. 2003)	• Researchers aim to uncover various aspects of a phenomenon, process, viewpoints, and perspectives of those involved. • Usually used when research does not fit an established approach.

Different qualitative designs (Table 3.2) were initially considered but subsequently ruled out, as they did not align with the thesis's qualitative objectives 5 and 6: exploring perceptions, experiences, and decision-making related to oral antibacterial prescribing in primary care OOH services. To illustrate, narrative research relies on personal stories rather than on perceptions and experiences of specific subjects. Grounded theory, while useful for understanding behaviours and perspectives, is used to generate new theories, which was not intended. Although OOH services may represent a unique setting, ethnography was inappropriate, as it relies heavily on observation, making it unsuitable for exploring perceptions and decision-making. It was also impractical given the service nature, ethical concerns, and limited time and resources within the PhD project. Case study was also excluded due to its limited suitability for exploring participants' experiences, perceptions, and decision-making and would be impractical to apply across seven HBs. Generic qualitative approaches use qualitative methods without strictly following a specific design, combining elements from multiple designs or using them flexibly. These approaches are typically chosen when the research does not align with established designs, prioritising pragmatism and feasibility (Caelli et al. 2003; Kahlke 2014). This design was not selected, because the thesis aim aligned clearly with phenomenology, another qualitative design.

Phenomenology was chosen as it supports the thesis aim of exploring experiences as perceived and/or lived by individuals (Grossoehme 2014; Creswell and Creswell 2018). Phenomenological research is often criticised for subjectivity, limited scientific rigour, potential researcher bias, and small sample sizes that limit generalisability (Denscombe 2021). However, it allows in-depth understanding of the phenomenon through the experiences of others, which in this thesis refers to the everyday experiences of those overseeing and/or involved in oral antibacterial prescribing in primary care OOH services.

3.5.2 Qualitative Data Collection Methods

Qualitative research emphasises subjectivity, flexibility, and contextual understanding, relying on methods, such as interviews and observations, to explore complex phenomena in natural settings, acknowledging researcher biases (Conrad et al. 2011).

3.5.2.1 Observations

Observations are commonly used in ethnography, an approach unsuitable for this study as noted above (Abdullah and Raman 2000). This method involves observing individuals'

behaviours and communications within natural environments rather than controlled settings (Mays and Pope 1995). It can be complemented by questioning and analysing documents to gain a thorough understanding. It enables researchers to address elements that might be missed by other methods, such as inconsistency between what people say and what they do, as well as uncover subconscious behaviours and practices. It also has the potential to limit sources of bias related to recall, selective perception, and the impact of their roles and self-presentation (Mays and Pope 1995).

Despite its advantages, the observational method was considered impractical and unsuitable for the thesis objectives 5 and 6, which explore perceptions of prescribing and HCPs' decision-making when prescribing oral antibacterial drugs. Observations would require significant time (Abdullah and Raman 2000) and travel to multiple locations to observe HCPs' interactions with patients and their prescribing approach in hard-to-observe settings (e.g., telephone consultations). They would also involve managing ethical challenges, such as obtaining patient consent to observe these encounters, and confidentiality. Additionally, the Hawthorne effect may alter participants' behaviour due to their awareness of being observed (Abdullah and Raman 2000; Mangione-Smith et al. 2002).

3.5.2.2 Focus Groups

Focus groups are discussion groups involving carefully selected participants who engage in interactions about a pre-determined subject chosen by the researcher, who typically facilitates the discussion as a moderator (Morgan 1996; Gill et al. 2008; Edwards and Holland 2013).

Focus groups are an efficient and cost-effective method for collecting data from multiple individuals simultaneously (Robinson 1999). They also encourage participation from individuals who may be hesitant to participate in individual interviews, such as those who perceive they have limited expertise or involvement. The group setting promotes dynamic interaction, encouraging participants to share perspectives, challenge each other's views, and engage in stimulating discussions (Clark et al. 2021). This interaction generates a diverse range of ideas that may not arise in individual interviews. In these interactions, the researcher plays a less central role, giving participants more freedom to highlight important issues and shape the conversation compared to individual interviews (Clark et al. 2021).

However, in focus groups, researchers may struggle to balance the level of control, potentially causing the discussion to deviate from the topic (Clark et al. 2021). Group dynamics may also skew the conversation, with stronger voices dominating the discussion, resulting in the group effect, where individual views are suppressed by the group view. Participants may even change their views to align with the group, affecting the discussion outcomes (Clark et al. 2021). Although focus groups encourage interaction, they may limit the depth and continuity of individual narratives (Green and Thorogood 2018), as participants may lack the opportunity for extended reflection compared to individual interviews. Additionally, the large volume of data obtained can be difficult to analyse, requiring examining individual views and group dynamics. Transcription is also time-consuming, particularly when participants speak over one another or when multiple voices need to be identified (Clark et al. 2021). Logistical challenges also exist, including choosing a suitable location, accommodating participants' mobility and schedule flexibility (Crabtree et al. 1993; Morgan 1996), determining group size, and securing participants' attendance (Clark et al. 2021). This is particularly challenging among HCPs who face competing clinical responsibilities (Greenbaum 1992; Fetters et al. 2016) making it difficult to arrange a mutually convenient time and location, given their limited availability. Although online focus groups could have mitigated some of these issues, focus groups were not considered due to the logistical difficulties of coordinating attendance among HCPs across Wales.

3.5.2.3 Group interviews

Group interviews involve interviewing several participants at the same time. Although sometimes used interchangeably with focus groups, they differ in important aspects (Clark et al. 2021). While both involve participants and a facilitator, group interviews are less interactive, with the researcher directing questions to each participant in turn to elicit individual response (Clark et al. 2021; Coe et al. 2021). Focus groups, by contrast, emphasise participants interaction moderated by the researcher (Clark et al. 2021). Thus, group interviews offer a practical solution to save time and resources, while focus groups generate richer, discussion-based data (Clark et al. 2021).

Group interviews were not chosen for this thesis as coordinating the schedule of multiple participants is challenging. Additionally, interviewing several participants at once may limit the time each person has to share their views fully. Similar to focus group, the lack of

privacy in a group setting may discourage participants from speaking freely, resulting in less accurate and detailed responses (Leshem 2012).

3.5.2.4 Individual Interviews

In healthcare research, interviews are the most common method for collecting qualitative data (Green and Thorogood 2018). While time-consuming, individual interviews enable in-depth exploration of a topic, giving each participant full attention and allowing them to express their thoughts more thoroughly than focus groups (Knott et al. 2022).

Interviews can be structured, semi-structured, and unstructured. Structured interviews use a fixed set of questions asked in the same way and order without probing (e.g., survey), often yielding quantitative data (DiCicco-Bloom and Crabtree 2006; Gill et al. 2008). These tend to be quick but limit deep exploration. In contrast, semi-structured and unstructured interviews are more flexible (Edwards and Holland 2013). Unstructured interviews are participant-driven, resembling natural conversation without a fixed format or pre-set questions (Flick et al. 2018). This free-flowing approach, usually starts with a broad question and evolves with the participant's responses (DiCicco-Bloom and Crabtree 2006), can be difficult to manage and time-consuming (Gill et al. 2008). In semi-structured interviews, the researcher follows a schedule of predetermined questions about the topic. This approach balances structure and flexibility, guiding areas of discussion while allowing deeper exploration by probing into specific responses (Gill et al. 2008; Edwards and Holland 2013).

Various interview modes offer different advantages and disadvantages. In-person interviews allow for capturing non-verbal cues and building strong rapport, as both interviewer and participant are physically present (Opdenakker 2006). However, they can be costly and logistically challenging, especially if participants are geographically dispersed (Opdenakker 2006), such as the different HBs in Wales. Telephone interviews provide greater scheduling flexibility and convenience but lack non-verbal cues and body language essential for building rapport (Opdenakker 2006; Novick 2008; Lo Iacono et al. 2016). They may also limit depth of discussion due to reduced opportunities for probing and difficulties interpreting silences (Novick 2008). While some limitations can be mitigated by advising participants to choose a quiet, comfortable space, they are more easily managed in in-person settings. Given these drawbacks, telephone interviews were not considered. Online interviews have become common since COVID-19 (Keen et al. 2022). These interviews combine the flexibility of

telephone interviews with the visual benefits of in-person interviews (Hanna 2012). They enable remote participation from comfortable locations (Hanna 2012), allow observation of non-verbal cues (Sedgwick and Spiers 2009), and improve accessibility for those unable to travel (Schlegel et al. 2021; Knott et al. 2022). However, they require careful preparation to ensure access to a private, quiet space for an uninterrupted conversation (Reñosa et al. 2021), and to address technical issues, such as software setup and connectivity (Schlegel et al. 2021). These interviews can be conducted using several platforms, including Microsoft Teams and Zoom. The two platforms share common features, such as screen sharing, chat, recording, transcription, and cross-device compatibility (Lieux et al. 2021). Microsoft Teams also provides an integrated workspace for communication and file sharing with dedicated channels while maintaining advanced security and privacy (Gauthier and Husain 2021; Suduc and Bizoi 2022). The platform is also endorsed by the NHS (NHS England 2023b) and Cardiff University (Cardiff University 2023) as it complies with the General Data Protection Regulation (GDPR) and Data Protection Act 2018 (NHS Counter Fraud Authority 2021).

3.5.3 Choice of Qualitative Methods

To address thesis objectives 5 and 6 (exploring individuals' perceptions, experiences, and decision-making), semi-structured individual interviews were deemed the most appropriate method. Considering the characteristics of interview modes and participant distribution, both in-person and online interviews via Microsoft Teams were deemed suitable. This flexibility allowed interviews to be tailored to individual circumstances and geographical locations (Rosenthal 2016) while maintaining high data quality, potentially attracting participation and improving response rates. Microsoft Teams was chosen as all targeted participants were NHS staff in Wales with existing access to the platform, ensuring data security and user familiarity.

3.5.4 Developing and Piloting Interview Schedules

Interview schedules provide a structured framework to guide interviews and ensure consistency in data collection (Kallio et al. 2016). Kallio et al. (2016) summarised a five-stage approach for developing robust schedules, which was followed for developing interview schedules for thesis objectives 5 and 6 (see Chapters 5 and 6 for details).

The initial stage focuses on identifying the prerequisites for conducting semi-structured interviews, including assessing their suitability and alignment with the research objectives.

The second stage involves retrieving and using previous knowledge to gain sufficient understanding on the topic, by critically reviewing literature and, where evidence is limited, drawing on empirical insights from experts. The third stage is formulating a preliminary interview schedule using the knowledge gained. This involves creating clear, non-leading, open-ended questions that cover key ideas and encourage detailed responses, with follow-up questions (either pre-designed or arising during the interview) to prompt further discussion. The fourth stage is piloting the interview schedule to assess its relevance, coverage, and need for refinement. This enhances the data collection quality and the researcher's interviewing skills. Kallio et al. (2016) described three piloting techniques (Table 3.3), but the specific approach used is detailed in the relevant chapters. The last stage is including the completed interview schedule within the study, providing a clear guide for data collection that builds on earlier stages and can be easily adapted by others.

Table 3.3: Pilot Test Techniques (Kallio et al. 2016)

Technique	Description
Internal testing	• Review the preliminary schedule with the research team to identify and address issues, such as unclear or leading questions. • Researcher may role-play as a participant and be interviewed by other members. • Useful especially when other piloting techniques are not feasible.
Expert assessment	• Invite external experts to critique the preliminary schedule, assess its coverage and appropriateness, with feedback on its relevance and structure.
Field-testing (commonly used)	• Test the schedule with participants in conditions similar to the real interview. • It ensures questions are clear and relevant, elicits diverse perspectives, helps refine questions, determines interview length and design issues.

3.5.5 Trustworthiness in Qualitative Research

Lincoln and Guba (1985) introduced key criteria (credibility, transferability, dependability, and confirmability) to demonstrate qualitative research trustworthiness, along with strategies to support each, many of which were applied in this thesis. Credibility refers to the certainty about how accurately the findings reflect participants' actual experiences (Ahmed 2024). To ensure credibility, prolonged engagement in the field (e.g. site visits and ongoing stakeholder interactions and input; see empirical chapters for details) is used to build rapport, develop contextual familiarity, and understand perspectives to collect rich, relevant information (Ahmed 2024). Additional strategies involve peer debriefing with researchers or colleagues to examine and reflect on the research process and findings (Stahl

and King 2020). Moreover, member checking allows individuals from whom data were obtained to confirm the accuracy of the findings (Polit and Beck 2004). Triangulation is another strategy that involves using multiple methods or data sources to better understand a phenomenon (Carter et al. 2014).

Transferability refers to the extent to which the findings can be applied to other groups or settings, with readers responsible for assessing this applicability (Lincoln and Guba 1985; Polit and Beck 2004). Provision of thick descriptions of the study context, sampling and selection, and the research process, is a key strategy, enabling readers to assess relevance to their own settings (Ahmed 2024).

Dependability, or the stability of data over time and conditions, is often enhanced through methodological documentation and audit trails (Polit and Beck 2004; Ahmed 2024). This can be done through documenting decisions and approaches in each step, detailing methods, data collection, analysis, and any changes made. This transparency allows readers to follow the process and replicate the study to produce consistent findings (Lincoln and Guba 1985; Korstjens and Moser 2018).

Confirmability refers to the neutrality of findings, ensuring they are derived from the data and not influenced by the researcher bias (Polit and Beck 2017). To help confirm that findings can be reproduced by others, approaches such as reflexive journaling, to critically examine thoughts and biases throughout the research process, as well as peer debriefing and member checking are suggested (Ahmed 2024).

3.6 Application of Mixed Methods Approach in the Thesis

As this thesis adopted an explanatory sequential design (Section 3.3.1), it began with a quantitative analysis to describe oral antibacterial prescribing in primary care OOH services in Wales using secondary data (thesis objectives 2–4). This was followed by two qualitative studies using semi-structured interviews: one explored stakeholders' views and perceptions of oral antibacterial prescribing in these settings (thesis objective 5), and the other explored experiences and decision-making related to prescribing these drugs in NHS 111 CSHs during OOH periods (thesis objective 6) (Figure 3.1).

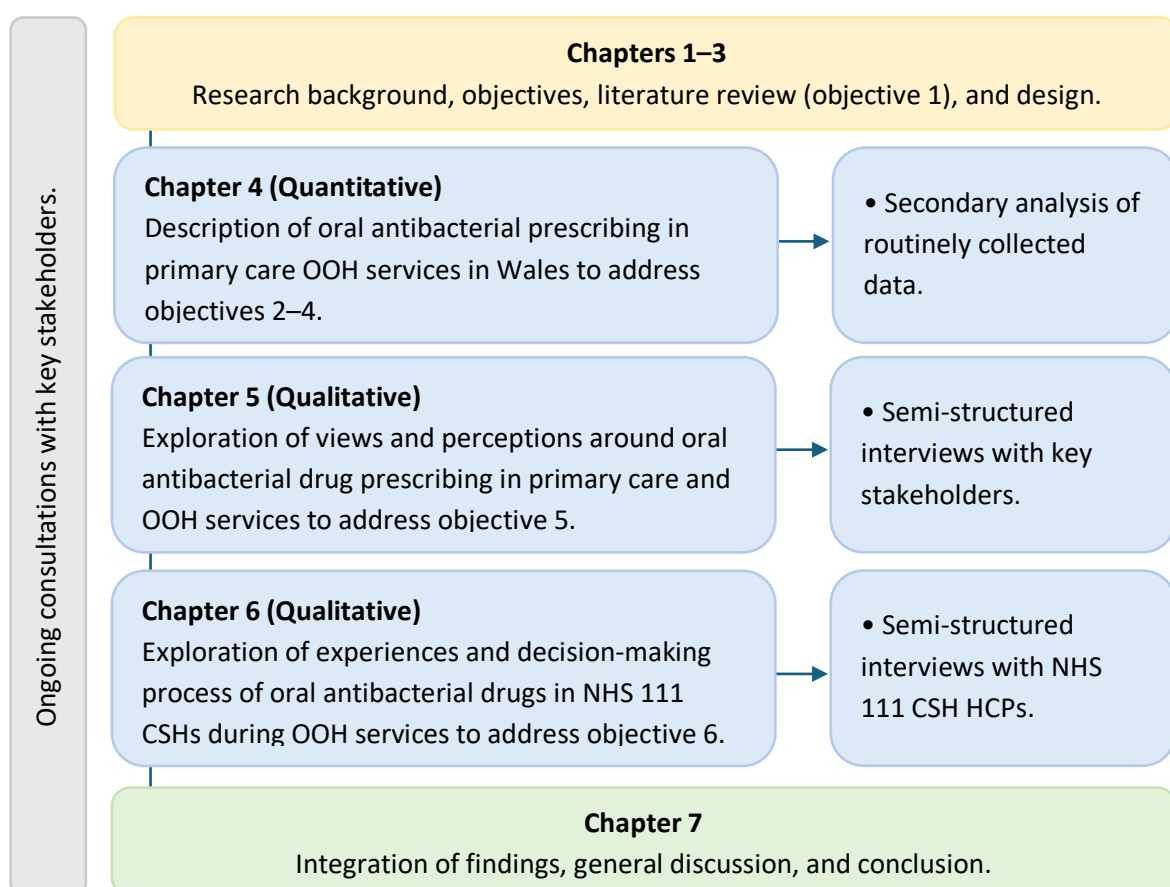


Figure 3.1: Flowchart of the Adopted Explanatory Sequential Mixed Method Research Design

3.7 Sampling and Recruitment in Quantitative and Qualitative Research

3.7.1 Sampling Considerations

Sampling in research is the process of selecting individuals or units from a defined population. Daniel (2012d) outlined a systematic approach to the sampling process. Table 3.4 defines key sampling terms before discussing the processes involved.

Table 3.4: Key Sampling Terms and Definitions

Key Term	Definition
Population	Entire group of items or individuals sharing specific characteristics of interest (Martínez-Mesa et al. 2016).
Sampling frame	A comprehensive list of all units (people) in a study population, representing the largest pool from which participants may be drawn.
Sampling unit	Individual element (person) selected for inclusion from which data is collected.
Census	Every individual/unit in the study population (sampling frame) to collect data from the entire population (Guest et al. 2013; Martínez-Mesa et al. 2016).
Sample	A subset of population whose characteristics are of interest (Martínez-Mesa et al. 2016).

Daniel's (2012c) approach to sampling begins with careful preparation, reviewing the study's aim (e.g., exploratory), population (e.g., inclusion criteria and accessibility), available resources (e.g., time and sampling frame), research design (e.g., non-experimental), and ethical considerations (e.g., anonymity). The next step is to choose between a census or a sample, based on factors, such as research objectives (e.g., total enumeration vs. quick decisions) (Daniel 2012a). If sampling is selected over a census, the appropriate sampling type and technique should be selected: probability, non-probability, or mixed methods (combining probability, non-probability, or both techniques). This is followed by determining the sample size and finally selecting the sample. Ideally, a sampling frame is available to help participant selection. However, it is not always accessible in practice, which may dictate the sampling type that can be used or require alternative access strategies, such as using snowball sampling (Kirchherr and Charles 2018) or gatekeepers (Uwamusi et al. 2023), both explained below.

Sampling techniques are broadly classified into probability (Table 3.5) and non-probability sampling. In probability sampling, every item or individual in the population has a non-zero chance of selection (Marshall 1996; Martínez-Mesa et al. 2016; Taherdoost 2016), which varies by sampling type, e.g., equal chance in simple random sampling, equal chance within strata but may differ across strata in stratified sampling. It aims to produce a representative sample and generalisable findings. While probability sampling is common in quantitative research, a census was more appropriate for the thesis's quantitative objectives 2–4. These objectives involved describing oral antibacterial prescribing across Wales using secondary data rather than making inferences. A census allowed inclusion of the entire population for comprehensive description within the available timeframe.

Table 3.5: Common Probability Sampling Techniques

Sampling Techniques	Brief Description
Simple random (Daniel 2012c; Creswell and Creswell 2018)	A sample is randomly selected from the population or list, where each individual/unit is equally likely to be selected.
Systematic (Daniel 2012c; Creswell and Creswell 2018)	A sample is chosen by selecting individuals/units from a population or list at regular or fixed intervals.
Stratified (Daniel 2012c; Creswell and Creswell 2018)	The population is divided into strata based on characteristics (e.g., gender), and a random sample is drawn from each stratum.
Cluster (Daniel 2012c)	The population is divided into clusters, and the entire clusters are randomly selected rather than individuals from each cluster.

In qualitative research, a census is rarely used due to logistical challenges, e.g., time and cost, but can be useful with small, defined populations (Guest et al. 2013). If not feasible, researchers typically use non-probability sampling, where participants are not randomly selected and have unknown or unequal chances of inclusion (Elfil and Negida 2017). Thus, the resulting sample may not represent the wider population, limiting the generalisability (Martínez-Mesa et al. 2016). Common non-probability sampling techniques include convenience, quota, snowball, and purposive sampling (Moser and Korstjens 2018).

Convenience sampling involves selecting participants who meet the inclusion criteria and are available and easily accessible, often on a first-come first-served basis (Luborsky and Rubinstein 1995). While cost-effective, it is prone to selection bias (Rahi 2017; Golzar et al. 2022) due to its reliance on availability (Daniel 2012b). Quota sampling obtains a sample that reflects the population's composition by ensuring key groups are proportionately represented, which other techniques may not guarantee (Luborsky and Rubinstein 1995). The population is divided into subgroups based on characteristics (e.g., age, gender, or profession), and a set number of participants from each subgroup are determined to match their distribution in the wider population (Yang and Banamah 2014). Selection is often done through convenience sampling (Acharya et al. 2013). Quota sampling requires a large sample size and involves greater cost and effort (Bornstein et al. 2013). It is particularly useful when examining differences across subgroups.

Snowball sampling involves using participants to share study information with others who meet the criteria on the researcher's behalf, forming a chain of participants (Flick 2023). It is cost-efficient (Chan 2020) and particularly useful when a sampling frame is unavailable (Sedgwick 2013; Kirchherr and Charles 2018) or when studying stigmatised groups/behaviours or hard-to-reach populations (Robinson 2014; Parker et al. 2019). As it relies on networking, snowballing is prone to selection bias (Sedgwick 2013; Parker et al. 2019; Chan 2020), as participants likely recommend individuals with similar views or backgrounds, leading to overrepresentation or skewed samples (Parker et al. 2019; Chan 2020). Purposive sampling allows researchers to select participants based on specific pre-defined characteristics, knowledge, or experiences relevant to the study. This technique is convenient and well-suited for exploratory research (Taherdoost 2016), allowing the

collection of rich, in-depth data most relevant to the topic (Gentles et al. 2015; Patton 2015a).

For the thesis's qualitative objectives, purposive sampling was deemed appropriate to explore the perspectives of stakeholders with specific knowledge of oral antibacterial prescribing (objective 5) and the experiences and decision-making of HCPs meeting defined criteria (objective 6) (see relevant chapters for details).

Another consideration in sampling is determining the appropriate sample size. Quantitative research typically uses large, predetermined samples to ensure accuracy and validity (Creswell and Creswell 2022; Ghanad 2023). Sample size can be estimated by reviewing literature of similar studies, applying statistical power analysis, using a census, or consulting published tables that suggest sizes based on criteria: precision, confidence, and variability (Israel 1992; Al-Subaihi 2003; Singh and Masuku 2014). However, researchers may sometimes be limited by the sample and data available to them (Curtis and Keeler 2023), such as when using secondary data where data quantity is predefined. In contrast, qualitative research involves smaller samples and prioritises data richness (Vasileiou et al. 2018), making it difficult to predetermine the exact sample size. Information power is one guiding approach, suggesting that smaller samples are sufficient when participants have strong expertise, relevant knowledge, and provide rich, detailed insights on the topic (Malterud et al. 2016). Data saturation, another common approach, involves collecting data until no new information is generated (Guest et al. 2006; Creswell and Creswell 2018; Vasileiou et al. 2018).

3.7.2 Recruitment of Participants

Participant recruitment involves informing eligible individuals about the study and inviting them to participate (Guest et al. 2013). This process is particularly important in the qualitative studies of this thesis, where primary data are directly collected from individuals. In contrast, secondary data analysis does not involve recruitment, as the data have already been collected for other purposes. Different strategies are used depending on the research type, physical and geographical context, participant age, and accessibility (Toly et al. 2022). These strategies are classified as active or passive. Active recruitment includes direct interactions, such as phone calls or presentations at places where the target population is commonly found (Estabrooks et al. 2017). Passive recruitment relies on individuals

responding to study information encountered indirectly, such as through newsletters, posters, or flyers placed in frequented locations (e.g., pharmacy, GP surgery, or hospital for HCPs) (Toly et al. 2022). Social media, a newer online recruitment tool (Gelinas et al. 2017), has proven efficient, particularly during crises such as COVID-19 (Toly et al. 2022). Platforms, including Facebook and X (formerly Twitter), offer advantages in time, cost (Involve 2014; Toly et al. 2022), accessibility, and reach. Posting and reposting advertisements across platforms can increase visibility and potentially participation (Involve 2014). Although social media may exclude those who do not use it, this limitation can be addressed through complementary strategies, such as asking individuals to help reach others offline (Involve 2014). This thesis used a mix of both recruitment strategies depending on the accessibility of the target group.

Gatekeepers play a key role in facilitating access to potential participants (McFadyen and Rankin 2016). In this thesis, they were essential for granting access to secondary data for the quantitative phase (objectives 2–4) and for identifying and sharing study information with hard-to-reach participants during the qualitative phase (objectives 5 and 6), where no public population lists existed. Gatekeepers may be selected based on the trust they hold within the target population (Namageyo-Funa et al. 2014), e.g., through professional affiliation, and can be identified via existing networks or referrals from known contacts. While their involvement is invaluable, it can also pose challenges, such as delays in research progress. Engaging them early is therefore crucial to address concerns, provide reassurance, and incorporate feedback to improve recruitment (McFadyen and Rankin 2016). Additionally, providing them with a clear project overview, detailing their role and what is expected from them helps ensure effective collaboration (Namageyo-Funa et al. 2014). Recruitment methods and gatekeeper involvement are presented in the relevant chapters.

3.8 Data Analysis

3.8.1 Quantitative Data Analysis

Quantitative analysis uses statistics to examine variables of interest and interpret data (Kotronoulas et al. 2023). It includes two main types: descriptive and inferential analysis.

3.8.1.1 Descriptive Analysis

Descriptive analysis summarises data in an easy-to-understand format, describing key features of the collected measures without attempting to generalise the findings beyond the dataset (Fávero and Belfiore 2019). This analysis can be conducted using a sample or an entire population (McDermid 2021). Descriptive analysis results are commonly presented through tables, graphs, or summary statistics such as means and medians (Fávero and Belfiore 2019). Since the main objectives of the quantitative phase (thesis objectives 2–4) are descriptive in nature without making broader inferences, descriptive analysis was deemed an appropriate analytical approach (Chapter 4, Section 4.3.3.5).

3.8.1.2 Inferential Analysis

Inferential analysis allows researchers to test hypotheses, make predictions, and draw conclusions about a population based on a sample from that targeted population (McDermid 2021). Most research questions involve two hypotheses: the null (no effect or difference) and the alternative (an effect or difference exists) (Yenduri and Silver 2023). In hypothesis testing, the null is assumed to be true until evidence supports its rejection. The p-value (a probability measure) helps determine whether observed results are statistically significant to reject the null hypothesis or likely due to chance. The alpha level, commonly set as 0.05, defines the threshold for statistical significance (Yenduri and Silver 2023). If the p-value falls below this level, the results are considered statistically significant, and the null hypothesis can be rejected. Statistical tests, such as student's t-test or analysis of variance, are used to calculate this value to assess the significance of the observed differences. The choice of the test to answer the research question depends on different factors, such as the research question (e.g., comparing groups), and the number and types of variables involved (Creswell and Creswell 2018). Inferential analysis was also considered to examine changes in prescribing volumes (as part of thesis objective 2) over the period investigated (Chapter 4, Section 4.3.3.5).

3.8.2 Qualitative Data Analysis

Data analysis is the most challenging stage of qualitative research (Thorne 2000). Using a structured approach enhances its transparency and trustworthiness. Various methods exist; each suited to specific research aims. Table 3.6 provides an overview of common methods.

Table 3.6: Common Qualitative Data Analysis Methods

Analytical method	Brief description
Content analysis (Krippendorff 1989,2019)	Analyses and quantifies the presence of certain words or concepts within a content, examining both manifest (explicitly present) and latent (underlying or hidden) content.
Thematic analysis (Braun and Clarke 2006)	Identifies and analyses patterns and themes in a dataset to uncover a broad view of the topic of interest.
Discourse analysis (Shaw and Bailey 2009)	Analyses the language used in conversation and interaction considering the context in which it occurs.
Interpretative Phenomenological Analysis (Mohajan 2018)	Analyses lived personal experiences of an incident to identify common meaning and understanding of a phenomenon.
Grounded theory (Bowen 2006)	Inductive analysis that creates new theories from the data rather than from existing knowledge or preconceived notions.
Narrative analysis (Cissé and Rasmussen 2022)	Analyses how individuals make sense of their lives through storytelling.

3.8.2.1 Reflexive Thematic Analysis

Reflexive thematic analysis was chosen for this thesis as it facilitates the exploration of individual perspectives, providing rich findings and highlighting similarities and differences across the data (King 2004; Braun and Clarke 2006). It offers a systematic approach for summarising key findings from large datasets into a coherent report (King 2004; Nowell et al. 2017). Its flexibility and accessibility also make it suitable for novice researchers (Braun and Clarke 2006). However, this flexibility may lead to inconsistencies and lack of coherence in theme development if not applied systematically. These risks can be mitigated by clearly stating the epistemological position guiding the analysis (Holloway and Todres 2003; Nowell et al. 2017; Finlay 2021), recognising that knowledge is co-constructed with participants. This view informed reflexive data collection and analysis, ensuring findings reflect participants' perspectives within their context. Therefore, the researcher's positionality is acknowledged in the relevant chapters to promote transparency and provide the basis for the analytical approach. Additionally, a systematic approach to theme development was adopted in this thesis, guided by Braun and Clarke's (2006) six-stage framework for thematic analysis (Table 3.7). Further details and illustrative examples provided in Chapters 5 and 6 to demonstrate the reflexive approach to theme development.

Table 3.7: Reflexive Thematic Analysis Stages (Braun and Clarke 2006)

Stage	Brief description
Familiarisation with data	• Reading and re-reading transcripts and making initial observations.
Generating initial codes	• Creating labels (codes) to capture key features relevant to the research question and organising them for later analysis stages.
Searching for themes	• Examining codes to identify broader patterns (themes) and grouping relevant data under potential themes to assess their meaning and alignment with the research question.
Reviewing themes	• Comparing themes with coded data and the whole dataset to ensure they align with the research question, and adjusting (e.g., removing, combining, splitting, or refining) themes.
Defining and naming themes	• Further analysing the themes, focussing on their scope and meaning, and selecting appropriate names that reflect each theme.
Producing the report	• Synthesising the analysis into narrative, supported by data extracts and contextualised with existing literature.

Reflexive thematic analysis treats the researcher's subjectivity as an integral element to the analysis (Braun and Clarke 2019; Campbell et al. 2021). Reflexivity involves recognising how personal and contextual factors influence research decisions, such as using reflexive diaries and actively reflecting on how preconceived notions may shape coding, theme development, and interpretation of participants' narratives). By continuously questioning and assessing these choices, researchers can understand their influence on the analysis (Olmos-Vega et al. 2023). This iterative approach enables deeper, more meaningful findings (Campbell et al. 2021). For example, coding is an iterative process involving ongoing reflection and refinement to ensure accurate interpretations of meaning within the data.

Data analysis can follow two approaches: inductive (data-driven) which generates codes directly from the data without fitting them into preexisting frames (Braun and Clarke 2006; Bingham 2023), and deductive (top-down), which uses predefined codes and frameworks derived from literature, theory, research questions, or propositions (Crabtree and Miller 1999; Bingham 2023). This thesis adopts a hybrid approach, combining both, integrating preexisting concepts from earlier analyses, stakeholder input, and literature, while remaining open to new themes constructed from the data to produce a thorough analysis (Fereday and Muir-Cochrane 2006).

3.9 Ethical Considerations

In research, four core ethical principles guide responsible conduct and help protect participants' rights, dignity, and safety: beneficence (obligation to benefit), nonmaleficence (avoid harm), autonomy (respect individual rights to make informed decision), and justice (fairness and equality). The UK Policy Framework for Health and Social Care Research outlines 19 principles to support ethical research conduct (Health Research Authority [HRA] 2025). Examples of these includes balancing anticipated benefits against mitigated risks, respecting individuals' autonomy through informed and voluntary consent, safeguarding privacy and confidentiality, and ensuring integrity and transparency, and involving patient, service user, and the public unless a clear justification is provided.

Patient and public involvement is increasingly recognised for improving the relevance and quality of health research and for supporting grants applications (NICE 2024). However, this thesis did not involve patients or the public at any stage, as the research focused on professional and organisational practices among HCPs and NHS stakeholders, limiting opportunities for meaningful lay involvement. Despite this, the research relevance was informed by national priorities, stakeholder discussions, and identified evidence gaps. Although patients and the public were not directly involved, the findings aim to support service improvement and enhance patient care.

Before conducting research involving human participants, a Research Ethics Committee (REC) review is essential to obtain approval and protect participants' rights, safety, and dignity (UK Research and Innovation 2024). An important initial step in the ethical review process is determining whether the study is classed as research, especially for studies involving patients, HCPs, or NHS premises, as this affects whether NHS REC approval is required. If a study is not research, it may be considered a service evaluation. Research aims to generate new, transferable knowledge, and may involve changes to standard practice. In contrast, service evaluation assesses or improves existing services without introducing changes or producing transferrable findings. To facilitate this classification, the Health Research Authority (HRA) decision tool is used, which considers whether the study involves randomisation, introduces changes to standard practice, or produces transferrable findings (HRA 2022b).

For studies classified as research, an application for review, such as the HRA/Health and Care Research Wales (HCRW) or NHS REC, must be submitted through the Integrated Research Application System (IRAS). IRAS is a unified platform for obtaining permissions and approvals for health and social care and community care research across the UK (HRA 2021). It uses filter questions to tailor the application to the study type to meet the regulatory body requirements (HRA 2021). The application process involves completing an online form, booking the application via the online booking service, and submitting supporting documents, including the research protocol, information sheets, consent forms, Curriculum Vitae (CV) of the researcher and chief investigator, and evidence of insurance or indemnity (for non-NHS sponsors) obtained from Cardiff University as the study sponsor. Therefore, sponsorship must be secured before submission. The application may require multiple amendments before final approval.

Once approved, the researcher must engage with the central site where the study is being conducted, sharing the local information pack (containing the Organisation Information Document, Schedule of Events, draft delegation log if applicable, and relevant study documentation) along with a research passport form and supporting documents. These are required to obtain the site's capacity and capability (C&C) confirmation, issue a letter of access, and receive the sponsor's green light to begin the study.

For non-research projects, such as service evaluation, other approvals are required. These may include Cardiff School of Pharmacy and Pharmaceutical Sciences (CSPPS)-REC review and consultation with the relevant R&D office or information /clinical governance team where the study is being conducted to determine local requirements, e.g., study registration with or without R&D review, to grant their permission.

Strict adherence to the highest ethical standards is a fundamental requirement when conducting research, especially when human participants are involved, ensuring their rights and well-being are protected throughout (McNair 2022). Informed consent and clear communication of the research process, e.g., through participant information sheets (PISs), are key to maintaining these standards (HRA 2020). The principles of the consent process outlined by the HRA (2020) were adhered to, and Cardiff University templates for consent forms and PISs were adapted for each study.

A key aspect of informed consent is ensuring participants and gatekeepers (who control/grant access to potential participants) understand their involvement and that participation is completely voluntary without any coercion. To ensure this, the information sheets should outline clear information on the study's background, purpose, participant selection, and voluntary nature, including assurances that declining participation would have no negative implications. Participants should be informed of their right to withdraw consent at any time before data de-identification, without any adverse consequences. Information on data protection and retention, in compliance with GDPR and the Data Protection Act 2018, as outlined in Cardiff University's retention policy, should also be offered to participants and adhered to by the researcher (Cardiff University 2020). Both participants and gatekeepers are required to provide written informed consent after reviewing the information sheets and agreeing to participate (HRA 2020). The consent form requires confirmation of statements, e.g., understanding the PIS, agreeing to participate, permitting audio/video recording, acknowledging withdrawal rights, and accepting data use under data protection legislation. This transparent approach enhances research integrity, ensuring ethical compliance and respecting individual autonomy. The consent process is detailed in the relevant chapters.

The process for studies involving secondary data is different, where the requirement for such ethical reviews depends on the nature of the data and how it is handled. Prior to 2024, Cardiff University's guidance stated that studies using anonymised data at access, whether publicly available or not, did not require ethical review except where non-public data carried potential for harm to specific groups or raised other valid concerns. Studies involving personal, identifiable data typically required ethical review unless the data came from specific public sources (e.g., published), posed no risk of harm, and raised no concerns (Cardiff University 2021). In 2024, this guidance was updated: if data is publicly available, anonymous at access, and poses no risk of harm or identifiability, ethical review is not mandated, but researchers are required to complete a self-assessment. Conversely, if the data is not publicly available, not fully anonymised, or involves handling identifiable or sensitive information, or if there is potential for harm, ethical review is required (Cardiff University 2024). This review is conducted by the researcher's university (UK Research and Innovation 2024), CSPPS-REC in this case, or by an NHS REC for specific study types.

3.10 Reflexivity

Reflexivity is the process of explicitly acknowledging the researcher's position, beliefs, and values, and examining how these may impact the research process and outcomes (Berger 2015). It is an ongoing, deliberate practice of recognising self-biases and actions throughout the research (Jamieson et al. 2023). Engaging in reflexivity and critical self-examination can enhance research rigour and minimise personal biases (Darawsheh 2014; Peddle 2022).

While complete detachment from personal experiences is difficult, researchers should remain aware and be mindful of their actions and behaviour (Palaganas et al. 2017; Spurling et al. 2017). The researcher's position and the steps taken throughout the study are important for readers to understand the research process and its potential impact on the outcomes (Watt 2007). Maintaining reflexive journals and engaging in ongoing self-reflection enhance transparency by clarifying what the researcher knows, how they know it, and how their biases may shape the research (Watt 2007). Sharing this reflexivity gives readers a clearer view of the researcher's viewpoint and its possible influence (Watt 2007).

At the beginning of this project, the researcher had no prior experience working in healthcare or involvement in antibacterial prescribing in Wales, including OOH services. They also had no pre-existing relationships with any of the interview participants. Their initial understanding of the topic was limited to the global concerns surrounding antimicrobial prescribing and the broader AMR crisis. However, as a full-time academic and practising clinical pharmacist in their home country (Saudi Arabia), with prior experience as an intern during their undergraduate studies, the researcher frequently encountered inappropriate antibacterial prescribing and complex cases of resistant bacterial strains.

Their understanding of healthcare services in Wales, particularly OOH services and the challenges associated with prescribing practices developed gradually. This growth was mainly through reviewing international literature relevant to the area, clarifying key concepts, engaging with supervisors and stakeholders and visiting community pharmacies to observe and understand local services, especially independent prescribing.

As direct observation of OOH services, such as NHS 111 CSHs or GP OOH, was not feasible, a virtual meeting was arranged with the Professional Lead for NHS 111 Pharmacists. During this meeting, the lead explained how the service operates, detailing the process from the

initial patient call to final management decisions. The researcher also maintained ongoing engagement with key stakeholders and prescribers in Wales. While some shared anecdotal assumptions about oral antibacterial prescribing in OOH services, none were fully familiar with the specific situation in Wales or had evidence-based knowledge about it. Engaging with literature and stakeholders continued throughout the project to stay current on any developments, share findings, and incorporate feedback. These interactions likely had minimal impact on the researcher's preconceptions. This is because they remained highly sensitive to participants' views and experiences and reflexive throughout the project, actively setting aside any emotions or assumptions regarding oral antibacterial prescribing.

In terms of data collection and analysis, the researcher had no previous experience conducting qualitative interviews before this project. They were concerned that this might affect their ability to build rapport, probe effectively, and collect high-quality data, particularly since English is their second language. However, the researcher took action to mitigate these challenges. They attended various workshops to enhance their qualitative research skills, covering interview schedule development, interviewing techniques, qualitative data analysis, and using NVivo software. They also conducted a pilot interview to reflect on their skills, rehearsed before each session, reviewed and reflected on previous interviews, consulted relevant literature, and sought guidance from their supervisors, who are experienced in qualitative research, and PhD students using similar research methods. Over time, the researcher developed important qualities, felt confident in their skills, and adopted their preferred tools for data analysis and visualisation. Further details and reflections on the research processes, key decisions, and adjustments implemented are provided within the relevant chapter.

3.11 Chapter Summary

This chapter outlines the research methods, designs, and analysis approaches considered to inform the choices made to achieve the thesis's aim and objectives. Table 3.8 summarises the thesis structure, linking each objective to its respective methodology, study design, methods, and analysis.

Table 3.8: Thesis Structure and Approaches

Thesis Aim	Thesis Objective(s)	Chapter Number and Title	Key Contents	Methodology	Design and Methods	Analysis
Explore oral antibacterial drug prescribing in Wales primary care OOH services.		Chapter 1: Introduction.	Introduces the research topic, thesis aim and objectives.			
	Objective 1	Chapter 2: Scoping Review.	Identifies and maps existing literature, highlighting key areas and evidence gap.	Literature review.	Scoping review with a narrative synthesis.	
		Chapter 3: Methodology.	Outlines the researcher's position, available methodologies, and rationale for the chosen approaches.			
	Objectives 2, 3, and 4	Chapter 4: Oral antibacterial prescribing in Wales: a secondary analysis of primary care and community pharmacy OOH services.	Establishes a foundational understanding of current prescribing patterns in Wales, serving as the basis for developing and addressing subsequent objectives.	Quantitative.	Non-experimental – Secondary data analyses.	Descriptive analysis with some inferential statistics.
	Objective 5	Chapter 5: Eliciting stakeholders' perspectives on oral antibacterial prescribing in primary care OOH services in Wales: a qualitative interview study.	Explores lead and/or primary care antimicrobial pharmacists' views on prescribing patterns observed and stewardship activities, highlighting practical realities and challenges in primary care OOH services and suggesting avenues for improvement.	Qualitative.	Phenomenology – Individual semi-structured interviews.	Reflexive thematic analysis.
	Objective 6	Chapter 6: A qualitative interview study exploring decision-making around oral antibacterial prescribing in NHS 111 CSHs during OOH periods.	Provides understanding of elements influencing or used by prescribers within NHS 111 CSHs when prescribing oral antibacterial drugs.	Qualitative.	Phenomenology – Individual semi-structured interviews.	Reflexive thematic analysis.
		Chapter 7: Integration and general discussion.	Summarises and integrates findings, discusses implications in the context of wider literature, and suggests directions for future work.	Mixed methods.	Explanatory sequential – Integration using triangulation protocol.	

Key: CSHs: clinical support hubs; NHS: National Health Service; OOH: out-of-hours; PIPS: pharmacy independent prescribing service.

*See Chapter 1 Section 1.10.1 for thesis objectives.

**Chapter 4 Oral Antibacterial Prescribing in Wales: A
Secondary Analysis of Primary Care and Community
Pharmacy Out-of-Hours Services**

4.1 Overview of the Chapter

This chapter analyses oral antibacterial prescribing patterns in primary care OOH services in Wales, including community pharmacy. It addresses thesis objectives 2–4, exploring current trends and variations across services at all-Wales and HB levels.

4.2 Introduction

The thesis introduction and scoping review (Chapters 1 and 2) identified a gap in understanding oral antibacterial prescribing in primary care OOH services in Wales. Although existing evidence recognises the contribution of these services to overall prescribing activity, they remain underreported in Wales national and HB-level surveillance data, which primarily focus on secondary and primary care during IH services. This lack of OOH-specific data may result in missed AMS opportunities.

Numerous AMS interventions have been implemented worldwide, with varying degrees of success (Tonkin-Crine et al. 2017). In Wales, initiatives such as the NPIs and Wales improvement goals, in addition to SSTF and TARGET toolkits (Chapter 1, Section 1.8.3), have mostly targeted secondary and primary care as a whole (Royal College of General Practitioners 2012; Public Health England 2015; AWMSG 2022b; Welsh Government 2022a). However, the applicability of these tools to primary care OOH services remains unclear. In particular, NPIs define targets at GP practice and HB levels; however, their suitability to OOH services is debateable given the unique challenges of OOH context (Chapter 1, Section 1.5.1 and Chapter 2, Section 2.4.10).

Improved understanding of prescribing patterns in OOH services could help identify specific targets for AMS interventions, such as patient population (e.g., children, females, those with a specific infection) or drug classes (e.g., 4Cs; Chapter 1, Section 1.8.4). It may inform tailored AMS guidance, help anticipate surges in demand, and support comparisons and evaluation of services across care models, regions, HCP groups, and seasonal trends. Analysing these patterns could support policy development and resource allocation in this underreported area. Therefore, this study represents an important starting point for understanding oral antibacterial prescribing in OOH services across Wales and provides baseline data for future research.

Primary care prescriptions include those resulting from primary care contacts, such as GP consultations. In Wales, prescriptions issued from these contacts and dispensed by community pharmacies are recorded in the Comparative Analysis System for Prescribing Audit (CASPA) system, established by Primary Care Services for financial reimbursement purposes. This includes prescriptions from both IH and OOH services (e.g., GP OOH and NHS 111 CSHs) issued by different prescriber groups (e.g., GPs, PIPs, and nurse IPs).

The number of non-medical prescribers in Wales has grown over time. By 2016, there were around 35,000 community nurse practitioner prescribers, 30,000 nurse SPs/IPs, 3,000 pharmacist SPs/IPs, and approximately 600 allied health professionals and optometrists with prescribing rights (Courtenay et al. 2017a). The number of PIPs specifically increased from 167 in 2016 to 483 in 2020 (Wickware 2021), reflecting growing workforce pressures and demands within the NHS. Reforms to UK pharmacy education are expected to further expand the prescribing workforce. From 2026, all newly qualified pharmacists will be eligible to register as PIPs (General Pharmaceutical Council n.d.-a), making a major step forward in pharmacists' role in healthcare delivery.

Although pharmacists in Wales were granted independent prescribing rights in 2007, prescribing within community pharmacy was not formally documented until December 2016 (Burns 2021). Early prescribing relied on informal agreements and personal relationships between community pharmacist independent prescribers (CPIPs) and local GPs (Mantzourani 2024). The absence of a formal service framework and reimbursement restricted CPIPs' ability to prescribe (Mantzourani 2024), resulting in underutilisation of their prescribing rights (Mantzourani et al. 2023).

To align with the WG's long-term strategic vision 'A Healthier Wales', which aims to bring care closer to home (Welsh Government 2018b), the Welsh Pharmaceutical Committee released its 2019 strategy 'Delivering a Healthier Wales'. This strategy set out the goal of having at least one PIP in every community pharmacy by 2030 and ensuring all patient-facing pharmacists become PIPs (Welsh Pharmaceutical Committee 2019). With this strategy and funding from HEIW, increasing numbers of community pharmacists began undertaking the independent prescribing course from 2019 onward (Hodson 2023). Because a national PIPS framework was not yet available, some HB selected a specific condition for their community pharmacists to focus on for prescribing. For example, those in CTMUHB decided

to focus on UTIs in their region, while CVUHB selected contraception as it had been identified as a need by their HB (Hodson 2023). Once qualified, pharmacists were commissioned by their HBs to provide these services in community pharmacies (Hodson 2023). By June 2021, CPIPs provided 16,005 consultations across 33 pharmacies, covering acute conditions, medicine withdrawal, and contraception (Burns 2021; Wickware 2021).

To address the lack of formal prescribing and reimbursement framework, a Pathfinder PIPS was launched in June 2020 across 13 pharmacies in six of the seven HBs (Mantzourani et al. 2023). This pilot enabled CPIPs to prescribe independently for conditions such as acute infections, substance misuse, and contraception (Mantzourani et al. 2023). The service encouraged CPIPs to use their skills and practice within their scope tailoring services to local population needs and HB priorities. Between April 2021 and March 2022, 69 pharmacies offered these prescribing services, with the number of active prescribers increasing to 95 by September 2022 (Evans 2023).

Following positive evaluation outcomes, PIPS was rolled out nationally in April 2022, expanding to more conditions beyond those in the pilot (NHS Wales Shared Services Partnership 2022). The service now allows CPIPs to manage conditions listed in the service specification (Table 4.1), including several acute infections. The rollout was gradual, with increasing numbers of pharmacies and CPIPs joining the service each month. This model enables patients to access care in pharmacies without GP appointments, maximising community pharmacy benefits, improving accessibility, and relieving some pressure on GP practices and A&E departments (Welsh Government 2021a). While the PIPS now provides a national framework, some HBs continue to commission additional services outside of PIPS scope, such as medicine withdrawal service, to address regional priorities (Hodson 2025).

As community pharmacies may open during weekends and bank holidays, and some offer extended weekday hours (Welsh Government 2019b; Smith 2022), this may extend access to PIPS. The pharmacy payment system, which increases with the range and volume of services and consultations delivered (Welsh Government 2019b), may encourage CPIPs to provide care beyond standard hours. This can result in oral antibacterials being prescribed during these periods, supporting OOH services.

Table 4.1: Conditions within the PIPS Specification 2022

Clinical Conditions and Circumstances that are in Scope of PIPS	
Ear • Otitis Externa / superficial infections of the external auditory canal • Impacted or excessive cerumen • Otitis Media	Upper respiratory tract • Sinusitis • Allergic rhinitis • Sore throat / tonsillitis • Oral thrush • Cough
Skin • Fungal and candida infections (excluding fungal nail infections) • Acne & rosacea (topical treatments only) • Inflammatory skin disorders and psoriasis (topical treatments only) • Dry Skin • Herpes Zoster • Skin infections (e.g., Impetigo, cellulitis) & paronychia • Skin reactions (urticaria, hives, bites/stings, etc)	Other • Viral infection • Pyrexia • Bacterial conjunctivitis • Gout exacerbation • Constipation • Other conditions covered by the All Wales Common Ailments Formulary where CAS supply is inappropriate
Urinary tract • Lower urinary tract infection • Upper urinary tract infection (pyelonephritis)	Contraception • Emergency contraception • UKMEC 1 • UKMEC 2

Taken from: NHS Wales Shared Services Partnership. 2022. Pharmacy Independent Prescribing Service: Common Ailments and Contraception.

Key: CAS: Common Ailments Scheme; PIPS: Pharmacy Independent Prescribing Service; UKMEC: The UK Medical Eligibility Criteria for Contraceptive Use

Community pharmacies have therefore made significant progress in expanding clinical services, enhancing their role as accessible first points of contact. A key development complementing this progress is the introduction of digital infrastructure to support these services. The Choose Pharmacy national platform, launched in October 2013, enables pharmacist to deliver and document different services (Digital Health and Care Wales n.d.-a). The platform was initially piloted in two HBs to facilitate the delivery of CAS (Welsh Government 2015a), and later expanded across Wales to include additional services such as Discharge Medicines Review, Emergency Medicines Supply, contraception, and seasonal flu vaccination (Digital Health and Care Wales n.d.-a). With the PIPS introduction, a dedicated Choose Pharmacy module was developed to support its delivery, allowing CPIPs to access digital Welsh GP Records, record consultation details, generate summaries and referral letters, and maintain complete patient histories (Digital Health and Care Wales n.d.-b).

There is a clear need to analyse local oral antibacterial prescribing patterns in primary care, particularly in OOH services. HCPs face challenges when prescribing, which are magnified during OOH encounters.

Despite growing interest in AMS and OOH services, findings from Chapter 2 indicate a lack of research on oral antibacterial prescribing within OOH services in Wales. Additionally, the utilisation and prescribing of these drugs under the PIPS has not been investigated.

Although Wasag et al. (2021) has examined primary care prescribing in Wales, their focus was mainly around the impact of COVID-19 over a relatively short period (three years).

More importantly, they did not address OOH services or community pharmacy prescribing. The current research may provide insights into prescribing patterns within these settings.

4.2.1 Aim and Objectives

This study aimed to investigate oral antibacterial prescribing patterns during OOH services in Wales across primary care settings, including GP surgeries/OOH, NHS 111 CSHs, and PIPS within community pharmacies. The specific objectives were as follows:

CASPA objectives (for GP surgeries/OOH and NHS 111 CSH prescribing):

- Quantify the prescribing volumes of oral antibacterial drugs and the 4Cs in primary care, IH, and OOH services at the all-Wales, HB, and prescriber group level, where data permit.
- Describe prescribing trends for oral antibacterial drugs and the 4Cs in primary care, IH, and OOH services at the all-Wales, HB, and prescriber group level, where data permit.
- Assess changes in prescribing of oral antibacterial drugs and the 4Cs between the first and last examined years at all-Wales level across primary care, IH, and OOH services and prescriber groups, where data permit.

Choose Pharmacy objectives (for PIPS in community pharmacy):

- Describe the demographic profile of patients accessing community pharmacy PIPS and its utilisation during OOH periods.
- Identify the most commonly prescribed oral antibacterial drugs by CPIPs via PIPS and their associated medical conditions during OOH periods.
- Evaluate CPIPs' prescribing choices of the 4Cs via PIPS for reported diagnoses during OOH periods.

4.3 Methods

4.3.1 Study Design

The study adopted a positivist approach (described in Chapter 3, Section 3.2) and used a quantitative longitudinal design to investigate oral antibacterial prescribing in primary care in Wales during OOH services. Descriptive analysis of prescribing at the national and HB levels was completed. Due to time and resource constraints, this service evaluation study employed a retrospective secondary data analysis approach, using routinely collected data on oral antibacterial prescriptions (from CASPA) and consultations (from Choose Pharmacy – PIPS module). A census approach to available data was used, aligning with the study's aim. Secondary data analysis involves analysing data collected by others or for a different purpose (Hox and Boeijs 2005). Its use, advantages, and limitations are discussed in Chapter 3, Section 3.4.2.2. To enhance data quality, several preparation techniques (Taleb et al. 2015) were applied where relevant, including data transformation (converting data from one form to another), data cleansing (identifying and correcting errors, removing duplicates, and addressing invalid or missing data), and data reduction (reducing data volume and complexity through techniques such as compression and clustering). Details on how these techniques were applied are provided in Sections 4.3.3.3 and 4.3.4.3.

4.3.2 Sources of Data

Two databases were used to retrieve oral antibacterial prescribing data to have a complete picture of primary care and PIPS prescribing in Wales during OOH services. Primary care prescribing data, i.e., number of oral antibacterial items during IH and OOH services (see Section 4.3.3 below), were obtained from the CASPA database under the 'National GP' category. Data on PIPS consultations were obtained from the PIPS module within the Choose Pharmacy database.

Although PIPS-prescribed and dispensed items are also recorded within CASPA under a non-GP category (labelled as 'National Pharmacy' from September 2019), key consultation details, such as time, date, and clinical indication, are only available in Choose Pharmacy. Moreover, unlike Choose Pharmacy and the 'National GP' category within CASPA, OOH-specific prescribing data from community pharmacy could not be identified in CASPA. This is because CASPA aggregates all prescribing data under the PIPS, without reference to

prescription time or day. For these reasons, data from Choose Pharmacy were used to analyse PIPS prescribing activity. Figure 4.1 presents how the two systems are related.

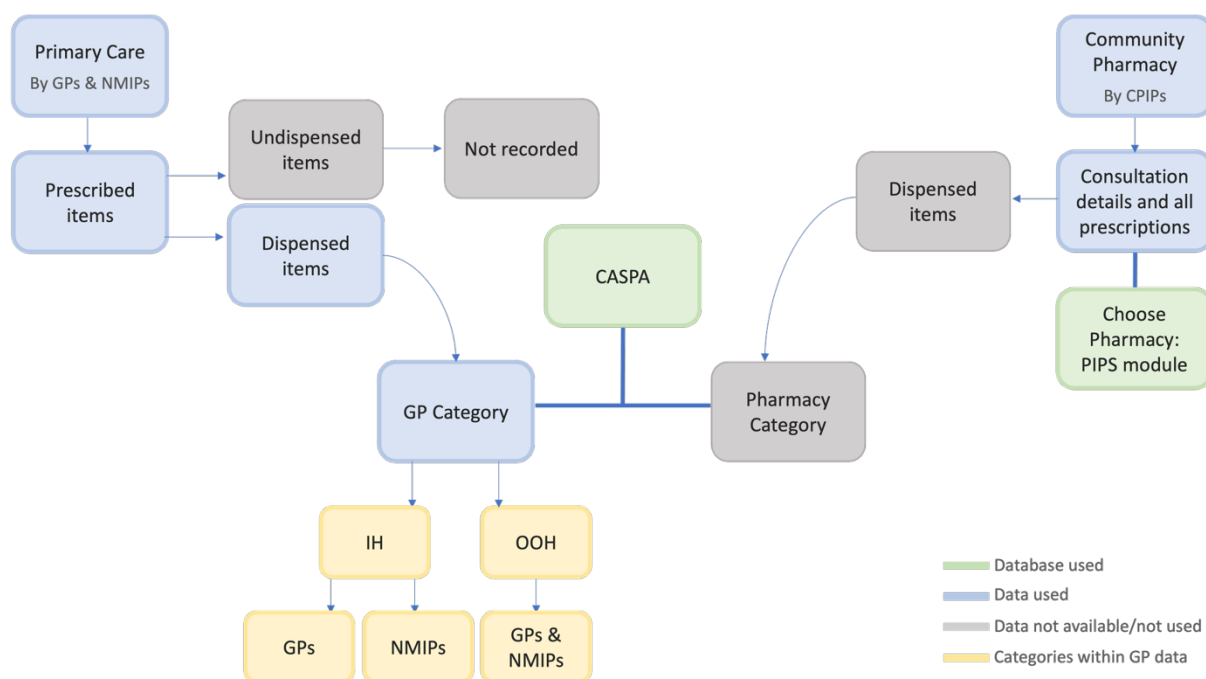


Figure 4.1: Visual Representation of the Systems and Used Data

Key: CASPA: Comparative Analysis System for Prescribing Audit; CPIPs: community pharmacist independent prescribers; GPs: general practitioners; IH: in-hours; NMIPs: non-medical independent prescribers; OOH: out-of-hours; PIPS: Pharmacy Independent Prescribing Service.

Note: entities other than GP Category exist in CASPA such as dental and hospital/secondary care.

Since data were obtained from two systems established for different purposes, the type and level of prescribing information varied. Therefore, a two-phase approach was employed for data management and analysis, with each phase tailored to the information available from its respective database.

4.3.3 Phase I: CASPA Database

4.3.3.1 Overview of the Database

CASPA is an electronic prescription system provided by NWSSP, designed primarily to capture prescribing data for the purpose of financial reimbursements for medicines prescribed in primary care and dispensed by community pharmacies. It stores prescription records issued by GPs, NMIPs, and others such as supplementary prescribers. However, it does not capture private prescriptions or those issued but not dispensed, as these are not submitted for NHS reimbursement, limiting knowledge of actual prescribing activities.

Nonetheless, because prescriptions in Wales are provided free of charge (Welsh Government 2017), it is reasonable to assume most are dispensed, as evidence suggested that this abolition did not lead to a noticeable increase in the number or cost of prescriptions dispensed after three years (Anon 2015). Although this phase uses dispensed data, these are referred to as 'prescribed data' throughout the study to maintain consistency across the thesis as they likely reflect actual prescribing. Moreover, the database does not include details on patient demographics, presenting symptoms, or clinical indications, making it impossible to assess outcome such as reasons for consultation or the clinical appropriateness of prescribing. Consequently, this phase of the chapter focused solely on analysing prescribing volume.

4.3.3.2 Data Extraction

Data were obtained from the CASPA in collaboration with the All-Wales Therapeutics and Toxicology Centre (AWTTC), an NHS organisation in Wales. AWTTC works closely with various stakeholders to ensure appropriate use of medicines, promoting quality and safety of healthcare services (AWTTC n.d.) and routinely uses CASPA data in their role (AWTTC 2016). To access the data, a formal request was submitted to the Welsh Analytical Prescribing Support Unit (WAPSU), a division of AWTTC responsible for analysing prescribing data, using their official data request form (Appendix 4.1) (AWTTC 2019).

Since CASPA data are only readily available for 84 months from the access date, the most recent seven years of data (April 2015 to March 2022, covering the last seven NHS financial years) were retrieved in May and June 2022. Financial years were used rather than calendar years to ensure consistency with national reporting of prescribing data from CASPA and other NHS sources. Monthly prescribing data were used instead of quarterly or annual figures to allow more precise detection of changes in prescribing patterns (Wang et al. 2017).

In CASPA, prescribing items are categorised according to the British National Formulary (BNF). Using this system, oral antibacterial items were extracted by individual groups, while the 4Cs were mostly identified at the individual drug level (Table 4.2). The number of prescribed items was obtained for each, representing the number of times an item was prescribed, regardless of the quantity supplied or treatment duration. For example, items

prescribed for 10, 14, or 28 days were each counted as a single item (see Section 4.3.3.4 for details on prescribing metrics).

Table 4.2: Categorisation of Oral Antibacterial Drugs and 4Cs as Obtained from CASPA Database

Antibacterial Drugs	4Cs
Aminoglycosides	Cefaclor
Antileprotic Drugs	Cefadroxil
Antipseudomonal Penicillins	Cefalexin
Antituberculous Drugs	Cefixime
Benzylpenicillin & Phenoxymethylpenicillin	Cefotaxime Sodium
Broad-Spectrum Penicillins	Cefpodoxime
Carbapenems	Cefradine
Cephalosporins	Ceftazidime Pentahydrate
Cephalosporins, Cephamycins & Beta lactams	Ceftriaxone Sodium
Clindamycin And Lincomycin	Cefuroxime Axetil
Macrolides	Cefuroxime Sodium
Mecillinams	Cephalosporins
Metronidazole, Tinidazole & Ornidazole	Clindamycin And Lincomycin
Other Beta-Lactam Antibiotics	Co-Amoxiclav (amoxicillin-clavulanate)
Penicillinase-Resistant Penicillins	Quinolones
Quinolones	
Some Other Antibiotics	
Sulphonamides And Trimethoprim	
Tetracyclines	
Urinary-Tract Infections	

In CASPA, OOH data are recorded under a dummy GP practice, together with IH data within the GP category for all HBs except CTMUHB, where OOH data are recorded under the hospital/secondary care category. Unique identifiers linked to OOH services within each HB (V-codes for CTMUHB and W-codes for all other HBs) were shared through the request form. These identifiers, obtained in collaboration with the Professional Lead for NHS 111 Pharmacists, enabled AWTTTC to locate OOH data. Data were then extracted into Microsoft Excel® and included the number of prescribed oral antibacterial items, both overall and those classified as 4Cs. These were obtained for primary care settings, including both IH and OOH services for each HB listed as GP category in CASPA (Figure 4.2). IH data were further categorised by prescriber type into either GPs or NMIPs, while OOH data were recorded collectively and could not be separated by prescriber group.

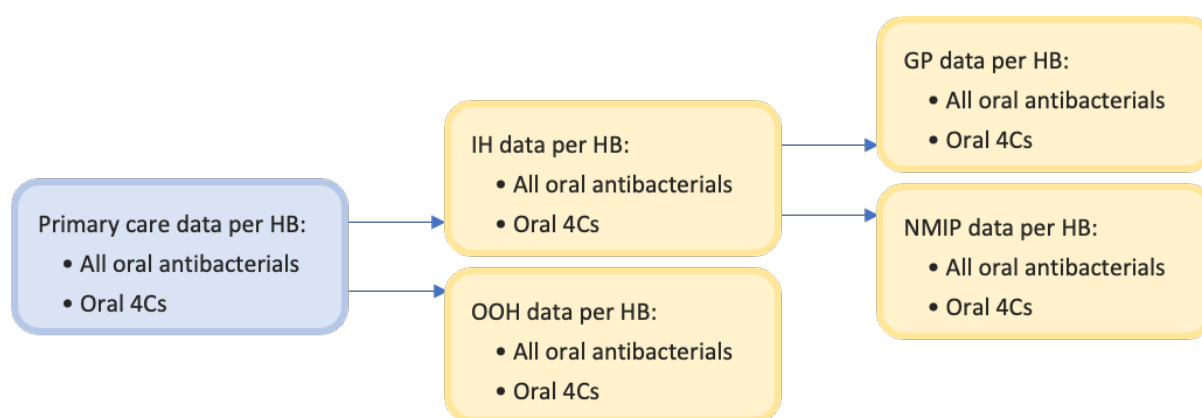


Figure 4.2: Data Categorisation from CASPA Database – GP Category (Monthly Data)

Key: 4Cs: Amoxicillin-clavulanate, Cephalosporins, Clindamycin, and Fluoroquinolones GPs: general practitioners; HB: health board; IH: in-hours; NMIPs: non-medical independent prescribers; OOH: out-of-hours.

4.3.3.3 Data Preparation

When CASPA data were obtained for each HB, they were initially categorised into three groups: all general practice data (which include IH GP and NMIP data, as well as OOH data), OOH data, and all general practice data by NMIPs (which include IH NMIP data only). The data were prepared to ensure their suitability for analysis. Data transformation was carried out using Microsoft Excel®, which involved reorganising the data into a format that facilitated analysis to address the research aim (Dhudasia et al. 2023).

To isolate IH data for each HB, except for CTMHUB, the volume of OOH prescriptions was subtracted from the total general practice data. This allowed the calculation of oral antibacterial and 4C volumes specific to IH services. For CTMUHB, where OOH data are recorded separately under secondary care rather than within the GP category (i.e., all general practice data) as described earlier, these data were combined with all general practice data, which for this HB represent IH data only (including IH GP and NMIP data), to calculate total general practice volumes. Lastly, GP prescribing volumes during IH services for all HBs were calculated by subtracting NMIP prescribing volumes from IH prescribing volume for both all antibacterial drugs and the 4Cs. This was not feasible for OOH data because, in CASPA, GP and NMIP prescriptions are not recorded separately for OOH prescriptions (Section 4.3.3.2). Table 4.3 summarises the categorisation process.

Table 4.3: Data Categorisation on CASPA

HBs	IH Data (GPs + NMIPs)	IH GP Data
ABUHB	GP data - OOH data	(GP data - OOH data) - NMIPs data
BCUHB	GP data - OOH data	(GP data - OOH data) - NMIPs data
CTMUHB	GP data	GP data - NMIPs data
CVUHB	GP data - OOH data	(GP data - OOH data) - NMIPs data
HDUHB	GP data - OOH data	(GP data - OOH data) - NMIPs data
PTHB	GP data - OOH data	(GP data - OOH data) - NMIPs data
SBUHB	GP data - OOH data	(GP data - OOH data) - NMIPs data

GP data for CTMUHB represented IH data only; GP data for other HBs represented both IH and OOH.

Key: ABUHB: Aneurin Bevan University Health Board; BCUHB: Betsi Cadwaladr University Health Board; CASPA: Comparative Analysis System for Prescribing Audit; CTMUHB: Cwm Taf Morgannwg University Health Board; CVUHB: Cardiff and Vale University Health Board; GPs: general practitioners; HBs: health boards; HDUHB: Hywel Dda University Health Board; IH: in-hours; NMIPs: non-medical independent prescribers; OOH: out-of-hours; PTHB: Powys Teaching Health Board; SBUHB: Swansea Bay University Health Board.

To enable within- and between-HBs analyses, standardised prescribing rates for oral antibacterial drugs and 4Cs were calculated per 100,000 population. Monthly prescribing numbers were adjusted using the respective mid-year population estimates for each HB and for all Wales population published on the WG Stats Wales website, where available (Welsh Government 2022b). This was done by dividing the total number of oral antibacterial or 4C items prescribed every year by the corresponding mid-year population estimate and multiplying by 100,000 (Equation 4.1).

Equation 4.1: Calculation of the Number of Items Prescribed for Each Health Board per 100,000 Population

$$\begin{aligned}
 & \text{The number of prescribed items (antibacterial drugs or the 4Cs) per 100,000 population} \\
 &= \frac{\text{the number of prescribed items (antibacterial drugs or the 4Cs)}}{\text{mid year population estimate of each health board per year}} \\
 & \times 100,000
 \end{aligned}$$

For the 2021–22 financial year, the most recent available estimates (2020–21) were used due to the absence of up-to-date estimates at the time of analysis. This standardisation accounted for the differences in HB population sizes and year-on-year changes in population within each HB except for the year 2021–22 where estimates were unavailable. Although

prescribing data were reported by financial year (April to March), mid-year population estimates for the corresponding calendar year (January to December) were used for adjustment. For both primary care IH and OOH services, annual percentage changes in prescribing from 2015–16 to 2021–22 were also calculated for each HB per 100,000 population. To ensure anonymity in reporting, HBs were coded from A to G.

As the objective was to examine the overall prescribing volume of oral antibacterial drugs, a simplified categorisation was adopted instead of using the extracted groups based on BNF categories (Table 4.2). BNF, class-level analysis was not conducted because CASPA provides aggregated prescribing data without contextual details (e.g., demographics, clinical indications), which would have limited interpretability and value. Accordingly, the data were grouped into two main categories: all oral antibacterial drugs and all 4Cs. This approach was viewed as more policy-driven, guided by the AMS targets set by the NPIs (AWMSG 2022b). Due to the nature and quality of the extracted data, no cleansing was required. The reliability of CASPA data is supported by routine validation processes, in which a random sample of approximately 60,000 prescription items is checked for accurate data recording and payment against WG key performance indicators (NHS Wales Shared Services Partnership n.d.).

4.3.3.4 Prescribing Metrics

Different metrics can be used to measure and evaluate antibacterial prescribing across healthcare settings, including inpatient care, long-term care facilities, and outpatient services. The choice of metric depends on factors, such as the aim, healthcare setting, clinical condition or drug class, and data availability. Within CASPA, several metrics are available, such as the defined daily dose (DDD), cost, and number of items.

The DDD is “*the assumed average maintenance dose per day for a drug used for its main indication in adults*” (WHO Collaborating Centre for Drug Statistics and Methodology 2018). It is a common measure of drug consumption and treatment intensity adopted by the WHO to standardise comparisons across settings. The DDD is calculated by dividing the total grams of antibacterial drugs used by the WHO-DDD value.

Although widely used, the DDD has drawbacks and may not always provide accurate estimates. The WHO-assigned values do not necessarily reflect doses commonly used in practice (Leung et al. 2021). Moreover, DDDs do not account for children dosing and dose

adjustments for specific populations, such as patients with renal impairment (Leung et al. 2021). This measure is also unsuitable for certain therapeutic areas, including vaccines, one-off treatments, contraceptives and hormonal therapies, and combination products (NHS the Information Centre for Health and Social Care 2012). Due to these limitations, other methods are currently available to estimate drug utilisation and prescribing.

Cost is another metric that can be used, for example, to forecast spending to support financial planning (NHS the Information Centre for Health and Social Care 2012). This metric was not considered, as the focus was on investigating prescribing volumes and patterns rather than conducting cost analysis.

Another common metric is the number of items, which counts how many times an item is prescribed regardless of the quantity, making it particularly suitable for measuring prescribing for acute treatments, including antibacterials and vaccinations (NHS the Information Centre for Health and Social Care 2012; Health Education and Improvement Wales 2021). This metric was considered the most appropriate for the study's objectives, as it captures antibacterials prescribed by GPs or NMIPs and dispensed in community pharmacies.

4.3.3.5 Data Analysis

Given the study's focus on quantifying prescribing volumes and investigating prescribing patterns, descriptive analyses were chosen as the main analytical approach. As this study used a full census (within a defined timeframe), there was no need to test hypotheses and make inferences to the general population (Field 2018).

Microsoft Excel® was used to calculate and visualise descriptive statistics. This included the total number of monthly items per 100,000 population for each HB (Section 4.3.3.3). These data were visualised using line charts to illustrate changes in prescribing over time. Analyses covered the whole of primary care, as well as IH services and OOH services, and prescriber groups when possible. Annual and cumulative (from the first year to 2020–21 and to 2021–22) percentage changes were also calculated for each HB and for Wales overall and presented in tables to allow clear comparison of prescribing trends.

Inferential analysis was used to examine changes in oral antibacterial and 4C prescribing over the study period across primary care overall, IH, OOH, and prescriber groups when data

allowed (objective 3). The null hypothesis stated no significant difference between the first and last years, while the alternative hypothesis predicted a significant change. The appropriate statistical test to assess this was identified following consultation with Cardiff University's Data Clinic service. As the third objective was to assess changes in prescribing volumes (continuous variable) between two time points (first and last years) to determine whether a significant change has occurred, paired statistical tests (the student t-test or the Wilcoxon signed-rank test) were initially considered before testing normality.

The Shapiro-Wilk test, a powerful test for detecting non-normality and particularly suitable for small sample sizes (Mishra et al. 2019), indicated that some data categories were not normally distributed (p-value <0.05), violating a key assumption of the parametric student t-test. Consequently, the Wilcoxon signed-rank test, a non-parametric test for comparing two related samples or repeated measurements from a single sample, was chosen. A p-value of <0.05 was considered statistically significant.

Due to limitations in the CASPA dataset, which lacks information on repeated prescriptions, medical conditions, age, and sex, the value and application of advanced modelling techniques, such as Poisson regression, was restricted and considered beyond the scope of this study. As the analysis was based on a census, no statistical power calculations or sample size estimations were required (Singh and Masuku 2014).

The IBM SPSS® Statistics (version 29.0) was used for normality testing and inferential analysis. Box-and-whisker plots, created using Microsoft Excel®, were used to visualise data distributions, including medians, minimum and maximum values, quartiles, interquartile ranges (IQRs), and outliers (Krzywinski and Altman 2014).

4.3.4 Phase II: Choose Pharmacy – PIPS Database

4.3.4.1 Overview of the Database

The Choose Pharmacy platform mandates CPIPs to record both patient and consultation details using a combination of dropdown lists and free-text fields (Table 4.4). Each patient is assigned a unique registration identifier within the platform, which enables tracking of individual consultations over time while maintaining confidentiality (as outlined in Section 4.2).

Table 4.4: Fields within Choose Pharmacy Database

Section	Data Field	Data Type	Notes	Data Used to
Patient search screen	Forename and Surname	Free text	Initial demographic details (e.g., postcode) maybe entered manually at the start of a consultation to enable matching with registered patients (against the Welsh Demographic Service or Patient Demographic Service for English patients as entered by GPs), after which other fields such as gender are automatically updated. *Sex is recorded as gender with two options only (male, female).	NA
	Date of birth	DD/MM/YYYY		NA
	Postcode	Free text		NA
	Gender	Auto-populated		Describe service use
	Presenting ailment	Free text		NA
Viewing WGPR	Consent to access the WGPR	Option buttons (Yes, no, not given but it is essential in the patient's best interest)	As Choose Pharmacy allows pharmacists to view patients' WGPR with their consent with separates related fields: If no: • Reason consent not provided for WGPR (free text). If not given but essential - Patient consent overridden: • Reason consent overridden (both dropdown list and free text).	NA
Consultation details	General Pharmaceutical Council (GPhC) number (active user)	Prepopulated	Pharmacist entering consultation; field allows entry of the number of pharmacist undertaking the consultation if different from the data entry user (e.g., when recorded on paper due to system downtime).	NA
	Date and time of consultation	Prepopulated	Calendar to choose date and sliders to adjust time; In the extracted data it appears in two field as: 1. Consultation date (display consultation date and time); 2. Actual consultation date (display actual consultation date and time) if it was entered retrospectively, e.g., if papers were used at the time of consultation.	Describe service use
	Referred by	Dropdown list	E.g., GP, OOH, self-referral as unable to see a GP (see Table 4.5).	Describe service use
	Presenting symptoms	Free text	Record reason why the patient presented for a consultation.	Categorise diagnoses and assess treatment
	Assessment of symptoms	Free text	Record relevant information to assessment.	
Assessment notes	Medical/social/family history	Free text	E.g., other medical conditions, smoker.	Categorise diagnoses and assess treatment
	Examination findings	Free text	Record findings, e.g., FeverPAIN score, pules, blood pressure.	
	Tests undertaken & results	Free text	Details of tests/results, e.g., Streptococcus A test: negative.	
	Consent to share with GP	Checkbox	Default = checked; can be deselected (separate consent fields for assessment of symptoms, medical/social/family history, examination findings, and tests undertaken & results).	
				NA

Key: GP: general practitioner; NA: not applicable; OOH: Out of Hours; WGPR: Welsh GP Record.

Table 4.4: Fields within Choose Pharmacy Database (continued)

Section	Data Field	Data Type	Notes	Data Used to
Sensitive information	Highly sensitive information	Dropdown list	(Yes/No); yes, if human immunodeficiency virus/acquired immunodeficiency, sexually transmitted diseases, fertilisation and embryology, termination of pregnancy, or gender reassignment.	NA
Management	Outcome	Option buttons	Options: refer patient / continue consultation.	Describe service use
	Additional allergy information	Free text	E.g., causative agent, description of the reaction, severity.	Assess treatment
	Refer to	Dropdown list	Used if patient cannot be treated within PIPS (e.g., to GP).	NA
	Time scale for referral	Dropdown list	Appears if referral was chosen (e.g., within 24, 48, 72 hours).	NA
	Referral information	Free text	Appears if referral was chosen; referral reason & relevant details to share with the receiving healthcare professional.	NA
	Drug name, strength & form	Dropdown (autocomplete)	Appears if continue consultation was chosen; can be left empty if treatment was not provided and only advice was given.	Describe service use and assess treatment
	Quantity	Free text		NA
	Dose	Free text		NA
	Advice and follow-up	Free text	E.g., self-care and safety-netting.	NA
	Consent to share with GP	Dropdown list	Options: yes/no; default = Yes.	NA
Additional information	What would the patient have done if not using the service?	Dropdown list	E.g., attended GP, emergency department, self-care (see Table 4.5).	Describe service use
	Patient request for the service to be provided in Welsh	Dropdown list	Options: yes/no.	NA
	Was the service provided in Welsh?	Dropdown list	Appears if preference for Welsh was chosen Options: yes completely/mostly/partly/no/not applicable.	NA
Information upon data extraction *Require no entry	Consultation ID		Unique for each consultation.	Describe service use
	Patient registration ID		Unique for each patient (can change if patient moves pharmacy)	NA
	Age		It is calculated by the data analysts based on the date of birth using a script when extracting the data from the system.	Service use and assess treatment
	GP practice code		Address and code of the GP practice the patient is registered with.	NA
	GP practice address line 1–4			NA
	Pharmacy location ID		Unique for the pharmacy where the consultation took place.	Describe service use

Key: GP: general practitioner; ID: identifier; NA: not applicable.

4.3.4.2 Data Extraction

Data on oral antibacterial prescribing from community pharmacies delivering PIPS across Wales were retrieved in collaboration with Digital Health and Care Wales (DHCW). Access to data was facilitated via a DHCW gatekeeper in October 2022. Extracted data contained all fields described in Table 4.4. The dataset covered the period from the introduction of the Choose Pharmacy PIPS module on 25 June 2020 to the end of September 2022, when the study was conducted. All consultation records were exported into Microsoft Excel®, with each row representing a single prescribed item within a consultation. Multiple items prescribed in one consultation, whether for the same or different conditions, were recorded in separate rows. Additionally, consultations resulting in no prescription, advice only, or referral were also included, each in their own rows.

4.3.4.3 Data Preparation

The original dataset included all PIPS consultations regardless of time, diagnosis, or reason for the encounter, and was shared in multiple monthly spreadsheets. However, given the study's aim, the data were first combined into a single spreadsheet and then filtered and categorised using data preparation techniques in Microsoft Excel®. Data cleansing was undertaken to improve quality and reliability and reduce the risk of inaccurate conclusions. This involved removing empty and duplicate rows, and correcting entries placed in incorrect fields. Data reduction was also performed by removing irrelevant fields (e.g., those related to patients consent).

Data transformation was also completed to reorganise the dataset into a format suitable for identifying OOH data. In the original database, consultation date and time were in a single column (formatted as: *dd/mm/yyyy hh:mm:ss*). To ease categorisation, this column was split into separate date and time columns. An additional column was also created containing the consultation date. This new column was formatted to display the day by adjusting the cell format to (custom-*dddd*). These transformations allowed locating OOH data, which included consultations on weekends, bank holidays, and weekdays from 18:31 to 07:59. Bank holiday consultations were manually identified by searching the spreadsheet and cross-referencing consultation dates against official Wales bank holiday dates (Appendix 4.2) listed on the GOV.UK website (GOV.UK 2022). Weekend and weekday OOH consultations were categorised using Microsoft Excel® formulas (Equation 4.2) for accurate classification.

Equation 4.2: Locating Weekend and Weekday OOH Consultations from Choose Pharmacy, PIPS Data

Weekend data

=OR(WEEKDAY(A2)=1,WEEKDAY(A2)=7)

Where 1 and 7 refer to Saturday and Sunday, TRUE refers to weekends, and FALSE to weekdays.

Weekday OOH data

=OR(MOD(B2,1)>TIME(18,30,0),MOD(B2,1)<TIME(8,0,0))

Where TRUE refers to OOH and FALSE to IH consultations.

To identify the geographical distribution of the service across Wales, pharmacy location IDs in the database, formatted as a six-digit number followed by a letter, were transformed to their corresponding HBs. This was carried out using a list of pharmacy codes per HB shared by the DHCW gatekeeper via the 'find and replace' function in Microsoft Excel®. This was done to identify how the service was accessed and to facilitate comparisons between HBs where applicable. To maintain anonymity and consistency, the seven HBs were labelled HB A to G to match those used in the CASPA dataset.

The consultation ID, which may link one or multiple rows to a single consultation (see Section 4.3.4.2), was used to identify the number of consultations and items prescribed per consultation, if any. Conditional formatting in Excel was applied to highlight cells based on specific COUNTIF criteria (Equation 4.3), allowing visual identification of multi-item consultations. Additional conditional formatting was used to highlight the entire rows containing potential duplicate entries missed during earlier manual cleansing to ensure all duplicates were removed (Equation 4.3).

Equation 4.3: Formulas Used for Conditional Formatting

Number of rows related to a single consultation

=COUNTIF(\$A\$1:\$A\$[last row],A1)=[number to identify]

where cells are highlighted in red if two-item consultation, yellow if three-item consultation, green if four-item consultation, blue if five-item consultation, grey if six-item consultation.

Duplicate rows identification

=COUNTIFS(\$A:\$A,\$A2,\$B:\$B,\$B2,\$C:\$C,\$C2,...)>1

Applied for all columns within the database, where rows occurring more than once are highlighted.

At this stage, a new spreadsheet was created to include only consultations conducted during OOH periods. Additional spreadsheets were then created for the full dataset (all consultations) and the OOH subset to group consultations by the number of prescribed items (e.g., spreadsheet for 1-item, spreadsheet for 2-item consultation). Relevant consultations were sorted accordingly. The number of consultations was determined by dividing the number of rows by the number of items prescribed per consultation. Consultations that did not result in any prescription (e.g., referral or advice) were also identified and separated from those with one item.

OOH consultations resulting in oral antibacterial prescriptions were identified using Excel's filter function, which allowed for the manual selection of relevant records (using the treatment provided column). A summary table was created to present monthly data on total consultations and those involving oral antibacterial prescriptions during weekdays (18:30-08:00), weekends, and bank holidays.

The OOH spreadsheet at this point was filtered to include only consultations involving oral antibacterial drugs during OOH periods. Where explicit diagnoses were missing, the NICE Clinical Knowledge Summaries (CKS) were used to infer possible diagnoses based on the content of free-text fields (NICE n.d.). Since the Choose Pharmacy lacks a dropdown menu or checklist for recording diagnoses (Table 4.4), these interpretations were mapped to relevant conditions listed in the PIPS specification (Table 4.1) (NHS Wales Shared Services Partnership 2022). To evaluate the choice of prescribed 4Cs, MicroGuide™ (a digital platform that provides access to local antimicrobial guidelines) was used, referencing the specific HB's recommendations (Induction Healthcare Group n.d.).

Patient demographics, mainly age and sex, were analysed to determine PIPS usage trends. Various age classification systems exist, such as Government Analysis Function's age-harmonised groupings (bands A to E), which categorises individuals into fixed intervals to show distribution (Government Analysis Function 2019). For example, one grouping includes: 0–15, 16–24, 25–34, 35–44, 45–54, 55–64, 65–74, and 75 and older. However, this study adopted the National Institutes of Health (NIH) age classifications (National Institutes of Health 2022):

- Neonates or newborns (birth–1 month).
- Infants (1 month–1 year).

- Children (1–12 years).
- Adolescents (13–17 years).
- Adults (≥ 18 years).
- Older adults (≥ 65 years).

This system was chosen to provide a clear, practical definition of service users based on the main developmental and physiological phases, rather than narrower 10-year bands, facilitating interpretation of age-related differences. As age was reported in years, the neonate, newborn, and infant groups (under 1 year) were combined into a single group.

4.3.4.4 Data Analysis

Descriptive analyses were used for this phase since inferential analyses were unnecessary with a complete dataset (Field 2018). For continuous variables, such as age, mean, median, and mode were reported. Categorical variables, including sex, referral source (i.e., who referred the patient to the pharmacy), patients' alternative actions if the service were unavailable, number of items prescribed, HBs, number of items prescribed per consultation, and those during OOH periods, were summarised using frequencies and proportions. Since age was also categorised into defined NIH classes, frequencies and proportions were also reported for each class. Table 4.5 describes the categories and codes of these variables.

Microsoft Excel® was used to calculate these statistics and visualise data. Line graphs were chosen to illustrate monthly prescribing volumes to show temporal changes over time. Bar charts were used to visualise the number and timing of oral antibacterial items prescribed and consultations.

Table 4.5: Variables Used to Describe PIPS Data

Variable(s)	Categories (Code)
Sex	• Male, female, unspecified.
Referred to the pharmacy by	• Self-referral as unable to see GP (SRNGP). • General practitioner (GEPR). • Other self-referral (OSERE). • Self-referral (SERE). • Other pharmacy (OTHP). • Other healthcare professional (OHCP). • Other (OTHER). • 111 NHS Direct/NHS 111 (111). • Out-of-hours (OOH). • Optometrist (OPTOM). • Accident and emergency (A&E).
Patient alternative action if the service was not available	• Made appointment with GP. • Made appointment for OOH. • Made appointment with OHCP. • Made appointment with a nurse or health visitor. • Done nothing. • Attended A&E. • Called NHS Direct/NHS 111. • Bought medication from pharmacy. • Not stated.
HBs	• HB A, HB B, HB C, HB D, HB E, HB F, HB G, unspecified.
Number of items per consultation	• None, 1 item, 2 items, 3 items, 4 items, 5 items, 6 items.
Number of consultations	• All time, all OOH, all OOH with oral antibacterial drugs.
Number of items during OOH consultations	• Weekends - None, 1 item, 2 items, 3 items, 4 items. • Weekdays - None, 1 item, 2 items, 3 items, 4 items. • Bank holidays - None, 1 item, 2 items, 3 items, 4 items.
Number of items in OOH consultations	• All items, all oral antibacterial drugs, oral 4Cs.
Total number of oral antibacterials in OOH consultations	• Weekends, weekdays, bank holidays.
Number of oral antibacterial prescribed in OOH consultations	• Per medical condition, per individual drug.
Age breakdown	• National Institutes of Health classes (adjusted): Newborns & Infants (<1 year), Children (1–12years), Adolescents (13–17 years), Adults (18–64 years), Older adults (≥65 years).

Key: GP: general practitioner; HB: health board; NHS: National Health Service; OOH: out-of-hours.

4.3.5 Quality Assurance

The two databases used are routinely and extensively used by the WG, policymakers, and various NHS groups to monitor, evaluate, report on healthcare service delivery and usage. This reinforces the reliability and accuracy of the data for drawing valid findings.

The second phase of the study, which analysed data from the Choose Pharmacy platform, was conducted as part of collaborative project involving three MPharm students. To ensure the quality and consistency of data processing and analysis, the students, the researcher, and the primary supervisor each worked independently to prepare the data (cleansing and transforming it to align with the study's aim and objectives). Data analyses were conducted once the team reached a consensus, ensuring that any discrepancies were resolved. Each student independently classified two-thirds of the OOH oral antibacterial prescribing data by medical conditions, ensuring that each set of data was assessed by at least two students. To evaluate the choice of prescribed 4Cs, one student and the researcher independently compared prescribed drugs against respective HB MicroGuide™ antimicrobial prescribing recommendations (Induction Healthcare Group n.d.). While existing literature may not mandate these steps, the researcher considered this quality assurance process essential for maintaining the accuracy and reliability of the data used.

4.3.6 Ethical Considerations

Ethical approval was not required as the study used routinely collected secondary data. CASPA data were fully anonymised and contained no personal or identifiable information (Tripathy 2013; Cardiff University 2021). PIPS data from Choose Pharmacy were obtained and formally registered with NHS Velindre Trust R&D by the gatekeeper. Prior to sharing the dataset with the researcher, patients date of birth and postcodes were removed by DHCW team. The researcher further verified that no identifiable information remained and could be used. While PIPS data initially included a unique patient registration identifier and pharmacist General Pharmaceutical Council (GPhC) numbers, these were removed before the analysis to maintain confidentiality throughout. The research team did not have access to the Choose Pharmacy system; therefore, linking these identifiers to individuals was not possible. Pharmacy location IDs, which could potentially reveal dispensing locations, were used only to categorise data by HBs and were not disclosed individually. To further ensure pseudonymisation, HBs were coded alphabetically (HB A to HB G) throughout the study.

4.4 Results

4.4.1 Phase I: CASPA Database

4.4.1.1 Volume of Prescribing in Wales

Between April 2015 and March 2022, a total of 14,997,291 oral antibacterial items were prescribed in Wales primary care, including both IH and OOH services. Of these, 1,265,499 (8.4%) were classified as 4Cs. Within OOH services, 445,339 oral antibacterial items were prescribed (3% of all primary care prescribing), of which 50,527 (11.3%) were 4Cs. OOH prescribing represented a relatively small proportion of overall primary care prescriptions during financial years 2015–16 and 2021–22, ranging from 2.7% to 3.2% for all oral antibacterial drugs and 3.6% to 4.2% for 4Cs annually. Tables 4.6 and 4.7 present the number of oral antibacterial and 4C prescriptions per population in primary care, IH and OOH services, and those issued by NMIPs within IH services, stratified by year and HBs.

Table 4.6: All Wales Oral Antibacterial Prescribing from April 2015 to March 2022

Presented numbers (n) are the number of items/mid-year population estimate in Wales x100,000

All Oral Antibacterial Prescriptions				
Year	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
2015–16	77,773	75,282 (96.8)	2,492 (3.2)	3,146 (4.2)
2016–17	75,204	72,780 (96.8)	2,424 (3.2)	3,737 (5.1)
2017–18	73,296	71,088 (97.0)	2,208 (3.0)	3,698 (5.2)
2018–19	68,194	66,292 (97.2)	1,902 (2.8)	5,165 (7.8)
2019–20	67,914	65,886 (97.0)	2,028 (3.0)	6,060 (9.2)
2020–21	54,2389	52,797 (97.3)	1,442 (2.7)	4,986 (9.4)
2021–22*	61,6612	59,949 (97.2)	1,713 (2.8)	6,124 (10.2)
All years	478,283	464,073 (97.0)	14,209 (3.0)	32,916 (7.1)
Oral 4C Prescriptions				
Year	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
2015–16	7,495	7,190 (95.9)	305 (4.1)	160 (2.2)
2016–17	6,760	6,485 (95.9)	275 (4.1)	180 (2.8)
2017–18	6,305	6,060 (96.1)	245 (3.9)	193 (3.2)
2018–19	5,725	5,520 (96.4)	205 (3.6)	255 (4.6)
2019–20	4,980	4,775 (95.9)	205 (4.1)	265 (5.6)
2020–21	4,686	4,496 (96.0)	190 (4.1)	294 (6.5)
2021–22*	4,433	4,245 (95.8)	188 (4.2)	298 (7.0)
All years	40,384	38,772 (96.0)	1,612 (4.0)	1,644 (4.2)

Key: IH: in-hours; NMIPs: non-medical independent prescribers; OOH: out-of-hours.

Note: IH data include both GPs and NMIPs data.

*Mid-year population estimate for 2020–21 was used to calculate the number of prescriptions in 2021–22

Table 4.7: Number of Items Across Different HBs in Wales from April 2015 to March 2022
Presented numbers (n) are the number of items/mid-year estimates for HB-specific population x100,000

All Oral Antibacterial Prescriptions				
HBs	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
HB A	477,403	466,502 (97.7)	10,901 (2.3)	30,430 (6.5)
HB B	424,292	411,188 (96.9)	13,104 (3.0)	21,107 (5.1)
HB C	530,398	527,315 (99.4)	3,083 (0.6)	14,674 (2.8)
HB D	503,617	465,210 (92.4)	38,407 (7.6)	20,941 (4.5)
HB E	493,034	479,879 (97.3)	13,155 (2.7)	35,902 (7.5)
HB F	436,073	428,547 (98.3)	7,526 (1.7)	34,552 (8.1)
HB G	469,929	456,648 (97.2)	13,281 (2.8)	59,761 (13.1)
All Wales	478,283	464,073 (97.0)	14,209 (3.0)	32,916 (7.1)
Oral 4C Prescriptions				
HBs	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
HB A	32,916	31,809 (96.6)	1,108 (3.3)	1,308 (4.1)
HB B	31,040	29,803 (96.0)	1,237 (4.0)	839 (2.8)
HB C	49,510	49,125 (99.2)	385 (0.8)	794 (1.6)
HB D	44,786	39,802 (88.9)	4,984 (11.1)	1,012 (2.5)
HB E	46,329	44,507 (96.1)	1,822 (3.9)	2,235 (5.0)
HB F	36,915	36,067 (97.7)	847 (2.3)	1,841 (5.1)
HB G	42,427	41,186 (97.1)	1,242 (2.9)	3,028 (7.4)
All Wales	40,384	38,772 (96.0)	1,612 (4.0)	1,644 (4.2)

Key: IH: in-hours; NMIP: non-medical independent prescribers; OOH: out-of-hours.

Note: IH data include both GPs and NMIPs data.

Mid-year population estimate for 2020–21 was used to calculate the number of prescriptions in 2021–22.

Prescribing proportions for each HB in relation to all Wales are presented in Appendix 4.3.

4.4.1.2 Prescribing Trends Over Time

4.4.1.2.1 Prescribing During Primary Care IH and OOH

Overall, primary care prescribing patterns in Wales were primarily driven by IH services, where most consultations occur. Oral antibacterial and 4C prescribing declined across HBs over time, though the extent of reduction varied. This trend began to reverse in 2021–22, with oral antibacterial prescribing, but not the 4Cs, rising again. Seasonal peaks were observed for total oral antibacterial prescribing trends, with higher prescribing in winter months and lower levels in summer. Except in 2015–16, HB C consistently recorded highest prescribing among all HBs, while HB B maintained the lowest levels (Figure 4.3 and 4.4).

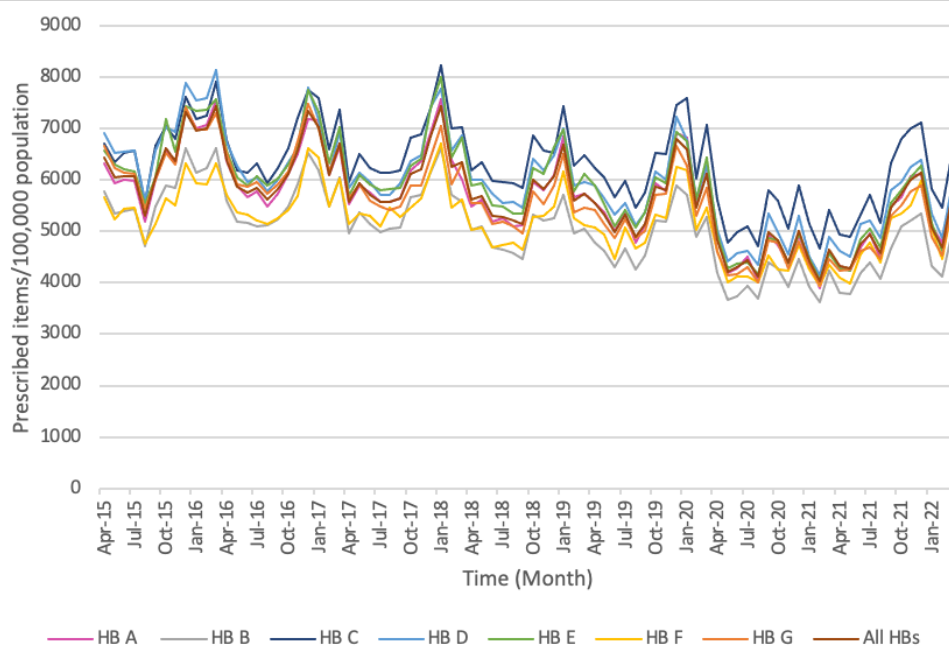


Figure 4.3: Monthly Trend of Oral Antibacterial Items per 100,000 Population in Primary Care
 *Monthly data were analysed but presented quarterly to improve readability

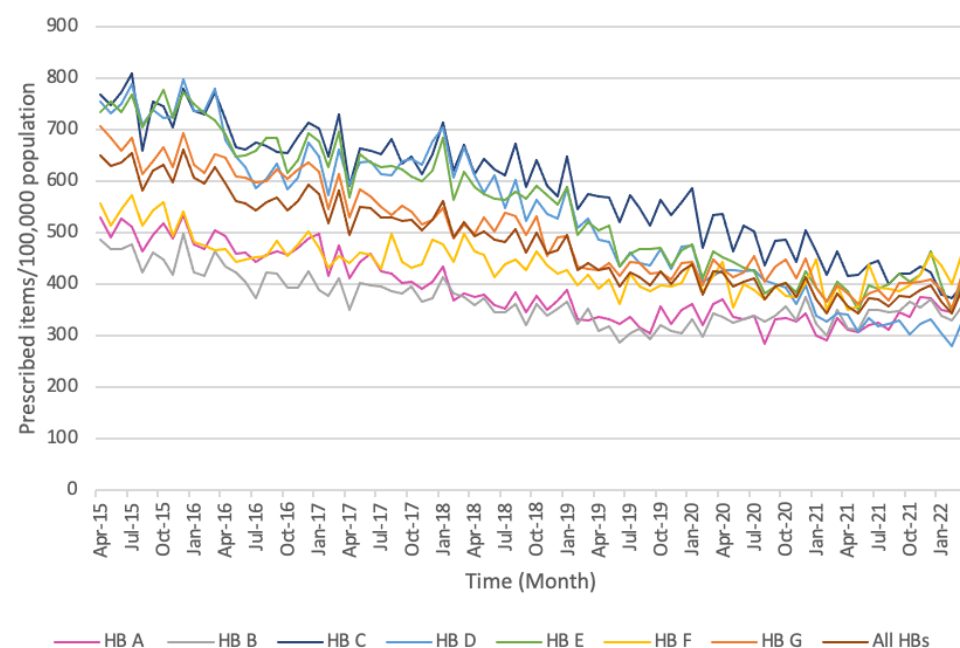


Figure 4.4: Monthly Trend of 4C Items per 100,000 Population in Primary Care
 *Monthly data were analysed but presented quarterly to improve readability

Table 4.8 presents the annual and cumulative percentage changes in prescribing across all HBs in Wales, highlighting the increase in prescribing volume observed in 2021–22.

Table 4.8: Percentage Change in Prescribing Across HBs and All Wales During IH and OOH Services

Oral Antibacterial Prescribing During IH and OOH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-3%	-3%	-2%	-7%	-3%	1%	-3%	-3%
	2017–18	-2%	-2%	0%	-1%	-2%	-2%	-7%	-3%
	2018–19	-8%	-9%	-5%	-6%	-7%	-8%	-7%	-7%
	2019–20	1%	-1%	0%	-2%	-2%	1%	0%	0%
	2020–21	-21%	-19%	-18%	-20%	-23%	-18%	-20%	-20%
	2021–22	15%	12%	13%	14%	14%	15%	13%	14%
Cumulative	2015–16 to 2020–21	-31%	-31%	-24%	-32%	-32%	-24%	-33%	-30%
	2015–16 to 2021–22	-20%	-23%	-14%	-23%	-23%	-13%	-24%	-21%
Oral 4C Prescribing During IH and OOH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-7%	-11%	-9%	-16%	-11%	-11%	-7%	-10%
	2017–18	-11%	-5%	-5%	2%	-7%	-1%	-12%	-7%
	2018–19	-12%	-9%	-6%	-12%	-9%	-5%	-8%	-9%
	2019–20	-7%	-11%	-11%	-20%	-18%	-8%	-13%	-13%
	2020–21	-2%	8%	-13%	-14%	-12%	-2%	-3%	-6%
	2021–22	4%	3%	-13%	-18%	-3%	4%	-7%	-5%
Cumulative	2015–16 to 2020–21	-35%	-26%	-36%	-48%	-45%	-25%	-36%	-37%
	2015–16 to 2021–22	-32%	-24%	-45%	-57%	-46%	-22%	-41%	-41%

■ Decrease or ■ Increase from the previous year

4.4.1.2.2 Prescribing During IH Services

There was an overall decreasing trend in IH oral antibacterial and 4C prescribing across all HBs (Figures 4.5 and 4.6). Throughout the study period, HB C consistently contributed to the highest prescribing levels for both categories. A notable decline was observed in HB D, especially in 4C prescribing, transitioning from the third highest to the lowest by 2021–22, with prescribing falling by more than half since the study began.

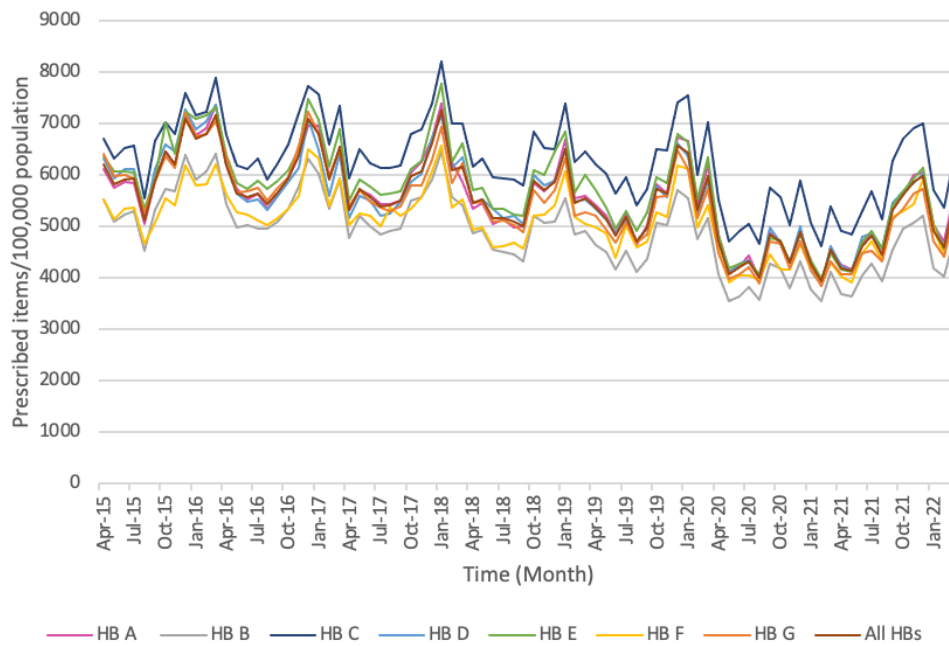


Figure 4.5: Monthly Trend of Oral Antibacterial Items per 100,000 Population in IH Services
 *Monthly data were analysed but presented quarterly to improve readability

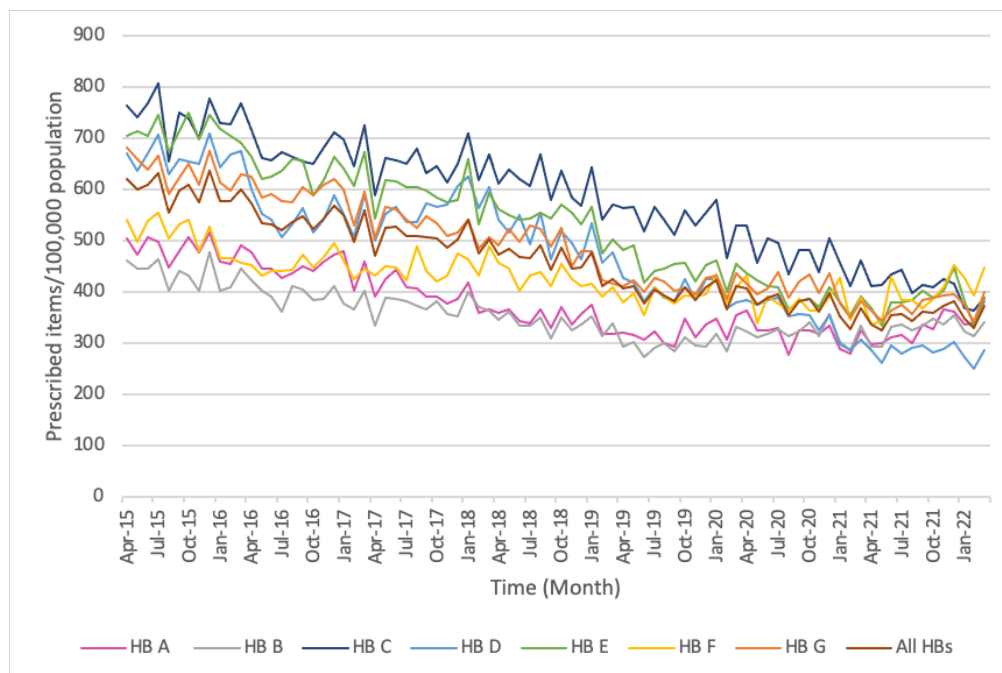


Figure 4.6: Monthly Trend of 4C Items per 100,000 Population in IH Services
 *Monthly data were analysed but presented quarterly to improve readability

The year-on-year and cumulative percentage changes within IH prescribing across HBs in Wales is presented in Table 4.9.

Table 4.9: Percentage Change in Prescribing Across HBs and All Wales During IH Services

Oral Antibacterial Prescribing During IH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-4%	-3%	-2%	-8%	-3%	1%	-3%	-3%
	2017–18	-2%	-2%	0%	-1%	-2%	-2%	-6%	-2%
	2018–19	-7%	-9%	-5%	-5%	-6%	-8%	-7%	-7%
	2019–20	1%	-1%	0%	-2%	-1%	2%	-1%	-1%
	2020–21	-21%	-19%	-18%	-19%	-23%	-19%	-20%	-20%
	2021–22	15%	12%	13%	14%	14%	16%	13%	14%
Cumulative	2015–16 to 2020–21	-30%	-30%	-24%	-31%	-32%	-24%	-32%	-30%
	2015–16 to 2021–22	-19%	-22%	-14%	-22%	-22%	-12%	-24%	-20%
Oral 4C Prescribing During IH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-7%	-10%	-9%	-17%	-11%	-11%	-7%	-10%
	2017–18	-12%	-6%	-5%	3%	-7%	-1%	-11%	-7%
	2018–19	-12%	-9%	-7%	-11%	-9%	-6%	-8%	-9%
	2019–20	-8%	-12%	-11%	-21%	-17%	-7%	-15%	-13%
	2020–21	-1%	8%	-13%	-13%	-12%	-3%	-3%	-6%
	2021–22	4%	2%	-14%	-19%	-3%	4%	-7%	-6%
Cumulative	2015–16 to 2020–21	-34%	-26%	-37%	-48%	-45%	-25%	-37%	-37%
	2015–16 to 2021–22	-32%	-25%	-45%	-57%	-46%	-22%	-41%	-41%

■ Decrease or ■ Increase from the previous year

Overall, prescribing data from IH services as a whole (including GPs and NMIPs) followed a similar declining pattern to that observed specifically in GP prescribing rather than the pattern seen in NMIPs (Figures 4.7 and 4.8).

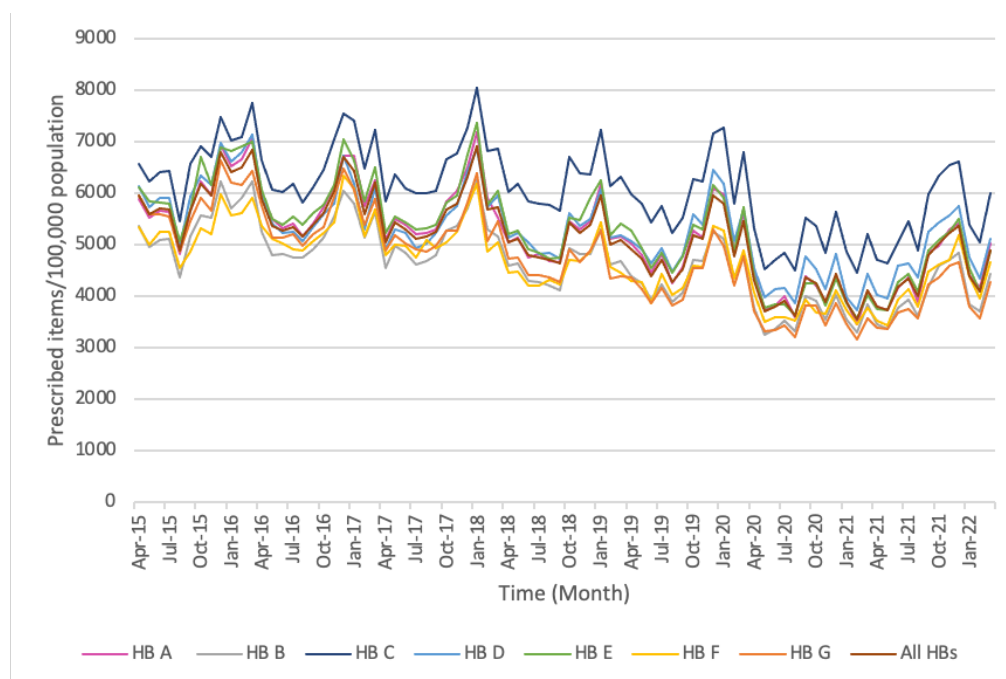


Figure 4.7: Monthly Trend of Oral Antibacterial Items per 100,000 Population in IH Services by GPs
*Monthly data were analysed but presented quarterly to improve readability

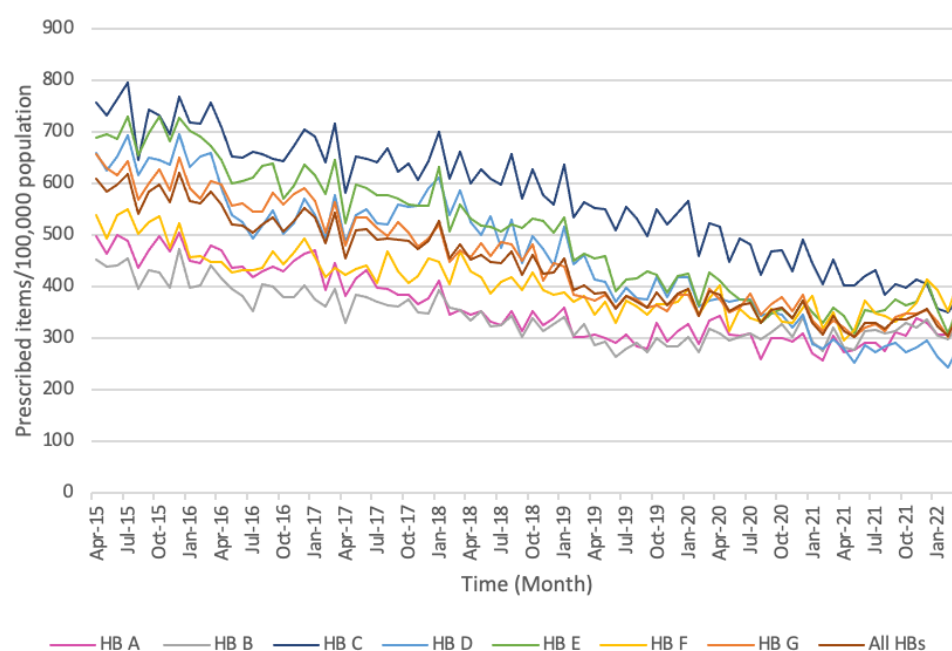


Figure 4.8: Monthly Trend of 4C Items per 100,000 Population in IH Services by GPs
*Monthly data were analysed but presented quarterly to improve readability

NMIP prescribing showed fluctuations but, unlike GP prescribing, diverged from primary care trends. It generally increased over time for all HBs except for HB D (Figures 4.9 and 4.10). HB G recorded the highest NMIP prescribing for both oral antibacterial drugs and 4Cs.

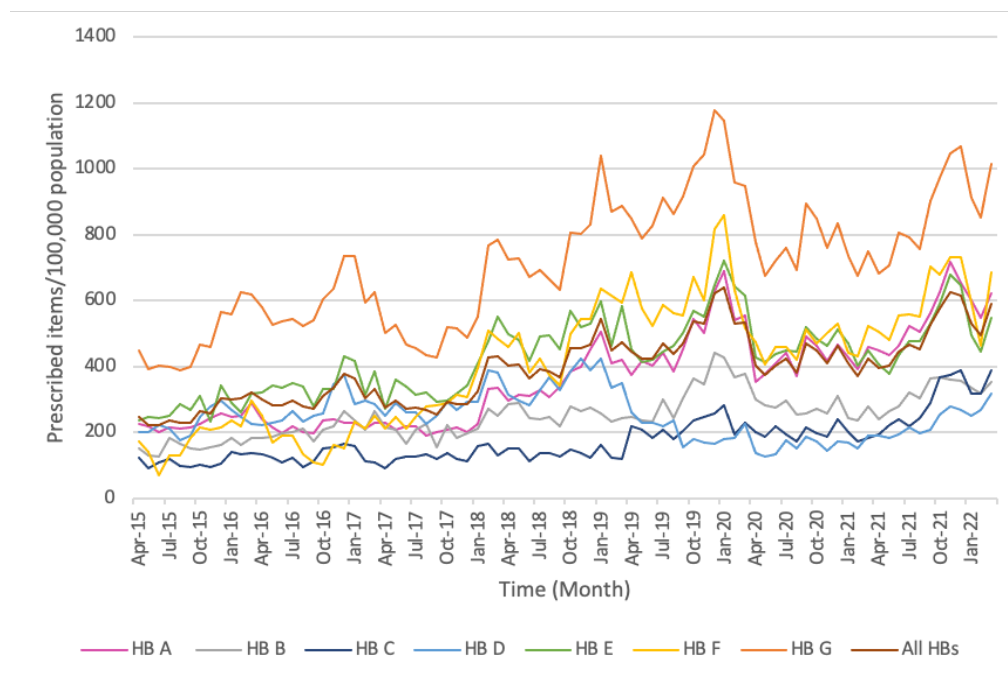


Figure 4.9: Monthly Trend of Oral Antibacterial Items per 100,000 Population in IH Services by NMIPs
*Monthly data were analysed but presented quarterly to improve readability

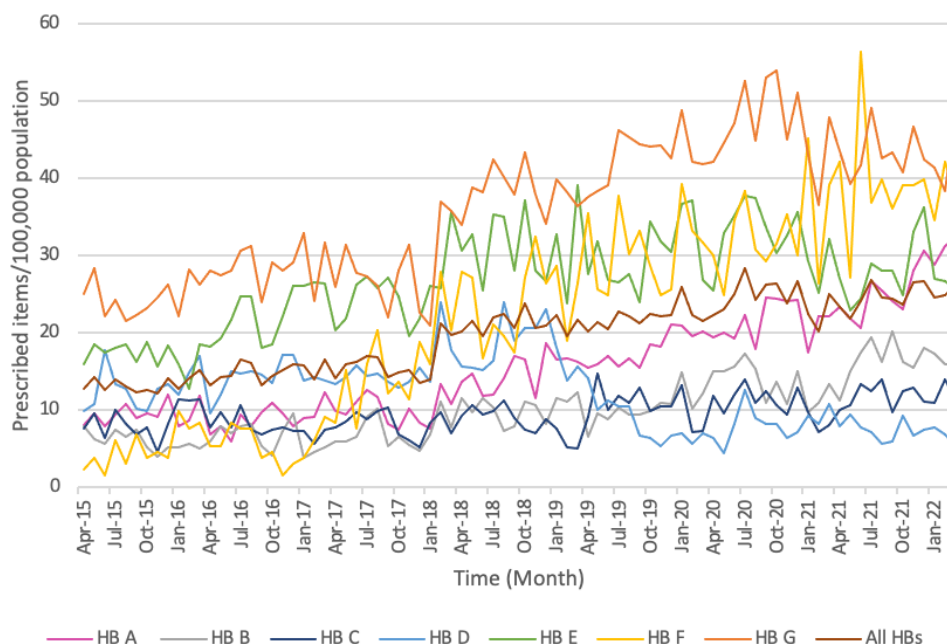


Figure 4.10: Monthly Trend of 4C Items per 100,000 Population in IH Services by NMIPs
*Monthly data were analysed but presented quarterly to improve readability

4.4.1.2.3 Prescribing During OOH Services

For oral antibacterial and 4C prescribing, HB D deviated the most from all Wales trend, starting with high levels and recording the largest reduction over time (Figures 4.11 and 4.12). Unlike in IH services, HB C consistently had the lowest prescribing; however, its prescribing steadily increased over the study period. Other HBs followed fairly similar downward trends overall, except HB G, which experienced a temporary decline in 2017 and 2018 before rising again toward the end of 2018 for both categories.

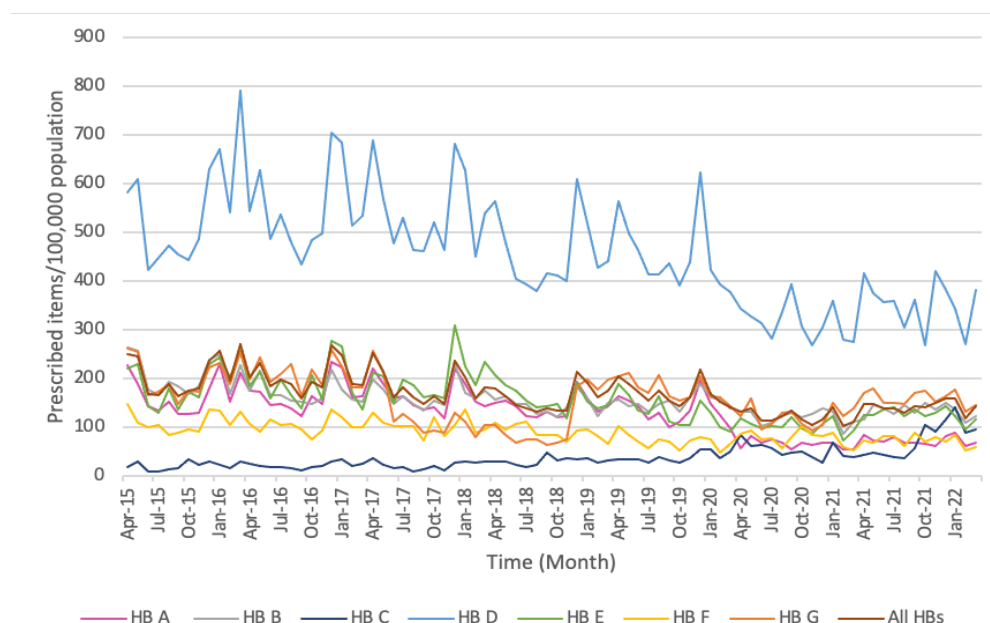


Figure 4.11: Monthly Trend of Oral Antibacterial Items per 100,000 Population in OOH Services
*Monthly data were analysed but presented quarterly to improve readability

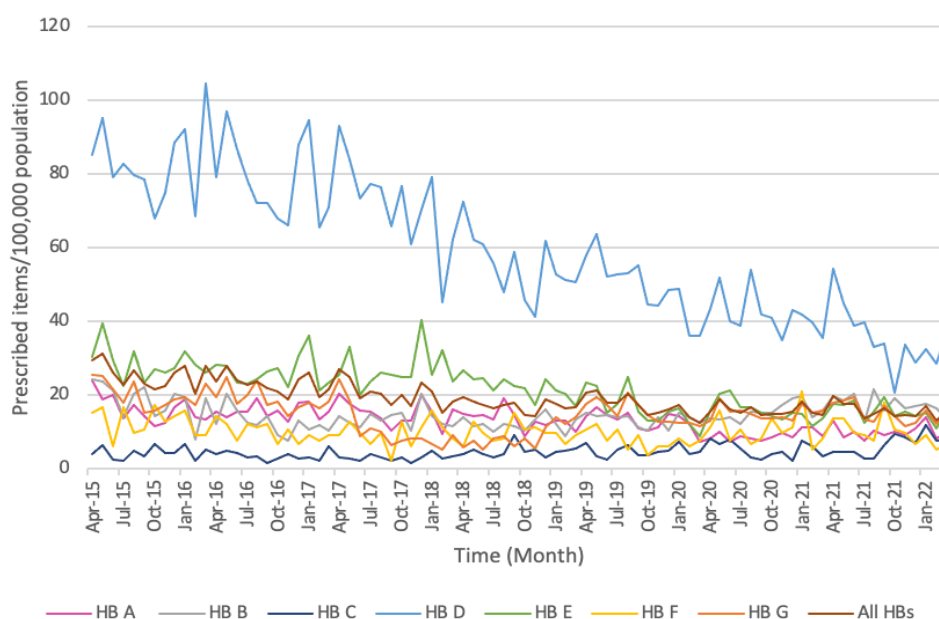


Figure 4.12: Monthly Trend of 4C Items per 100,000 Population in OOH Services
*Monthly data were analysed but presented quarterly to improve readability

Table 4.10 presents annual and cumulative percentage changes in OOH prescribing across HBs and Wales overall, highlighting a rise in oral antibacterial prescribing in most HBs in the last examined year (2021–22) and a sustained upward trend in HB C throughout the study.

Table 4.10: Percentage Change in Prescribing Across HBs and All Wales During OOH Services

Oral Antibacterial Prescribing During OOH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-1%	-17%	2%	0%	-2%	-6%	2%	-3%
	2017–18	-1%	-2%	2%	-1%	5%	0%	-39%	-9%
	2018–19	-14%	-13%	40%	-16%	-21%	-13%	-10%	-14%
	2019–20	-5%	4%	26%	0%	-17%	-21%	56%	7%
	2020–21	-52%	-21%	35%	-30%	-22%	10%	-31%	-29%
	2021–22	11%	11%	46%	12%	24%	-7%	31%	19%
Cumulative	2015–16 to 2020–21	-61%	-42%	149%	-42%	-47%	-30%	-40%	-42%
	2015–16 to 2021–22	-57%	-35%	264%	-35%	-34%	-34%	-21%	-31%
Oral 4C Prescribing During OOH Services									
Type	Year	HB A	HB B	HB C	HB D	HB E	HB F	HB G	All Wales
Annual	2015–16	0	0	0	0	0	0	0	0
	2016–17	-4%	-33%	-20%	-6%	-9%	-22%	-7%	-10%
	2017–18	-4%	10%	-15%	-8%	4%	-3%	-45%	-11%
	2018–19	-11%	-11%	61%	-23%	-19%	1%	-14%	-16%
	2019–20	-3%	10%	-1%	-10%	-25%	-21%	72%	0%
	2020–21	-30%	16%	8%	-15%	-5%	39%	-2%	-7%
	2021–22	12%	12%	26%	-16%	-1%	-8%	0%	-1%
Cumulative	2015–16 to 2020–21	-44%	-17%	16%	-49%	-45%	-15%	-25%	-38%
	2015–16 to 2021–22	-38%	-7%	47%	-57%	-46%	-22%	-25%	-39%

■ Decrease or ■ Increase from the previous year

4.4.1.3 Change in Prescribing

The change in the number of prescribed oral antibacterial and 4C items per 100,000 population between the first and the last examined year was statistically significant across the different settings, and prescriber groups within IH services (p-value < 0.002 for each category) (Figure 4.13). Therefore, the null hypothesis was rejected, supporting the alternative hypothesis that prescribing volumes changed over time.

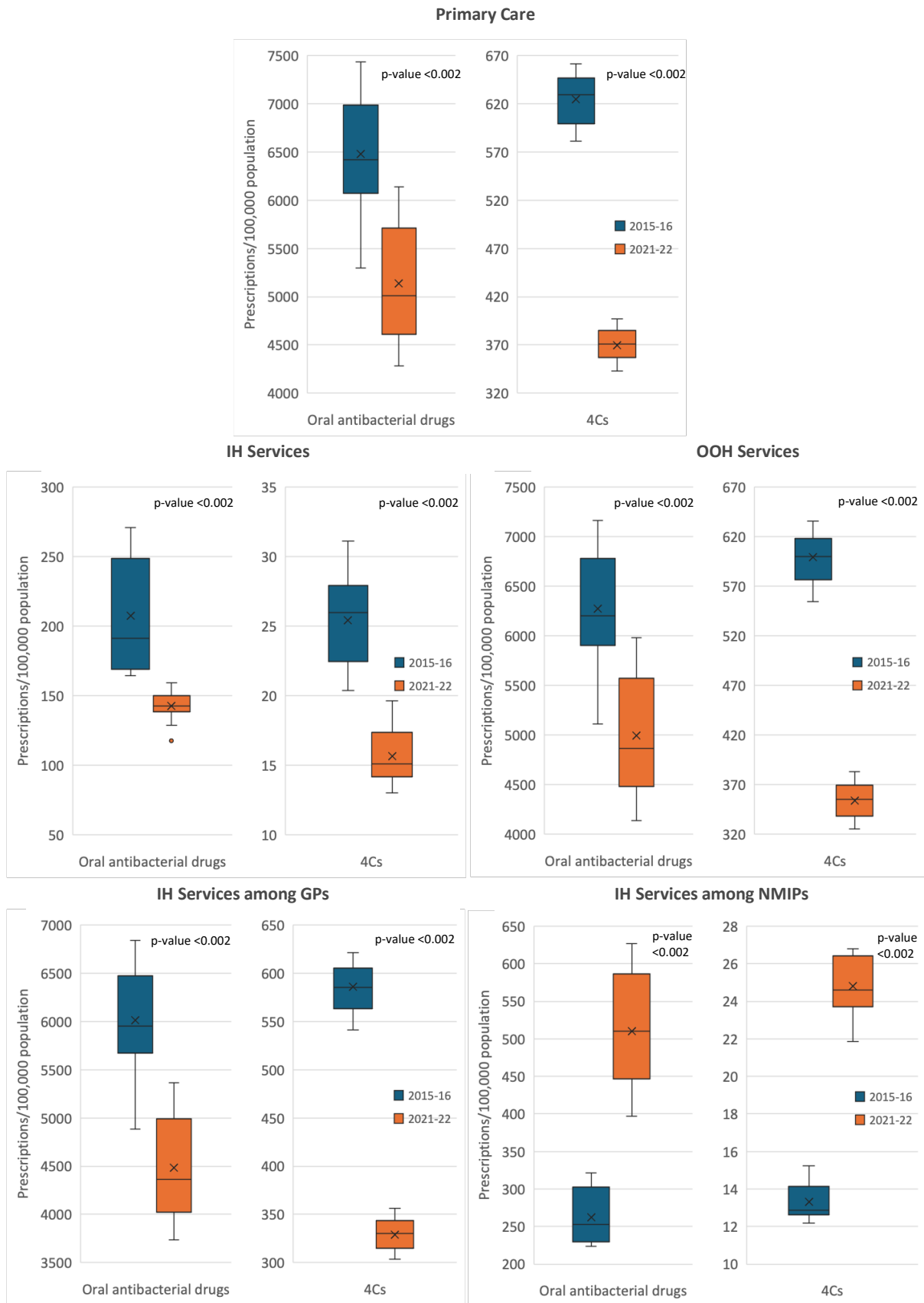


Figure 4.13: Change in Prescribing between the First and Last Examined Years

4.4.2 Phase II: Choose Pharmacy – PIPS Database

4.4.2.1 General PIPS Prescribing Volume

Since June 2020, the number of PIPS consultations has risen, predominantly during IH compared to OOH periods, peaking at 3,354 consultations in August 2022 for all consultations (Figure 4.14). Due to the smaller scale of OOH activity relative to total consultations, changes in OOH consultations, including increases, are less visible.

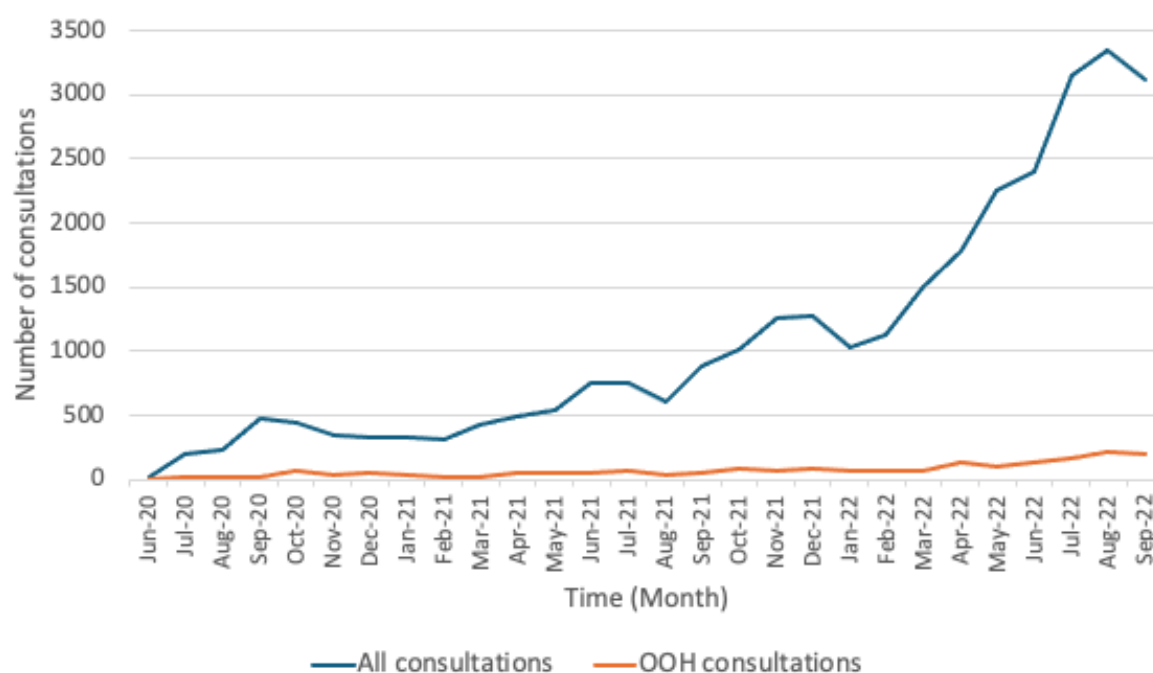


Figure 4.14: Monthly Consultations within the PIPS

Between June 2020 and September 2022, CPIPs across Wales conducted 30,401 PIPS consultations, with 29,256 items prescribed in 24,356 consultations (Table 4.11). Of the remaining 6,045 (19.9%) consultations where no items were prescribed, 2,105 (34.8%) resulted in referrals (e.g., GPs, emergency departments, optometrists, dentists), while 3,940 (65.2%) continued without prescription.

OOH consultations accounted for 1,961 (6.5%) of the total, resulting in 1,950 prescriptions (6.7% of prescribed items). In 279 (14.2%) consultations, no items were prescribed; 65 (23.3%) led to referrals, and 214 (76.7%) continued without prescription. The majority of all PIPS consultations (66.8%) and those during OOH periods (74.1%) resulted in a single item

being prescribed (Table 4.11; additional details on table categories, e.g., age and sex, are provided in the narrative that follows).

Table 4.11: Descriptive Overview of PIPS Consultations

Demographics (Service Users and Consultations)		All Consultations	OOH Consultations	OOH Consultations with Oral Antibacterial Drugs
Age in years at consultation	Mean (SD)	41.96 (22.27)	41.47 (22.76)	43.99 (22.16)
	Median (IQR)	40 (22-60)	40 (22-61)	44 (25-62)
	Range	0-99	0-93	1-92
Sex n (%)	Male	9,276 (30.5)	579 (29.5)	197 (25.5)
	Female	21,121 (69.5)	1,382 (70.5)	575 (74.5)
	Unspecified	4 (0.01)	0	0
Referred to pharmacy by n (%)	SRNGP	11,814 (38.9)	835 (42.6)	391 (50.7)
	GEPR	8,006 (26.3)	165 (8.4)	44 (5.7)
	OSERE	5,517 (18.2)	394 (20.1)	114 (14.8)
	SERE	3,803 (12.5)	428 (21.8)	141 (18.3)
	OTHP	466 (1.5)	41 (2.1)	26 (3.4)
	OHCP	405 (1.3)	24 (1.2)	7 (0.90)
	OTHER	249 (0.8)	13 (0.7)	8 (1.0)
	111	87 (0.3)	43 (2.2)	30 (3.9)
	OOH	40 (0.1)	18 (0.9)	11 (1.4)
	OPTOM	10 (0.03)	0	0
	A&E	4 (0.01)	0	0
Patient alternative action if the service was unavailable n (%)	Made GP appointment	27,600 (90.8)	1,233 (63.9)	409 (53.0)
	Attended A&E	159 (0.5)	31 (1.6)	18 (2.3)
	Called NHS Direct/111	350 (1.2)	172 (8.8)	101 (13.1)
	Made OOH appointment	824 (2.7)	396 (20.2)	229 (29.7)
	Bought medication from pharmacy	176 (0.6)	18 (0.9)	3 (0.4)
	Done nothing	357 (1.2)	23 (1.2)	3 (0.4)
	Made appointment with OHCP	921 (3.0)	88 (4.5)	9 (1.8)
	Made appointment with a nurse or HV	11 (0.04)	0	0
	Not stated	3 (0.01)	0	0

Key: %: percentage; 111: NHS Direct/NHS 111; A&E: accident and emergency; GEPR: general practitioner; HB: Health Board; HV: health visitor; IQR: interquartile range; n: number; OHCP: other healthcare professional; OOH: out-of-hours; OPTOM: optometrist; OSERE: other self-referral; OTHER: other; OTHP: other pharmacy; PIPS: Pharmacy Independent Prescribing Service; SD: standard deviation; SERE: self-referral; SRNGP: self-referral as unable to see GP.

Note: Highest percentages are highlighted in yellow.

Table 4.11: Descriptive Overview of PIPS Consultations (continued)

Demographics (Service Users and Consultations)		All Consultations	OOH Consultations	OOH Consultations with Oral Antibacterial Drugs
Consultation per HB n (%)	HB A	2,557 (8.4)	59 (3.0)	34 (4.4)
	HB B	6,117 (20.1)	278 (14.2)	17 (2.2)
	HB C	3,307 (10.9)	220 (11.2)	90 (11.7)
	HB D	5,588 (18.4)	717 (36.6)	307 (39.8)
	HB E	6,963 (22.9)	168 (8.6)	93 (12.1)
	HB F	262 (0.9)	46 (2.4)	26 (3.4)
	HB G	5,604 (18.4)	473 (24.1)	204 (26.6)
	Unspecified	3 (0.01)	0	0
	Total consultations	30,401	1,961 (6.5)	772 (2.5) (39.4 of OOH)
Number of items per consultation n (%)	None	6,045 (19.9)	279 (14.2)	0
	1 item	20,304 (66.8)	1,453 (74.1)	663 (73.6)
	2 items	3,309 (10.9)	192 (9.8)	91 (10.1)*
	3 items	650 (2.1)	35 (1.8)	16 (1.8)
	4 items	82 (0.3)	2 (0.1)	2 (0.2)
	5 items	10 (0.03)	0	0
	6 items	1 (0.00)	0	0
	Total items	29,256	1,950 (6.7)	901 items prescribed. Of these, 773 (85.8) were oral antibacterial drugs¶

?: percentage; HB: Health Board; n: number; OOH: out-of-hours.

*One consultation with two oral antibacterial drugs in HB D.

¶For 2–4 item consultations, only one antibacterial drug is usually prescribed except for one consultation, two oral antibacterial drugs were prescribed.

Note: Highest percentages are highlighted in yellow.

Weekend consultations accounted for the highest number of consultations and prescriptions among OOH periods. Most OOH consultations resulted in a single item prescription. Table 4.12 presents a breakdown of PIPS consultations across OOH periods.

Table 4.12: Detailed OOH Consultations and Prescriptions

Variable	Category	Number (%) or Proportion
Period of OOH consultations and number of items prescribed	Weekdays consultations	131 (6.7)
	• None	17 (13.0)
	• 1 item	102 (77.9)
	• 2 items	13 (9.9)
	• 3 items	0
	• 4 items	0
	Weekend consultations	1,696 (86.5)
	• None	243 (14.3)
	• 1 item	1,251 (73.8)
	• 2 items	166 (9.8)
	• 3 items	34 (2.0)
	• 4 items	2 (0.1)
	Bank holiday consultations	134 (6.8)
	• None	19 (14.2)
	• 1 item	100 (74.6)
	• 2 items	13 (9.7)
	• 3 items	1 (0.75)
	• 4 items	0
	All OOH consultations	1,961 (100)
	• None	279 (14.2)
	• 1 item	1,453 (74.1)
	• 2 items	192 (9.8)
	• 3 items	35 (1.8)
	• 4 items	2 (0.1)
Number of items prescribed in OOH consultations	All items	1,950 (100)
	Oral antibacterial drug	773 (39.6)
	Oral 4Cs	14 (0.7 to all items) (1.8 to oral antibacterial drugs)
Oral antibacterial drugs within OOH consultations per period	Weekdays consultations	33 (4.3)
	Weekend consultations	685 (88.6)
	Bank holiday consultations	55 (7.1)
	Total	773 (100)

4Cs: amoxicillin-clavulanate, cephalosporins, clindamycin, and fluoroquinolones; OOH: out-of-hours.
 Note: Highest percentages are highlighted in yellow.

4.4.2.2 Characteristics of PIPS Users

4.4.2.2.1 Age and Sex

Overall, patients visiting PIPS ranged in age from newborns to 99 years, with a mean age of 41.96 years. Females accounted for nearly 70% of users (Table 4.11). The demographic profile of OOH attendees was similar, with a mean age of 41.47 years and 70.5% female

users. Across both IH and OOH periods, most PIPS consultations were for adults aged 18–64 years, followed by those aged 65 and older (Table 4.13).

Table 4.13: Age Breakdown Based on the National Institutes of Health

Age Group in Years	All Consultations (n=30,401)	OOH Consultations (n=1,961)	OOH Consultations with Antibacterial Drug (n=772)
Newborns & Infants (<1)	100 (0.3)	11 (0.6)	0
Children (1–12)	2,345 (7.7)	174 (8.9)	62 (8.0)
Adolescents (13–17)	1,441 (4.7)	103 (5.3)	36 (4.7)
Adults (18–64)	20,508 (67.5)	1,284 (65.5)	507 (65.7)
Older adults (65+)	6,003 (19.8)	389 (19.8)	167 (21.6)
Unspecified	4 (0.01)	0	0

OOH: out-of-hours

Note: Data shown are numbers and percentages n (%), with highest percentages highlighted in yellow.

4.4.2.2.2 Reasons for Consulting the PIPS and Alternative Actions

The majority of patients (all consultations: 69.6%; OOH consultations: 84.5%) presenting to PIPS self-referred to the service. This includes the following categories: self-referral as unable to see GP (SRNGP), self-referral (SERE), and other self-referral (OSERE). Among these, over half reported being unable to schedule a GP appointment (SRNGP, all consultation: 38.9%; OOH consultations: 42.6%). GP referrals were the second most common source, accounting for 26.3% of all consultations and 8.4% for those during OOH periods. A vast majority of patients (90.8% of all consultations; 63.9% of OOH consultations) indicated they would have sought a GP appointment if PIPS had not been available. Notably, one in five OOH users stated that they would have accessed OOH services instead, compared to only 2.7% of all-time PIPS users. Further details are presented in Table 4.11.

4.4.2.2.3 PIPS Consultations Across HBs

Across Wales, HB E represented the highest PIPS utilisation (22.9%), followed by HB B, where one-fifth of all consultations were made, HB G (18.4%), and HB D (18.4%). During OOH periods, however, HB D accounted for greatest proportion of over one-third of OOH consultations, followed by HB G (24.1%), and HB B (14.2%) (Table 4.11).

4.4.2.3 Oral Antibacterial Drug Consultations During OOH Periods

Of all OOH consultations, 772 resulted in oral antibacterial item being prescribed (773 items, 39.6% of OOH items), corresponding to a prescribing proportion of 39.4%. Female patients accounted for approximately three-quarters (74.5%) of these consultations (Table 4.11).

Because UTIs are more prevalent in females, analyses were conducted excluding UTI diagnoses to examine sex distribution across other conditions. Females still represented a higher proportion of consultations (268; 60.2%) resulting in an oral antibacterial prescription than males (177, 39.8%). Over 80% of those prescribed oral antibacterial drugs during OOH periods were self-referred (including SRNGP, OSERE, and SERE), with 50.7% reporting difficulty accessing a GP (SRNGP). More than half (53.0%) indicated they would have made a GP appointment if the service did not exist, while almost 30% would have used OOH services (Table 4.11).

HB D had the highest consultation proportion (39.8%) resulting in oral antibacterial being prescribed, followed by HB G (26.6%). Although lower, OOH antibacterial prescribing followed a pattern similar to overall prescribing (Figure 4.15).

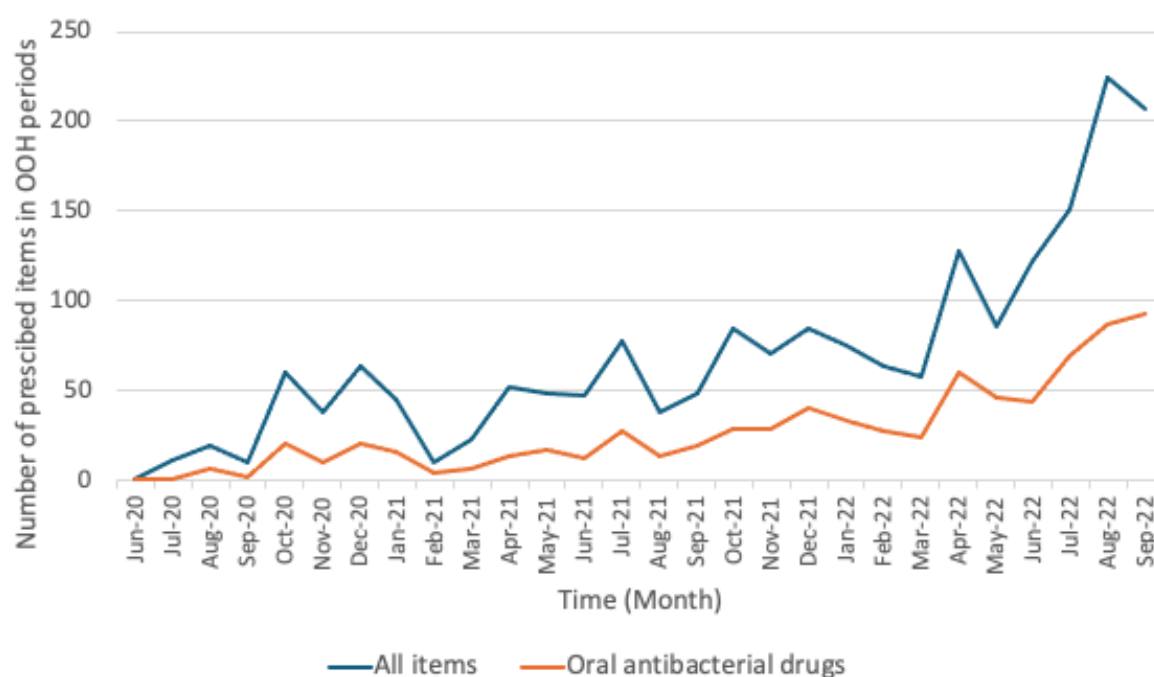


Figure 4.15: Monthly Prescribing within the PIPS During OOH Periods

OOH consultations and oral antibacterial prescribing during these periods increased annually and predominantly occurred during weekends. These accounted for 86.5% of OOH consultations and 88.6% of prescribed oral antibacterial items, exceeding those during weekday evenings and nights and bank holidays (yearly distribution is shown in Figures 4.16 and 4.17).

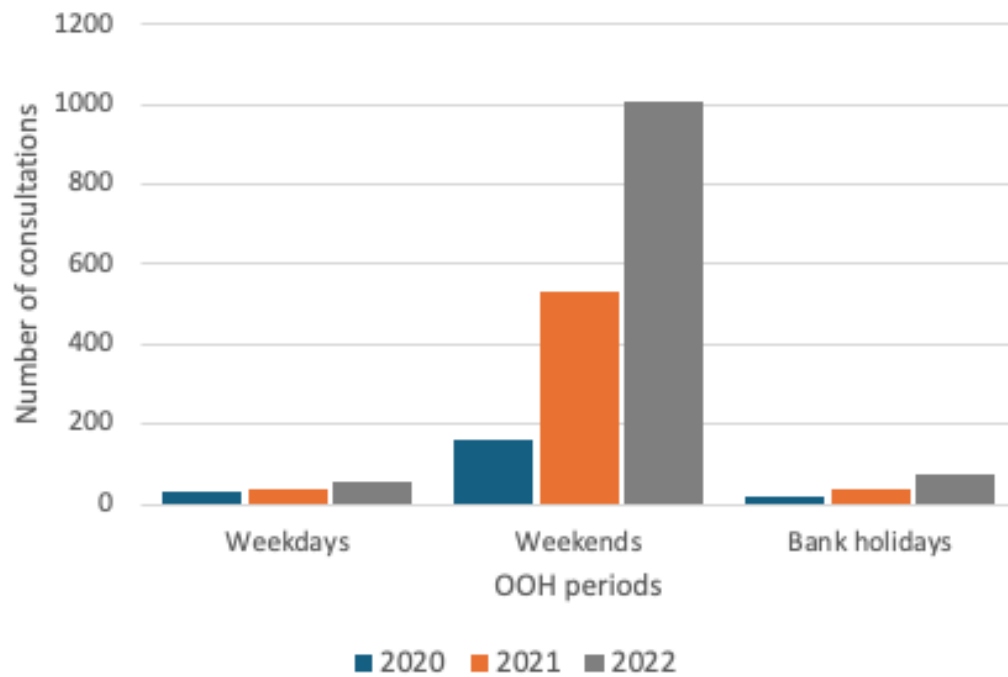


Figure 4.16: Distribution of PIPS Consultations per Year During OOH Periods

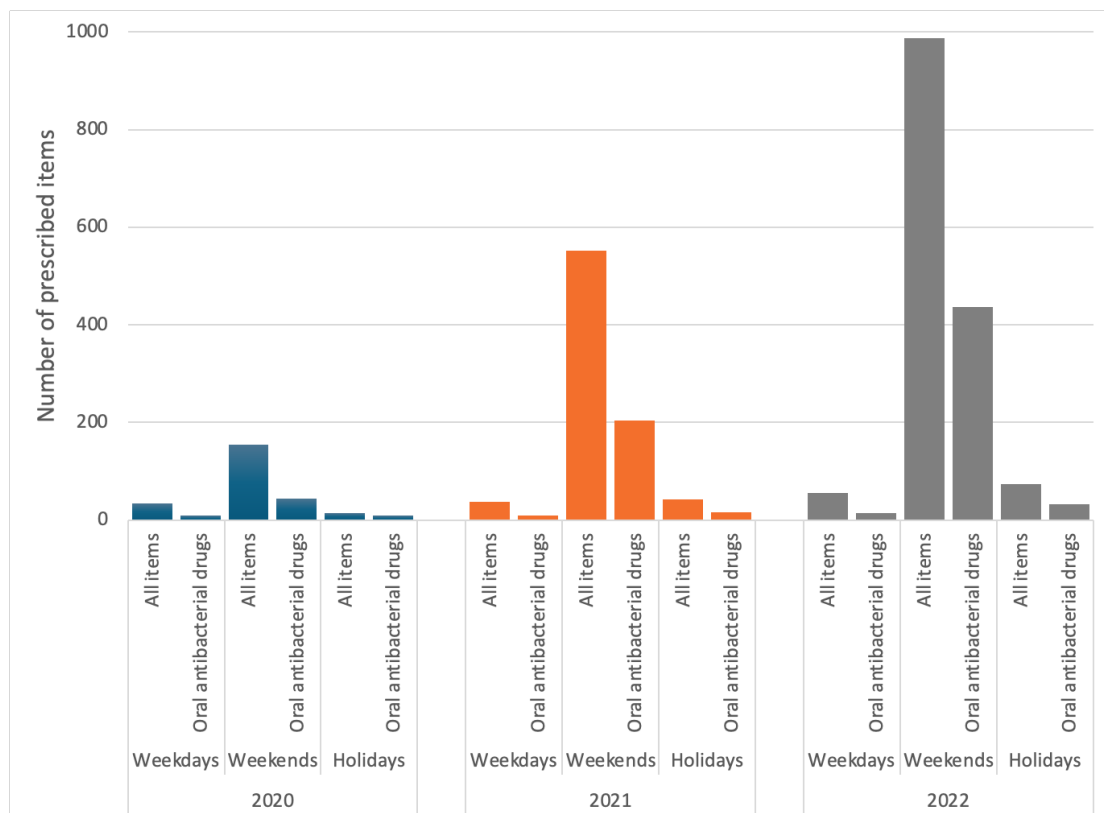


Figure 4.17: Distribution of Items Prescribed within the PIPS per Year During OOH Periods

4.4.2.4 Common Medical Conditions and Associated Oral Antibacterial Items

Overall, UTIs (327 cases, 42.3%) were the most common indication for oral antibacterial prescription during OOH periods (Table 4.14). These were mainly lower UTIs (320 cases, 41.4% of all conditions) which accounted for 97.9% of all UTI cases. Only a few were upper UTIs or pyelonephritis (7 cases, 0.91% of all conditions), representing 2.1% of UTIs. Sore throat/tonsillitis (107 cases, 13.8% of all conditions) and skin infections (84 cases, 10.9% of all conditions) were the second and third most frequent diagnoses leading to oral antibacterial prescriptions, respectively (Table 4.14).

Table 4.14: Medical Conditions with Oral Antibacterials Prescribed During OOH Periods

Medical Condition	Prescription Items n (%)
Lower urinary tract infections	320 (41.4)
Sore throat or tonsillitis	107 (13.8)
Skin infections	84 (10.9)
Chest infections†	46 (6.0)
Other¶	46 (6.0)
Skin reactions	40 (5.2)
Otitis media	27 (3.5)
Wounds	24 (3.1)
Out of scope†	22 (2.9)
Cysts, boils, or lumps	18 (2.3)
Sinusitis	15 (1.9)
Otitis externa	11 (1.4)
Upper urinary tract infections	7 (0.9)
Cough	6 (0.8)
Total	773 (100)

†Medical conditions outside PIPS specification, such as chest infections and other out of scope (e.g., dental-related)

¶Unclear/multiple diagnoses

During OOH consultations, 14 different oral antibacterials were prescribed, comprising 773 items (Table 4.15). Nitrofurantoin, prescribed exclusively for UTIs, was the most prescribed (243, 31.4%), followed by flucloxacillin (167, 21.6%) and amoxicillin (116, 15.0%) frequently prescribed for skin infections (31% of cases) and chest infections (34% of cases), respectively. Combination of oral antibacterial drugs was rare, with only one case in HB D involving trimethoprim-sulfamethoxazole and metronidazole for a diverticulitis flare-up.

Table 4.15: Oral Antibacterial Prescribed During OOH Periods

Oral Antibacterial Drugs	Prescription Items n (%)
Nitrofurantoin	243 (31.4)
Flucloxacillin	167 (21.6)
Amoxicillin	116 (15.0)
Penicillin V	95 (12.3)
Trimethoprim	58 (7.5)
Clarithromycin	47 (6.1)
Fosfomycin	12 (1.6)
Doxycycline	11 (1.4)
Amoxicillin-clavulanate	8 (1.0)
Pivmecillinam	7 (0.9)
Ciprofloxacin	5 (0.7)
Metronidazole	2 (0.3)
Cefalexin	1 (0.1)
Trimethoprim-sulfamethoxazole	1 (0.1)
Total	773 (100)

Of the 14 oral antibacterials prescribed during OOH periods, three were from the 4Cs, accounting for 1.8% of oral antibacterials and less than 1% of all items. Amoxicillin-clavulanate (n=8) was mostly prescribed for bites and wound infections (six cases), while ciprofloxacin (n=5) and cefalexin (n=1) were prescribed for upper and lower UTIs. These 14 prescriptions occurred in three HBs (Table 4.16). Eleven of these 4C prescriptions were appropriate according to MicroGuide™ recommendations. Of the remaining three (one per HB), two involved amoxicillin-clavulanate advised by GP OOH for a suspected upper UTI and a wound infection, but these did not align with MicroGuide™ recommendations. The third was ciprofloxacin prescribed to an elderly patient with renal and cardiac comorbidities presenting with a suspected UTI, for which appropriateness could not be determined based on the information given.

Table 4.16: Prescribing of 4Cs within the HBs

HB	Amoxicillin-clavulanate	Ciprofloxacin	Cefalexin
HB D	3	4	0
HB E	1	0	1
HB G	4	1	0

4Cs: amoxicillin-clavulanate, cephalosporins, clindamycin, and fluoroquinolones; HB: health board

4.5 Discussion

This study presents the first quantitative analysis of oral antibacterial prescribing in primary care OOH services in Wales alongside providing important findings on broader primary care prescribing. It is also the first to investigate prescribing within community pharmacies under PIPS during OOH periods since its implementation. Furthermore, the study offers a basic understanding of the characteristics of PIPS users, focusing on those prescribed oral antibacterial drugs outside regular hours. Relating findings across CASPA and PIPS data is limited by the fact that the timeframes and the level of information available from each is different. However, efforts were made to interpret the findings in relation to each other, where possible.

4.5.1 Oral Antibacterial Prescribing in Wales

Following the 2016 review by Jim O'Neill on AMR, which stressed the urgent need for effective AMS (O'Neill 2016), the UK Government made concerted efforts to combat the resistance crisis. They set a target soon after in 2016 to halve prescribing by 2020 (DHSC 2016). In 2019, the UK 20-year vision for AMR and 5-year NAP were introduced to continue these efforts, with the latter aiming for a 15% reduction in human use by 2024 as a step toward the long-term vision (DHSC 2019b).

Within the scope of this study, CASPA data showed that the reduction goal was not only met but was exceeded for oral antibacterial prescribing in primary care in Wales, including both IH and OOH services. Between 2015–16 and 2020–21, prescribing fell by 30%, although a subsequent rise in 2021–22 reduced the overall decline to 21% for the entire period. In 2019–20, the year the first NAP was published, prescribing dropped by 20% in the following year. However, it is important to note that the CASPA data analysed covers a timeframe that does not exactly match the NAP targets (2019–24), and reductions observed during this period should be interpreted cautiously. The decline coincided with the first year of COVID-19, when fewer face-to-face consultations, reduced circulation of RTIs due to public health measures, and shifts in healthcare-seeking behaviour likely contributed to lower prescribing (discussed further below). By 2023, Wales achieved a 15% reduction in antibacterial prescribing in general practice compared with 2014 (Public Health Wales 2024b; Welsh Government 2024b), whereas the UK as a whole fell short, achieving over an 8% reduction

from 2014 levels (UK Government 2024). This suggests the relative success of Wales in reducing unnecessary antibacterial use in primary care.

At a regional level, Wales also releases NPIs annually, which set ambitious yet achievable targets for HBs. For 2022–23, these included a 5% reduction in primary care prescribing of all antibacterial drugs (measured as total items per 1,000 STAR-PU [specific therapeutic group age-sex related prescribing units]) and a 10% decrease in 4Cs (measured as combined items per 1,000 patients) every quarter year, using 2019–20 as the baseline (AWMSG 2022b). Although measured differently, CASPA data from the present study revealed an overall downward trend in oral antibacterial prescribing in Wales primary care during IH and OOH services, despite variations among HBs, indicating progress toward UK and Wales pre-set targets. These findings align with English primary care data, which examined prescribing trends of commonly prescribed antibacterial drugs between 2014 and 2022 (McCloskey et al. 2023). That study reported a consistent decline in prescribing volumes of all drugs, although a temporary increase was observed around the onset of COVID-19 in 2020, before volumes started to return to pre-pandemic levels.

Reductions in Wales overall prescribing were more pronounced in OOH service, which declined from 2,492 to 1,713 items per 100,000 population (a 31% reduction) between in 2015–16 and 2021–22, compared to IH services, where prescribing fell from 75,282 to 59,949 items per 100,000 population (a 20% reduction) over the same period. Although the absolute decrease in OOH is smaller, this likely reflects the relatively low proportion of prescribing in these services, which accounts only for 2.7% to 3.2% of total annual primary care prescribing. These figures are relatively lower than those reported in England by Zhu et al. (2021b) between 2016 and 2020 and earlier by Edelstein et al. (2017) between 2010 and 2014, ranging from 3.3% to 3.6% and 4.5% to 5.4%, respectively. The smaller absolute reduction in OOH prescribing also suggests that prescribing decisions in these settings may require tailored approaches. These services face unique challenges, such as resource constraints, limited safety netting, and unfamiliar patients with potentially more critical conditions, which may benefit from targeted strategies.

International evidence illustrated some differences in prescribing tendency between IH and OOH services. In Belgium, most GPs reported that they tend to prescribe antibacterial drugs at a lower threshold during OOH care than during regular hours (Colliers et al. 2018).

Similarly, studies from Australia, Sweden, and Norway showed that patients consulting OOH services were more likely to receive antibacterial prescriptions (Baker et al. 2020; Cronberg et al. 2020; Haugom et al. 2021). System-level factors may have a role in shaping OOH prescribing patterns. For instance, Belgium lacks a triage system, allowing unrestricted patient access to care (Colliers et al. 2018), potentially increasing demand for medications. Moreover, OOH services during weekends are organised by GPCs, which may cause a sense of isolation and limited access to diagnostic tools, prompting more cautious prescribing. Additionally, unlike the UK, all GPs are required to work in OOH care, and nurses are not authorised to prescribe, placing additional pressure on GPs. In Sweden, known for low antibacterial prescribing, the setup is different, with patients able to access OOH services for a fee via nurse triage or walk-in (Cronberg et al. 2020). Given the differences between IH and OOH services across healthcare systems, it appears crucial to develop AMS strategies that are tailored to each country's needs.

While Wales overall primary care prescribing has declined, prescribing by NMIPs has increased over time based on data from IH services. This reflects the growing number of NMIPs and their expanding clinical roles, including in oral antibacterial prescribing. Similar trends were reported by Alghamdi et al. (2020) and Deslandes et al. (2022), who found that the number of items prescribed in Wales primary care increased during their study periods, including those for infections (Deslandes et al. 2022). However, Deslandes et al. (2022) noted that infection-related prescribing declined toward the end of their study. Alghamdi et al. (2020) further documented a 108% and 325% increase in nurse IPs and PIPs, respectively, between 2011 and 2018 in primary care. This growth was likely driven by the WG's plan emphasising the need to utilise NMIPs' skills in primary care. The WG and HBs promoted prudent healthcare by introducing GP clusters and funding education and training to expand posts in GP practices (Welsh Government 2015c). Many NMIPs subsequently moved from secondary to primary care roles (Hodson et al. 2017), including positions in OOH services. These developments place NMIPs as a vital part of the primary care workforce that may address staffing pressures and improve care access.

The upward trend in NMIP prescribing seen in CASPA data, although drawn from IH services, is mirrored by PIPs, which showed growth in oral antibacterial prescribing among CPIPs since its pilot in 2020. Early prescribing volumes were low, possibly due to the limited

number of qualified CPIPs and the relatively few community pharmacies delivering PIPS, especially during OOH periods. Additionally, the narrow scope of CPIPs' practice, mostly shaped by early HB commissioning priorities (e.g., UTIs, contraception), may have influenced antibacterial prescribing volumes. Many CPIPs may also have initially felt confident prescribing only within their initial scope of practice that did not involve antibacterials, such as contraception, and gradually expanded to manage acute infections (RPS 2022). Over time, the steady increase in prescribing benefitted from the growing PIPs workforce in Wales overall, reaching 29% in 2022 (Burns 2022), and by CPIPs expanding their scope of practice. This growth was further supported by the April 2022 national rollout and the release of a service specification which included many infections. As the service became more established, it expanded to additional sites to meet rising demand, contributing to the WG's vision of 'A Healthier Wales', which promotes accessible care delivered as close to home as possible (Welsh Government 2018b).

The study revealed that 39.4% of PIPS contacts during OOH periods involved an oral antibacterial being prescribed. A comparable figure could not be calculated for CASPA data. However, Giesen et al. (2006) reported that infectious conditions are among the top reasons for seeking OOH care, potentially leading to higher antibacterial prescribing. Given the evolving role of CPIPs and the wider establishment of the service, it would be valuable to examine whether prescribing within PIPS in Choose Pharmacy and CASPA has changed in recent years, particularly since most examined data relate to the PIPS pilot phase and pre-COVID-19 period in CASPA.

Due to the lack of evidence on community pharmacy prescribing during OOH periods, comparison with existing literature in similar settings was not possible. However, the present study identified a higher proportion of encounters resulting in antibacterial prescriptions than those reported in previous primary care OOH research. For example, Lindberg et al. (2017) and Rebnord et al. (2017), who exclusively studied respiratory conditions in Norway, reported antibacterial prescribing rates of 34.2% (14.7% of all OOH encounters) and 23%, respectively. In Iceland, 33.1% of all primary care OOH contacts resulted in an antibacterial prescription (Palsdottir et al. 2020), while studies from Denmark and England reported rates of approximately 20% in paediatric primary care OOH settings (Lous et al. 2019; Edwards et al. 2020). These variations suggest the need to consider factors

that could influence prescribing rather than focusing on volumes alone, such as variations in healthcare models across settings (community pharmacy versus GP surgery) and countries. Additionally, prescribing may be shaped by differences in population use patterns (e.g., preferences, reasons for consultations, and types of conditions managed) as well as the availability of experienced HCPs, operating hours, and accessibility of OOH services (e.g., triage systems or fee-for-service). National differences in policies, regulations, resources, and guidelines may also influence prescribing practices.

4.5.1.1 Impact of COVID-19 on Prescribing

The overall decline in prescribing signifies prescribers' efforts to enhance practice and comply with the UK NAP and Wales targets aimed at reducing unnecessary prescribing and promoting reasonable use. While the NAP goals are nationwide, Wales has made a notable contribution to AMS in these settings, as reflected by reductions in prescribing. Though, it is crucial to consider other factors, particularly during and after 2020–21, when prescribing volumes reached their lowest.

The COVID-19 pandemic considerably impacted care delivery and public health-seeking behaviours (Murphy et al. 2020; UKHSA 2021a). In response to rising cases, the UK Government imposed infection control measures and multiple nationwide lockdowns starting in March 2020, with subsequent lockdowns in November 2020 and January 2021, varying in severity and duration. These aimed to control virus transmission by limiting person-to-person contact, with measures gradually eased or tightened as the situation evolved (Institute for Government analysis 2022). In March 2020, GP surgeries were instructed by the Government to conduct consultations remotely, reserving in-person appointments for urgent cases only (Downey 2020; Murphy et al. 2021). These measures altered patients access to care, leading to a rise in self-management, especially for RTIs (UKHSA 2021a).

A study in Wales examined primary care antibacterial prescribing and revealed a reduction in dispensed prescriptions since the pandemic began, predominantly for narrow-spectrum drugs and those used for RTIs (Wasag et al. 2021). This decline is likely attributed to the above-stated reasons and ongoing efforts to meet UK NAP goals. These findings align with the present study, which observed a downward trend in CASPA prescribing data, including OOH services, with the greatest reduction in 2020–21 during peak restrictions. However, as

this study covered only one year after the pandemic's onset, when prescribing levels began to rise, further research and monitoring is needed.

Community pharmacists played an important role as accessible HCPs, especially early in the pandemic when many services incorporated remote delivery options (Welsh Government 2020). However, because COVID-19 coincided with the PIPS pilot, its impact on prescribing is difficult to examine. Therefore, findings should be interpreted cautiously, with further evaluation needed now that the service is established.

4.5.1.2 Prescribing Variations Across HBs

Although overall prescribing in Wales declined, variations were observed across individual HBs. Factors beyond COVID-19, remote consultations, and anticipated behavioural changes likely contributed to these differences. One notable aspect is the restructuring that occurred in April 2019, which changed the names and boundaries of two HBs (Welsh Government 2019e). Abertawe Bro Morgannwg University Health Board (ABMUHB) became SBUHB and ceased serving the Bridgend area, which was transferred to Cwm Taf University Health Board (CTUHB), renamed CTMUHB later. These changes may have affected prescribing trends within these HBs due to shifts in population size, demographics and prescriber numbers. Consequently, part of the variation in prescribing among these HBs may reflect the structural adjustments rather than true changes. These could have influenced the population base used to generate prescribing figures, potentially affecting the comparability of HB-level data over time, although the extent of this impact is unclear. This limitation should therefore be considered when interpreting the HB observed trends.

It is also plausible that individual HBs may have implemented locally developed AMS interventions or provided tailored support to their HCPs (e.g., resources, training, or guidance). For instance, according to CASPA data, HB C showed an upward trend in OOH prescribing despite having the lowest overall volume, whereas a substantial reduction was observed for HB D that had highest prescribing initially. Therefore, exploring possible HB-level interventions (e.g., through case studies) may inform their adoption across other HBs, supporting collaborative approaches.

Regional variations were also evident in PIPS data, which revealed differences in consultation numbers and prescribing volume across HBs, with HB D and G contributing to the higher visit and prescribing volumes during OOH periods. These variations likely arise

from several factors, such as differences in geographical areas, population demographics, healthcare needs, and service availability, including the number of CPIPs and pharmacies offering PIPS. Additionally, when the service was first implemented, each HB tailored prescribing areas to their population's needs. For instance, CVUHB focused on contraception while CTMUHB prioritised UTIs, but over time, some expanded CPIPs' prescribing authority beyond their original scope as confidence and demand grew. As this information is not readily available, comparisons across HBs were not possible.

4.5.2 PIPS Utilisation

4.5.2.1 Age and Sex

The number of consultation and prescribing volumes within PIPS seem to vary by individual demographics, particularly age and sex. While the mean and median ages of PIPS users differed slightly at all-time and all-OOH consultations, they were almost identical for those receiving an oral antibacterial drug during OOH periods, suggesting a normal age distribution.

Examining age based on the NIH classification showed that adults aged 18–65 years represented the largest proportion of PIPS attendees, followed by those over 65. The broad range covered by this age bracket may explain this pattern, and further analysis of subgroups within this category could help identify differences in service use. Additionally, difficulty accessing healthcare during standard hours has been identified as a potential factor to visit OOH services (Yin et al. 2015). This age group primarily comprises workforce individuals who may encounter employment or family responsibilities (Fieldston et al. 2012; Nørøxe et al. 2017) that restrict their ability to attend IH appointments. Therefore, they often choose to seek alternative services, such as OOH, for convenience and timely access. Older individuals, the second-highest group, are more likely to experience age-related biological changes resulting in weakened immunity and compromised organ functions (Bajaj et al. 2021). This increases their susceptibility to infections and chronic illnesses, such as chronic obstructive pulmonary disease and renal impairment, which can lead to acute exacerbations. Consequently, they may require more frequent and timely medical attention, including through PIPS.

In terms of sex, females represented the majority of PIPS patients across all levels examined. This aligns with an earlier evaluation of Choose Pharmacy CAS, which showed higher female

engagement with the service, with approximately two-thirds of registered users and consultations being females (Welsh Government 2015a). This has also been observed in UK GP practices for minor ailment consultations, where females accounted for 60% of consultations (Pillay et al. 2010).

The present findings are also in line with studies on general primary care OOH services (Huber et al. 2011; Turner et al. 2017), and those focusing on infectious conditions, such as respiratory and urinary infections, where females sought care more often (Lindberg et al. 2017; O'Connor et al. 2019; Palsdottir et al. 2020; Spek et al. 2020). Hayward et al. (2016) reported a positive correlation between female sex and the increased likelihood of receiving antibacterial prescriptions in primary care OOH consultations in England. Despite differences in settings, countries, and healthcare systems setups, particularly during OOH periods, this consistent pattern validates the observed sex-related variation in healthcare utilisation. Understanding this could inform targeted strategies, such as educational campaigns to meet population needs, and resource planning to promote equitable access to care.

Numerous reasons may explain the observed sex variation in PIPS consultations. One likely contributing factor is the difference in health-seeking behaviour, with males generally less likely than females to seek medical advice for both mental and physical health concerns (Thompson et al. 2016; Andreas et al. 2020). The same pattern was observed even when reproductive-related consultations, such as pregnancy and birth, were discounted (Yingying et al. 2013). Gendered cultural and social norms may also influence health behaviours, as seeking medical help may be perceived as a behaviour that contradicts masculine traits, discouraging males from accessing healthcare services (Creighton and Oliffe 2010).

Structural and biological factors further contribute to these differences (Urology Care Foundation 2022), with certain conditions, such as UTIs, being far more common among females. According to the Urology Care Foundation, approximately 60% of females experience at least one UTI episode in their lifetime, compared to 12% of males. In the present study, UTIs were the leading medical condition for oral antibacterial prescriptions during OOH PIPS consultations. However, even when UTI cases were excluded from OOH consultations involving antibacterial drugs, females still constituted the majority of these consultations.

4.5.2.2 Consultations Time

Most PIPS consultations during OOH periods occurred on weekends, accounting for 86.5% of all consultations. Similarly, weekends represented 88.6% of oral antibacterial items issued during OOH consultations compared to weekdays and bank holidays. These findings align with Hayward et al. (2016), who analysed four years of retrospective data to describe antibacterial prescribing demographics and compare prescribing trends between IH and OOH services. They found that about 75% of antibacterial prescriptions in primary care OOH settings were dispensed over weekends. This is likely because weekends occur more frequently than bank holidays and offer extended, more convenient hours, especially for full-time workers.

It is plausible that limited safety netting, particularly on weekends, may lead to higher prescribing rates, as reported by other HCPs working OOH (Williams et al. 2018). Patients may have to wait longer before accessing the care needed, e.g., from GPs, on weekends compared to weekdays. This potential delay may prompt HCPs working OOH, including CPIPs, to prescribe more during weekends as a precaution to ensure timely treatment.

4.5.2.3 Reasons for Consulting Community Pharmacy PIPS and Alternative Actions

Most patients accessing PIPS were self-referred, primarily due to difficulties in securing GP appointments. However, this may also suggest growing awareness of the service, patient familiarity, and trust in CPIPs' competence. Other factors that may influence patients' preference for CPIPs include their flexibility, accessibility, and the potential for longer consultation compared to time-limited GP appointments (Mann et al. 2017; Mantzourani et al. 2023). Limited GP availability, particularly during OOH periods, may further drive patients toward alternative care. In some regions, barriers such as long-distance travel expenses or the cost of private medical services make CPIPs a more convenient option. Patients also benefit from the flexibility to have prescriptions filled free of charge at the same pharmacy where they received PIPS or at another location of their choice (NHS Wales Shared Services Partnership 2022).

Access to community pharmacy is generally high across the UK. In England, 89.2% of the population live within a 20-minute walk of a pharmacy, rising to 99.8% in the most deprived areas (Todd et al. 2014). Additionally, more people live within this distance of a pharmacy than a GP surgery (Todd et al. 2015), and this coverage has further increased to 91.7% in

2023 (Zied Abozied et al. 2025). However, differences in pharmacy opening hours and available services should be considered. Moreover, with funding cuts, pharmacy closures have disproportionately affected deprived areas, potentially limiting access where it is most needed (Zied Abozied et al. 2025). In Wales, most of the population live within two miles of a community pharmacy, with evidence showing a significant correlation between CAS use and deprivation, as pharmacies in most deprived areas deliver more consultations (Thayer et al. 2023). Further research is needed to determine whether PIPS use follows a similar pattern, and how this could inform policies to ensure equitable access to services. Currently, not all pharmacies have a PIP, and even when the WG strategy of placing a PIP in each pharmacy is fulfilled, they may not provide the full range of services defined in the service specification. Achieving equitable access would therefore require both PIP presence and consistent delivery of full PIPS.

The high proportion of self-referrals to PIPS may also suggest a positive sentiment towards the service accessibility and care provided. Previous research has reflected the high perceived level of patient's satisfaction with PIPs' services and recommendations provided in primary care (Stewart et al. 2009; Alshehri et al. 2023), highlighting the value patients place on the quality and thoroughness of the conversations they have with their pharmacists. While most patients in the present study used the service due to inability to consult a GP, further research into their motivations for choosing PIPS over alternative options, as well as their satisfaction with the service could help enhance its delivery and overall patient experience. Ongoing work within Cardiff University reviewing patient feedback on the service is expected to contribute to this understanding.

In the absence of PIPS, most patients indicated that they would schedule a GP appointment, highlighting the value of PIPs. Integrating PIPs into frontline roles, as highlighted in the Crown report (DH 1999) when non-medical prescribing was first proposed, supports timely access to advice and treatment while utilising their clinical expertise. This also promotes seamless collaboration among HCPs to deliver patient-centred care. This integration could alleviate some pressure on GPs and help rebalance their workload, as shown in previous research (Stewart et al. 2009; Alshehri et al. 2023; Lewis 2023; Mantzourani et al. 2023).

Integrating such a role may also have far-reaching benefits beyond the settings in which it was implemented. It can help address issues like GP shortages (Geissler 2019; Welsh

Government 2023d), particularly in rural areas of North Wales (BCUHB) where GP recruitment and retention remain challenging (Brennan 2017). These shortages are often accompanied by reduced accessibility, increased workload, difficulty filling vacancies, and reliance on locum staff. Additionally, this approach contributes to more efficient utilisation of NHS resources, particularly in GP consultations. Estimates suggest that the average 9-minute GP appointment costs £39.23, compared to the mere £14 for a minor ailment consultation in community pharmacies (Jones and Burns 2021; Pharmaceutical Services Negotiating Committee 2022). These figures highlight the potential cost savings from redirecting appropriate cases to community pharmacists.

Further exploration of PIPS implementation is crucial to identify challenges and opportunities for improving care delivery. Meanwhile, pharmacists must continue developing their skills to provide high-quality, patient-centred care. Establishing a supportive environment that enables them to do so, through appropriate staffing, sufficient resources, and improved communication with other HCPs, is therefore essential. Moreover, allocating protected time for education, training, and professional development is necessary to maintain growth and competence (Health Education and Improvement Wales 2022). Prioritising these measures is likely to benefit the NHS, all stakeholders involved, and most importantly, patients' outcomes, with potential extended impact on OOH services.

Recent developments in community pharmacy represent an important step forward. In England, Wales, and Scotland, pharmacy technicians are currently authorised to supply and administer medicines via Patient Group Directions (PGDs), except for controlled drugs (DHSC 2024). PGDs are written instructions authorising the supply or administration of medicines to patients in predefined clinical situations (Welsh Medicines Advice Service 2024). Additionally, the WG has provided funding for pharmacies to support the adoption of innovative automated technologies, such as dispensing robots and 24-hour Automated Teller Machine style prescription collection systems to enhance efficiency and patient convenience (Welsh Government 2021b). These changes could free pharmacists' time to focus on clinical care and prescribing, support service expansion, and ensure optimal use of the wider pharmacy workforce.

4.5.2.4 Prescribing of 4Cs

Prescribing of 4Cs by CPIPs during OOH periods was generally low, with only 14 (1.8%) of 773 oral antibacterials prescribed involving these high-risk drugs. Evaluation of 4C selection in this study showed that all but one were issued in accordance with MicroGuide™ recommendations (Induction Healthcare Group n.d.), or based on GP OOH guidance. While comparable CASPA data are unavailable, the low prescribing observed in PIPS likely reflect broader declining trends in primary care IH and OOH use of these drugs, except for NMIP prescribing, which CASPA data indicate has been increasing. However, this increase may correspond to the growing number of NMIPs in primary care seeing more patients, rather than inappropriate prescribing. Given their association with increased risk of *Clostridium difficile*-associated diarrhoea, the 4Cs should only be used when clinically necessary (Marwick et al. 2013; NICE 2015b). The perceived competence and mindfulness of CPIPs in their prescribing, particularly when it comes to these high-risk drugs, contribute positively to rational prescribing and patient safety.

It should be acknowledged, however, that the assessment of prescribing choices against MicroGuide™ recommendations was conducted several months to three years after the original consultations. Potential updates to first-line therapy recommendations during this period should therefore be considered as a limitation of the analysis.

4.5.2.5 Most Common Diagnoses and Prescribed Items During OOH

Based on PIPS data, UTIs were the most frequently diagnosed condition treated with oral antibacterial drug during OOH periods, followed by throat and skin infections. This contrasts with findings from a Belgian study by Colliers et al. (2019), where RTIs (44%) were more prevalent. However, comparing the present findings with these may not be suitable due to multiple differences. Colliers' data were collected between 2016 and 2018, before COVID-19, and reflect a different healthcare system.

The predominance of UTIs in the present study is not surprising, given the higher susceptibility of females to such infections (discussed in Section 4.5.2.1). Furthermore, PIPS implementation coincided with COVID-19's first national lockdown, as noted earlier. During this period, many individuals with respiratory symptoms or infections chose to self-isolate rather than consulting HCPs immediately. Additionally, the national response to the pandemic, including lockdowns, social distancing, and adapting infection control measures,

such as face mask use and sanitisation practices, reduced the incidence of respiratory infections (UKHSA 2021a).

It is important to acknowledge that the information within the Choose Pharmacy – PIPS module was often insufficient to fully evaluate CIPs' selection of oral antibacterial drugs. However, the fact that nitrofurantoin, the recommended first-line treatment for UTIs across all HBs (Induction Healthcare Group n.d.), was the most frequently prescribed oral antibacterial drug suggests general adherence to UTI local prescribing guidelines. In comparison, a study in the United States of America (USA) found that physicians overprescribed fluoroquinolones and underused the first-line treatment for uncomplicated UTIs, resulting in an estimated 3.7 million women receiving non-first-line therapies annually (Langner et al. 2021). A similar study in Denmark reviewed UTI prescribing and reported 'moderately high' adherence among GPs but noted increased fluoroquinolone use with increasing age (Holm et al. 2019). While fluoroquinolones have been increasingly prescribed in these settings, their use in the present study was limited, with ciprofloxacin (the only fluoroquinolone reported) prescribed just five times, suggesting cautious, guideline-consistent prescribing by CIPs.

The evaluation of whether guidelines were adhered to in the present study was limited to the drug selection and did not evaluate other prescribing aspects (e.g., duration, dose). To illustrate, a single-centre primary care study in Australia assessed adherence to national guidelines for treating uncomplicated UTIs and found poor adherence among HCPs. This was primarily due to incorrect dosages and durations, where only three cases involved incorrect drug selection (Phamnguyen et al. 2019). Hence, a comprehensive evaluation of prescribing considering the complete regimen (selection, dose, frequency, and duration), is necessary. This approach aligns better with AMS goals, which emphasise optimising antimicrobial selection, dosage, and duration for best clinical outcomes while minimising toxicity and impact on AMR (Gerding 2001; Owens et al. 2004).

The successful UTI management in Wales community pharmacies has expanded the clinical responsibilities of non-independent prescriber pharmacists. In 2021, a pilot UTI service was launched in HDUHB and received strong GP support and high patient satisfaction, with 91% of patients indicating they would have sought care elsewhere without the service and 98% stating they would return to the pharmacy for future UTI symptoms (Health Education and

Improvement Wales n.d.-a). These positive outcomes informed the development of a national, non-mandatory UTI service in June 2024 as a part of the CAS, delivered under PGDs to manage uncomplicated UTIs in non-pregnant women aged 16–64 years (Community Pharmacy Wales 2024; Welsh Medicines Advice Service 2024). An evaluation of patient experience with the service between June 2024 and July 2025 showed high satisfaction, with a median score of 10 (excellent), regardless of whether antibacterials were supplied (Mantzourani et al. 2025). From October 2025, the service became mandatory in 99% of community pharmacies (Community Pharmacy Wales 2025c; Welsh Government 2025b) and is delivered by all pharmacists not only those qualified as IPs. This wider delivery enables greater proportion of pharmacies to provide the service, thereby increasing treatment availability and helping release some pressure from OOH services and other healthcare services.

Notably, certain conditions, such as bacterial chest and dental-related infections, were frequently encountered and treated with oral antibacterial drugs despite being outside the PIPS specification (NHS Wales Shared Services Partnership 2022). This suggests that CPIPs either felt clinically competent to diagnose and manage these cases or believed that prescribing was in the patient's best interest. For example, analysis of dental consultations revealed that patients were often advised to see a dentist or GP, yet antibacterials were still prescribed. This may reflect limited access to dental services due to appointment availability or cancellations, prompting CPIPs to issue prescriptions as a safety net. However, as these cases fall outside the PIPS specification, CPIPs should refer patients to dental services during IH or OOH periods, as urgent dental care must be provided only by dental professionals, as emphasised in Wales improvement goals (Welsh Government 2022a,2023a).

4.5.3 Comparative Models in Community Pharmacy Prescribing

Although the UK is progressing in integrating independent prescribing within community pharmacy, the speed and breadth of implementation vary across its nations. In England, the 'Pharmacy First' service was introduced in February 2024, allowing community pharmacists to assess and prescribe for seven common conditions without GP referral. These conditions include acute otitis media, impetigo, infected insect bites, shingles, sinusitis, sore throat, and uncomplicated UTIs in women (NHS England 2024b; Glover et al. 2025). The service

currently relies primarily on PGDs and established clinical pathways to support pharmacist prescribing (NHS England 2024b).

Scotland offers the most advanced community pharmacy prescribing model, having launched its 'Pharmacy First' scheme in July 2020, which replaced the Minor Ailment Scheme available since 2006. This service enables community pharmacists to prescribe for minor ailments and common clinical conditions. The current common clinical conditions are treated under PGDs and include uncomplicated UTIs in women, hay fever, shingles, impetigo, and a range of skin conditions (Community Pharmacy Scotland 2023). Additionally, an extension to the service 'Pharmacy First Plus' was introduced allowing qualified CPIPs to prescribe for various clinical conditions beyond the standard 'Pharmacy First' scope, including respiratory infections without restriction, provided they work within their area of competence (Community Pharmacy Scotland 2020).

While countries such as Canada and the USA provide useful examples of how pharmacist prescribing is structured elsewhere, their frameworks differ fundamentally from the UK in terms of regulation and prescribing rights. As such, these international examples are not comparable to the UK context, which is the scope of the study.

4.5.4 Current PIPS Specification in Wales and Future Directions

In Wales, consideration should be given to clarifying and potentially expanding the PIPS specification (NHS Wales Shared Services Partnership 2022). For example, 'cough' is a nonspecific symptom that can indicate many conditions, including chest infections, yet the 2022 wording lacks clarity about which conditions fall within the scope. Additionally, expanding the specification to explicitly include conditions such as chest infections, rather than limiting it to upper respiratory infections, could align more with the model adopted in Scotland and enhance CPIP utilisation, particularly during OOH periods. However, adding infections, such as community-acquired pneumonia (CAP), raises different challenges. CAP management usually requires thorough examination and diagnostic processes, including CRB-65 scoring, which relies on vital signs (NICE 2025). Without POCT, there is ongoing debate about whether CPIPs are equipped to diagnose and treat these infections safely (Hodson 2025). As a result, CAP was excluded from the PIPS specification due to these diagnostic limitations and the lack of a clearly defined scope.

The 2024 update to the PIPS specification introduced some changes, including adding migraine, replacing cough with other acute respiratory tract conditions, and redefining the upper respiratory tract category as respiratory tract (NHS Wales Shared Services Partnership 2024). Despite these revisions, the specification remains unclear about the exact conditions covered, even the revised term ‘acute respiratory conditions’ that could include various conditions, e.g., CAP and bronchitis. Upon further clarification, it was confirmed that the term includes any respiratory infection within the CPIP’s competence (Mackridge 2025).

Currently, a few pharmacies in Wales have access to CRP testing facilities, and the decision on when to use them is left to the discretion of the CPIP conducting the consultation. However, the lack of funding for necessary consumables (e.g., POCT) may sometimes limit the practical ability of CPIPs to manage these cases (Mackridge 2025). In certain areas, CPIPs operate under agreed scope of practice developed in collaboration with local GPs after completing training sessions. This scope sets criteria (e.g., patients aged 18–65 without chronic conditions) for managing chest infections, with the local cluster funding the POCT CRP machine (Jones 2025). When patients meet the agreed criteria, CPIPs can diagnose and initiate treatment directly. If not, or if clinical concerns arise, patients are referred to the GP for further evaluation. Although CRP testing use is at the CPIP’s discretion, it is used selectively, typically when uncertain and as part of a broader assessment to support decision-making but not relied upon solely (Jones 2025).

The WG has established goals to improve population health and well-being and to deliver a healthier Wales (Welsh Government 2022d). One way to support this is by improving patient experience and access to clinical services, including those provided by CPIPs. Expanding CPIPs’ scope beyond the current PIPS specification may support the overall government efforts, particularly during OOH periods.

In June 2022, the Royal Pharmaceutical Society (RPS), with support from the WG, released a structured guide to help IPs who wish to extend their scope of practice (RPS 2022). The guide uses the Continuing Professional Development cycle, enabling IPs to reflect on their needs, plan goals, take action to succeed (e.g., training and self-directed learning), and evaluate their progress. It also includes case studies from various sectors to illustrate this approach, offering valuable support for IPs seeking professional growth, enhanced practice, and adaptability to their HB’s needs. Additionally, from 2026 onward, the revised initial

education and training standards will enable newly qualified pharmacists in the UK to register as PIPs, which also has the potential to expand the provision of clinical services such as PIPS. However, not all pharmacists qualifying in 2026 will be registered as prescribers due to transitional arrangements, including cohorts trained under the 2011 standards and those qualifying via Overseas Pharmacists Assessment Programme (OSPAP) routes. Nevertheless, as IPs often qualify with a single scope, many work within limited and variable scopes across regions. To fully deliver the WG's vision of 'A Healthier Wales', expanded scope for all CPIPs is essential to ensure equitable access to services and strengthen care delivery nationwide.

4.5.5 Strengths and Limitations

The study achieved its aim through the analysis of secondary data. Using routinely collected, nationwide data offers several advantages, including the provision of data from difficult-to-access settings and the avoidance of challenges associated with primary data collection (Rew et al. 2000). It also enabled access to and analysis of large samples in a cost-effective and time-efficient manner. However, this approach is not without drawbacks.

The CASPA database captures all primary care prescriptions dispensed in community pharmacies across Wales and submitted to NHS Wales Prescribing Services for reimbursement. It enabled tracking changes in oral antibacterial prescribing volume over time. Although data on oral antibacterial classes were initially obtained from WAPSU, individual class-level analysis was not conducted in the CASPA phase. Analyses focused on overall antibacterial and 4C prescribing volumes, aligning with the AMS NPI targets and fulfilling the study's aim of describing broad prescribing trends relevant to policy (e.g., all antibacterials and 4Cs). In contrast, PIPS dataset allowed examination of prescriptions at individual level, providing context for more detailed understanding. Nonetheless, analysing individual classes in CASPA could have identified those contributing most to prescribing trends and highlighted potential overprescribing. Therefore, such analyses would be particularly valuable for studies supporting targeted AMS interventions aimed at drugs that are frequently unnecessary or overprescribed.

The study was constrained by the level of data in CASPA, which was designed for reimbursement purposes and provides population, rather than individual data. Therefore, key details such as clinical indications, dosing, or patient demographics which could be potential confounders, were not captured. Access to robust data on these variables for

specific populations (e.g., paediatrics) would support optimisation of antibacterial use and help reduce the risk of AMR (Charani et al. 2021). Additionally, although the study focused on oral dosage forms, a few drugs in the CASPA database (e.g., ceftriaxone) are injectables. However, due to limitations in the obtained database, oral and injectable forms could not be distinguished, and therefore, all were analysed. Nonetheless, it is not anticipated that inclusion of injectables would have a significant impact on overall trends, as, based on knowledge of primary care practices, these drugs are not often prescribed in these settings. It should also be noted that NPI targets are reported using different measurement units, such as item per 1000 STAR-PU, than the one used in this study. The STAR-PU adjusts for age and sex (Health Education and Improvement Wales 2021), data unavailable in the CASPA database obtained. Therefore, comparing the study findings, which relied on number of items as a metric, with NPIs may be inaccurate.

As previously stated, CASPA records only dispensed prescriptions from community pharmacies and thus may not fully reflect the actual prescribing by HCPs. However, since April 2007, medications in Wales have been free of charge, increasing the likelihood that prescriptions are filled (Welsh Government 2017). Evidence also supported this, with a study reporting that more individuals collected their prescriptions within six months following charge removal (Groves et al. 2010). Consequently, factors such as financial constraints and medication costs are less likely to hinder prescription fulfilment in Wales. This is particularly relevant for antibacterial drugs, which generally have high collection rates (Matsui et al. 2000; Zweigorn et al. 2012).

As common with retrospective secondary data analyses, adapting the Choose Pharmacy database to the study objectives was challenging because the data were collected for different purposes (Rew et al. 2000). The researcher had no control over variables or data quality, and it was not possible to question or collect additional variables to better assess prescribing quality and justification. Additionally, the existing differences between the databases used made it necessary to analyse the results separately.

The lack of detailed, standardised documentation in Choose Pharmacy (free-text entries to record consultation details) complicated the categorisation and analysis of specific data, such as diagnoses, and limited the ability to assess prescribing appropriateness. To address this, a team of MPharm students reviewed the contents of free-text boxes, including

presenting symptoms and main complaints, and categorised diagnoses based on NICE CKS (NICE n.d.). However, some consultations remained unclear and were grouped as 'others'. Evaluating the choice of prescribed 4Cs was not initially a main objective and proved unfeasible due to inconsistent, ambiguous, or incomplete entries. Insufficient information on patient conditions and illness severity made it challenging to report results and make accurate assessments of practice. Addressing these issues would require more comprehensive CIP documentation and improved data collection in Choose Pharmacy through structured coding systems, such as the Systematised Nomenclature of Medicine Clinical Terms (SNOMED CT) (SNOMED International 2025), to ensure consistent capture of key information. This would support future evaluations of clinical practice and care quality, allowing for more accurate assessments.

Despite these limitations, this study provides valuable overview of oral antibacterial prescribing in primary care OOH services in Wales. It also highlights the uptake of PIPS and offers empirical data on oral antibacterial prescribing through the service during OOH periods. However, knowledge of AMS interventions implemented by individual HBs at different time points to tackle AMR and encourage appropriate prescribing remains limited, presenting an opportunity for future research.

4.5.6 Implications and Future Research

To better understand prescribing practices and enhance interpretation of CASPA data, a data linkage study connecting CASPA prescribing records to individual consultations would be beneficial. This would allow a more comprehensive analysis by incorporating factors, such as patient characteristics and diagnoses, helping to identify patterns and associations between prescribing decisions and specific patient profiles or conditions. Such linkage could provide additional insights for evaluating prescribing appropriateness. Additionally, case studies focusing on prescribing patterns within each HB could provide in-depth knowledge of current practices, local initiatives, and key drivers and barriers to improvement.

To enhance the evaluation of prescribing appropriateness by CIPs, future research should include a detailed review of prescribing practices both within and beyond the PIPS specification. This should assess adherence to local guidelines and patient-specific recommendations to determine whether prescribing is safe, evidence-based, and outcome-focused. Further investigation into the impact of PIPS on patient outcomes and the wider

healthcare system, including potential benefits of its clinical remit, would also be valuable. Such research could inform NHS policy and support efficient resource allocation in Wales.

Further qualitative research is also needed to understand the observed oral antibacterial prescribing trends across HBs. This includes exploring whether existing AMS initiatives have influenced prescribing. Moreover, understanding how prescribers (medical and non-medical), particularly those working OOH, make clinical decisions is essentially important. Investigating the factors that shape their prescribing choices, along with the necessary resources and barriers faced, will be crucial to improving clinical practice. Such research can provide insights into effective strategies for optimising prescribing and delivering the best possible patient care.

4.6 Conclusion

This study examines oral antibacterial prescribing within primary care in Wales, including community pharmacy under PIPS, focusing on OOH services. It offers a comprehensive overview of PIPS users, oral antibacterial prescribing patterns, and the medical conditions leading to these prescriptions. To the researcher's knowledge, this is the first to explore oral antibacterial prescribing in Wales primary care OOH services and the first to investigate CPIP prescribing in community pharmacy in the UK. The findings have important implications for clinical practice and future research.

Since its launch, PIPS has experienced a considerable increase in consultations and prescriptions, including oral antibacterial drugs. This reflects the rising number of qualified CIPs and participating pharmacies, highlighting the service's expanding utilisation. Most patients were females, adults, and those who self-referred. Nitrofurantoin was the most prescribed oral antibacterial drug, with UTIs being the most frequently treated condition with oral antibacterial drug.

Primary care data from CASPA revealed a general downward trend in prescribing over the study period, primarily driven by reductions in IH prescribing. Various factors may underlie the observed, and unexplained trends in IH and OOH services, warranting further exploration. These include potential influencers on prescribing trends and available AMS interventions across HBs, and investigating efforts needed to improve prescribing practices. The following chapter explores these through the perspectives of key stakeholders.

Chapter 5 Eliciting Stakeholders' Perspectives on Oral Antibacterial Prescribing in Primary Care Out-of-Hours Services in Wales: A Qualitative Interview Study

5.1 Overview of the Chapter

This chapter explores the views of key stakeholders on oral antibacterial prescribing in primary care, with a focus on OOH services. It represents an attempt to enhance understanding of the prescribing patterns observed in Chapter 4 and to identify potential factors and AMS interventions that may have influenced prescribing over the study period.

5.2 Introduction

Optimising oral antibacterial prescribing is critical to slow the spread of AMR. While national strategies have made notable progress in reducing unnecessary prescribing, variations across services and geographical regions continue to exist. In the UK, England has been the focus of extensive research on antibacterial prescribing, and the following trends are drawn specifically from studies conducted there.

Primary care prescribing of antibacterials commonly used for RTIs and UTIs declined overall between 2014 and 2022, reflecting government and health authority efforts to reduce unnecessary use. Prescribing briefly increased early into COVID-19 before returning to pre-pandemic levels (McCloskey et al. 2023). For example, prescriptions in GP practices fell by 15.5% between April and August 2020 compared with the same period in 2019 (Armitage and Nellums 2021), while reductions of 13.5% and 16% were observed between March and September 2020 compared with 2019 and 2018, respectively (Hussain et al. 2021).

Whilst antibacterial prescribing in GP practices in England has declined since 2014, OOH prescribing has remained largely stable (UKHSA 2019). Data from 2010–14 in Oxfordshire even showed an increasing OOH prescribing trend despite fewer encounters, plausibly reflecting the introduction of NHS 111 in 2012 in that area (Hayward et al. 2016). By pre-triaging, as Hayward et al. (2016) suggested, NHS 111 may have reduced overall contacts but increased the proportion of higher-acuity patients attending OOH, leading to higher prescribing. From mid-2016 to early 2020, before COVID-19, IH prescribing fell significantly, while OOH levels remained relatively unchanged (Zhu et al. 2021b). However, both services saw reductions after the onset of COVID-19, likely due to national restrictions (Zhu et al. 2021b). As the data extend only to June 2020, uncertainty exists as to whether these reductions persisted beyond the immediate post-COVID-19 period.

More recent data from England suggest a rebound in prescribing. Between March 2019 and March 2023, antibacterial items dispensed in primary care increased by 17.2% per 1,000 inhabitants, with a significant rise after the second lockdown (Kurdi et al. 2024). However, Kurdi et al. (2024), did not examine OOH prescribing, leaving gaps in understanding post-COVID-19 trends. The ESPAUR similarly reported a rebound between 2021 and 2023 in GP prescribing, although levels remained below those observed in 2019 (UKHSA 2024a), indicating that early reductions were not fully sustained. Between 2023 and 2024, GP prescribing declined by 1.9% (UKHSA 2025). In the 'other community' category, where OOH represented about half of prescribing, antibacterial use increased between 2022 and 2023, exceeding 2019 levels (UKHSA 2024a). Between 2023 and 2024, OOH prescribing decreased (as Chapter 1, Section 1.5 outlined) accounting for 31.4% of this category (UKHSA 2025).

Comparable antibacterial prescribing data in Wales are limited. Wasag et al. (2021) has examined Wales primary care prescribing during the pandemic from April 2018 to April 2021, revealing a marked decline between April 2020 and 2021 compared with the same period in 2018 and 2019. The latest national report on antimicrobial improvement goals and trajectories also indicated a drop in overall primary care prescribing in 2020–21, reflecting the impact of COVID-19, as Wasag et al. (2021) reported, followed by a sharp increase in 2022–23 linked to a GAS outbreak and RTIs (Public Health Wales 2024a). By the end of 2023–24, prescribing was slightly below the pre-set target rate (Public Health Wales 2024a), indicating improvement following these external pressures. However, prescribing in OOH services specifically has not been formally investigated before the analysis in Chapter 4.

Stakeholder discussions with the research team frequently expressed the perception, based more on anecdote than evidence, that OOH services may operate with less clinical oversight and control over antibacterial prescribing, potentially leading to higher prescribing than IH services. Although various AMS initiatives, including Wales improvement goals and NPIs (AWMSG 2022b; Welsh Government 2022a,2023a), have been introduced, they are widely perceived to target IH services, as their applicability to OOH services is not explicitly stated. Stakeholders involved in OOH services have questioned the relevance of these goals, specifically the NPIs, given the distinct pressures in OOH services.

Analysis of oral antibacterial prescribing in Wales primary care IH and OOH services from 2015–16 to 2021–22 using CASPA data (Chapter 4) revealed an overall downward

prescribing trend, largely driven by IH services. However, prescribing patterns varied across HBs and between service types. Specific trends, such as the substantial reduction in HB D compared with other HBs or the transient dip observed in HB G OOH prescribing, could not be fully explained by the available data. These observations highlighted important variations and gaps in understanding, emphasising the need to complement numerical analyses with qualitative insights. Exploring the perspectives of key stakeholders was therefore essential to understand prescribing in Wales primary care, and particularly OOH services.

To address this, the study engaged members of the AWAPG due to their extensive AMS expertise and knowledge of national and regional practices. This group, formed in 2014 (Public Health Wales 2016), brings together representatives from PHW and antimicrobial pharmacists from across the HBs, including consultant, primary care, and secondary care antimicrobial pharmacists, though their roles vary by HB (Chapter 1, Section 1.9). The group collaborates to achieve common AMS goals while tailoring approaches to the local needs and resources of each HB (Public Health Wales 2015). It also works closely with other national groups to develop prescribing guidance, audits, and NPIs (AWMSG 2022a,b,2023).

5.2.1 Aim and Objectives

The study aimed to explore the perspectives of lead or primary care antimicrobial pharmacists in Wales on oral antibacterial prescribing in primary care, with a particular focus on OOH services. This involved addressing the following objectives:

- Explore reflections on influential factors or interventions arising from oral antibacterial prescribing patterns (analysed in Chapter 4) in primary care and OOH services in particular.
- Explore any unplanned or critical event(s) that may have impacted oral antibacterial prescribing in primary care and OOH services in particular.
- Investigate AMS initiatives or interventions, at national or HB level, that may have affected oral antibacterial prescribing in primary care and OOH services in particular.
- Identify areas for improvement and potential solutions to address inappropriate prescribing of oral antibacterials in primary care and OOH services in particular.
- Describe potential barriers and facilitators to implementing AMS interventions in primary care OOH services.

5.3 Methods

5.3.1 Overview of the Methodology Approach

Based on the explanation in Chapter 3, Section 3.2, this chapter adopts a constructivist phenomenological approach. An exploratory qualitative study was conducted using semi-structured interviews, which allow the use of a pre-defined interview schedule, while providing flexibility to probe and expand on participants' responses (Chapter 3, Section 3.5.2.4) (Drever 2003; Ruslin et al. 2022). Individual interviews were selected over group formats (Chapter 3, Section 3.5.2) to gain a rich understanding of prescribing at national and HB levels from antimicrobial pharmacists' perspectives, allowing each participant time to fully express their views (Morgan 1997). This approach aimed to facilitate in-depth exploration of prescribing within each HB, and to contextualise HB-level prescribing trends identified in Chapter 4 using CASPA data. In addition to the interview questions, participants were presented with graphs of prescribing changes over time for their HB to reflect on these trends. They were asked to discuss existing measures or interventions to tackle overprescribing that they were aware had been implemented or were under consideration by their respective HB. They were also invited to suggest actions to improve prescribing.

5.3.2 Ethical Approval and Study Registration

Using the HRA decision tool (HRA 2022b), the study was classified as a service evaluation, as it did not aim to alter or intervene with current practices, produce transferrable findings, or involve randomisation. Therefore, NHS approval was not required. Instead, a favourable opinion was sought from the CSPPS-REC and granted 4 May 2023 (reference number: 2223-17; Appendix 5.1).

As the study involved interviewing NHS staff from all seven HBs, registration with each HB was necessary. However, each HB had different registration requirements and procedures that needed completion so that their staff could participate. Some accepted the CSPPS-REC's opinion and requested assurance from their Information Governance teams that there were no concerns about conducting the study. Others required completion of a local registration form, while some requested approval from their R&D department. Additionally, most HBs requested endorsement from the Director of the relevant department. Despite variations in these processes, all requirements were completed, and registration/permission was

obtained from all HBs before the study commenced. The entire process, from initial contact with HBs to securing the last permission, took approximately 16 weeks.

5.3.3 Data Collection Tool

Following the approach recommended by Kallio et al. (2016) (Chapter 3 Section 3.5.4), a semi-structured interview schedule was developed (Appendix 5.2) to facilitate discussion with participants. The interview questions were informed by three sources suggested by King et al. (2019): anecdotal insights from stakeholders, relevant literature, and preliminary work. The questions were subsequently refined based on feedback from the research team.

To illustrate, the questions were informed by views of key NHS professionals with OOH knowledge and experience: the Professional Lead for NHS 111 Pharmacists and the Divisional Director of Primary, Community Care, and Complex Care in one of the HBs. The latter was one of the first pharmacists in Wales to work in OOH services and subsequently had an educational role to those who had newly joined the service. Additionally, the questions were informed by reviewing relevant literature on OOH prescribing. Lastly, the researcher reflected on the preliminary findings from Chapter 4, which helped formulate HB-tailored question(s) to elicit different aspects of prescribing practices. Although Chapter 4 highlighted that community pharmacy contributes to overall prescribing in primary care and OOH services, no questions were specifically asked about community pharmacy. This was because of overlapping timelines, where the two studies (the PIPS phase in Chapter 4 and the development and approvals for this study) were conducted concurrently.

The interview schedule consisted of two sections. The first section focused mostly on open-ended questions to elicit in-depth responses, supplemented by closed-ended questions where relevant, e.g., if information needed confirmation. Probes and prompts were used to allow further exploration and clarification of answers. The second section presented graphs illustrating oral antibacterial drug and 4C prescribing trends for each participant's HB in relation to overall prescribing across Wales for primary care collectively and OOH services (Table 5.1). An example for one HB is presented in Figure 5.1. These graphs were utilised as visual prompts to explore and/or clarify reasons for specific changes for their HB. The interview schedule was reviewed by the project supervisors before data collection, after the pilot and the first interview (Kallio et al. 2016; King et al. 2019; Ruslin et al. 2022).

Table 5.1: Summary of Prescribing Graphs Provided to Participants

Graph	Prescribing Category	Setting	Comparison
1	All oral antibacterials	Out-of-hours services	Health Board vs Wales
2	4Cs	Out-of-hours services	Health Board vs Wales
3	All oral antibacterials	Primary care collectively	Health Board vs Wales
4	4Cs	Primary care collectively	Health Board vs Wales

4Cs: amoxicillin-clavulanate, cephalosporins, clindamycin, and fluoroquinolones.

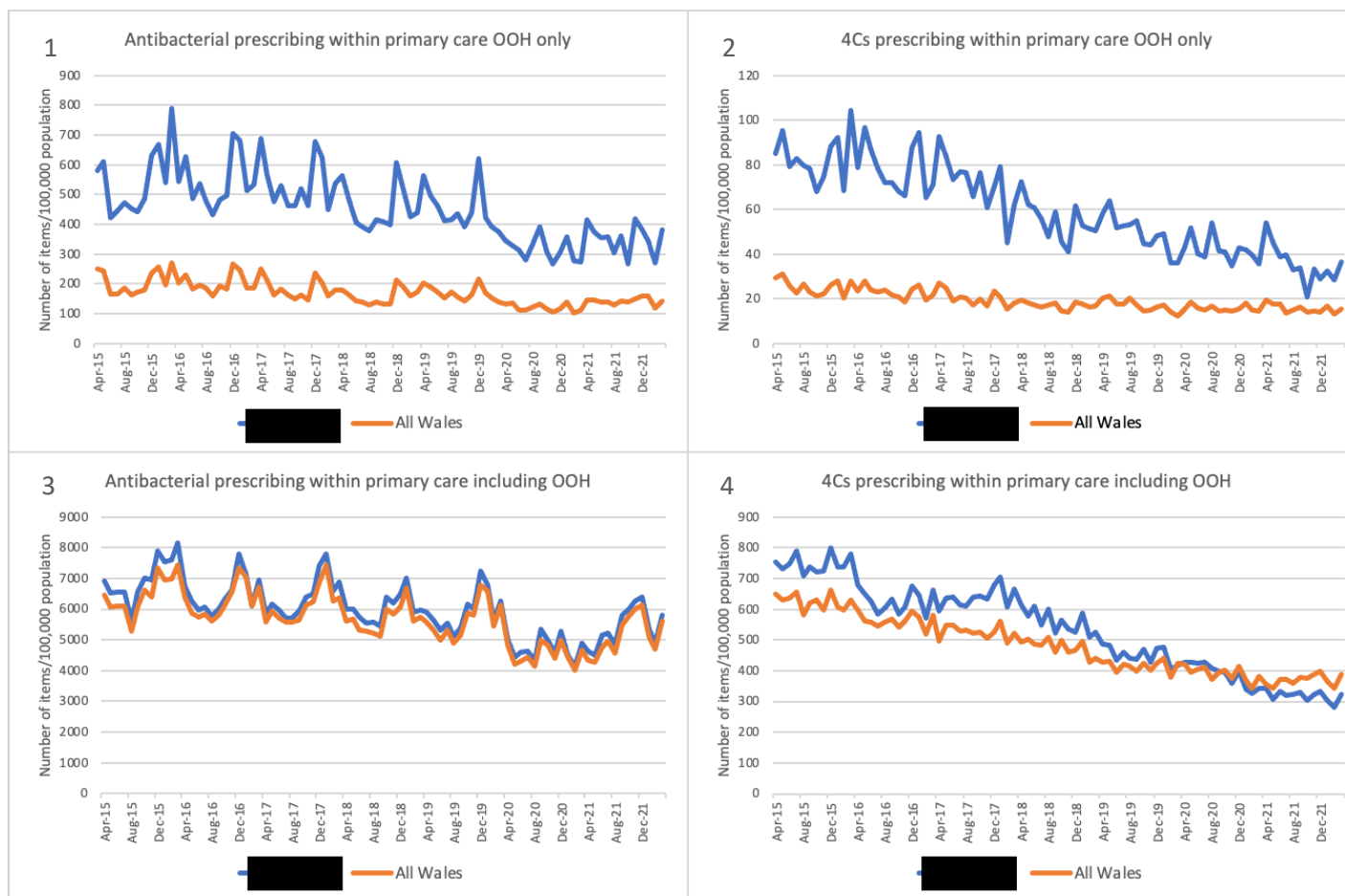


Figure 5.1: Example of Prescribing Pattern Graphs Provided for One Health Board

5.3.4 Sampling and Recruitment

Participants were purposively sampled to include individuals, one from each HB, with specific characteristics (Chapter 3 Section 3.7.1) (Patton 2015b). The focus was on recruiting the HB lead antimicrobial pharmacist due to their specialist role in AMS. These individuals were expected to have deep knowledge of antimicrobial prescribing and stewardship nationally and within their HBs and well suited to discuss and contextualise the quantitative trends in Chapter 4. However, as antimicrobial pharmacist roles are not consistent across HBs, primary care antimicrobial pharmacists were also considered for inclusion.

Prior to recruitment, a discussion with a member of the AWAPG revealed that one HB lacked such posts. This posed a potential limitation in achieving full representation across HBs. Consequently, a minor amendment was submitted and approved by the CSPPS-REC (Appendix 5.3) to allow the inclusion of an equivalent professional in addition to the originally defined posts. The revised sampling criteria included: being either the lead or primary care antimicrobial pharmacist, or an equivalent individual, where appropriate. Although the sample was small, it aligned with the study's purpose of recruiting one individual per HB (n=7). This approach was guided by the concept of information power (Malterud et al. 2016), which emphasises the relevance, depth, and richness of information over sample size or data saturation (Chapter 3, Section 3.7.1). Five dimensions were collectively considered when applying information power:

- Study aim: the aim was focused on exploring primary care and OOH antibacterial prescribing and AMS interventions in Wales, both nationally and within individual HBs. This focus increased the potential informational contribution of each participant.
- Sample specificity: participants were purposively recruited and highly specific (i.e., lead and/or primary care antimicrobial pharmacists with strategic oversight of AMS and prescribing within their respective HBs). As individuals occupy such defined roles and hold direct system-level insight, this could enhance the relevance and informational value of each interview.
- Use of established theory: the study was informed by findings from Chapter 4 and stakeholders' interests and priorities, which provided the conceptual direction and analytical focus.

- Quality of dialogue: in-depth, semi-structured individual interviews allowed for detailed and rich accounts. AMS was not a new area for either the researcher or the participants, facilitating informed discussion, clear communication, and depth of exploration, thereby strengthening the quality of the data generated.
- Analysis strategy: a thematic cross-case approach was adopted to capture variation across HBs and identify similarities and differences in perspectives. Given the high specificity and strategic roles of participants, a smaller number of interviews was considered sufficient to achieve adequate information power.

As no publicly available list of the study population existed, participants were recruited through a gatekeeper (Chapter 3, Section, 3.7.2) (Hennink et al. 2020). The gatekeeper was a member of the AWAPG, who worked in one of the HBs and had been involved in earlier stages of the project and showed interest in its focus. Their role was to identify individuals meeting the inclusion criteria and to share the study documentation with them.

Information sheets and consent forms for both the gatekeeper and participants were adapted from standard CSPPS templates. All documents and correspondence were written in English. The researcher contacted the gatekeeper via email with a personalised invitation letter, information sheet, and consent form (Appendix 5.4). The gatekeeper was asked to return a signed consent form, either electronically or as a scanned printed copy. A reminder was planned if no response was received within 14 days from the initial contact; however, this was unnecessary as consent was obtained promptly.

The researcher sent the gatekeeper a participant invitation letter with PIS and consent form attached. The gatekeeper was instructed to share these with potential participants (six additional individuals, one from each remaining HB, making a total of seven participants including the gatekeeper themselves) via email (Appendix 5.5). The gatekeeper was instructed not to amend any documents, offer further information, or exert any pressure to influence participation. Participants were clearly informed that participation was voluntary, with no incentives offered. They were informed that the study would be part of the researcher's PhD thesis. A 14-day period was provided to potential participants to read, ask, and decide whether to participate. After this, the gatekeeper was asked to send a reminder to all potential participants (Appendix 5.6). Those who had replied at that point were asked to ignore the reminder. After another 14 days from the reminder, it was assumed that those

who did not respond did not wish to participate, and no further contact was made. However, those who responded after the second 2-week period were still included.

Individuals who agreed to participate were required to provide signed consent, either electronically or as a scanned printed copy, via email to the researcher. Once consent was received, each participant was contacted individually via email to confirm their availability. Interviews were scheduled at mutually convenient times based on their preference. They were allowed to ask any questions about their participation before the interview.

A personalised email was sent to each consenting participant one week prior to their scheduled interview (Appendix 5.7). This included an adapted and simplified version of the interview schedule to outline the topics to be discussed. Each participant also received four prescribing graphs for their respective HB (described in Section 5.3.3) to facilitate discussion of trends, specifically those unclear to the researcher. Sharing these in advance aimed to support participant reflection and enhance the depth and accuracy of responses, as suggested in the literature (Haukås and Tishakov 2024). This was especially important for exploring prescribing patterns, as recalling details from old data could be difficult if it was only provided during the interview. It also aligned with ethical principles by promoting transparency and ensuring informed consent (Haukås and Tishakov 2024).

5.3.5 Piloting

Pilot interviews are commonly conducted with a subset of the study sample or peers (Young et al. 2018) to simulate actual interview conditions (Kallio et al. 2016). Given the limited number of eligible participants (only seven across Wales) and the equal importance of each perspective, the researcher chose to preserve the study sample by piloting with someone outside it. The pilot was therefore conducted with a member of teaching staff from the CSPPS, a known contact who had recently taken on the role of a secondary care antimicrobial pharmacist in one HB. They were selected for their role in AMS and knowledge of the NHS system. This approach helped in gaining feedback from an accessible individual with a similar background to the intended participants, strengthening interviewing skills, and testing and refining the questions for clarity and biases (ambiguous, leading questions), while conserving the targeted sample.

This member was first identified by the project supervisor (KH), who made the initial contact. Once they agreed to participate, the researcher sent an invitation email, along with PIS and consent form. Upon receiving consent, the interview was scheduled based on their availability, and the interview schedule was sent one week beforehand. The interview was conducted face-to-face in a quiet office room at the CSPPS, with only the staff member, the researcher, and the project supervisor (RD) present. The supervisor attended to observe and support the researcher, give feedback on interviewing skills, and ensure ethical conduct, without actively participating in the discussion. The interview was recorded using a digital device and transcribed verbatim by the researcher.

Although the interviewee did not meet the inclusion criteria, lacking experience in primary care and OOH services to provide the anticipated level of detail, their responses were considered to refine the interview schedule but were excluded from the study findings. They were also invited to comment on the clarity of the questions, helping to improve the interview for subsequent participants. For example, “how do you perceive” was unclear to the interviewee and was revised to “what are your thoughts”. The pilot also helped estimate interview duration, allocate sufficient time for each section, and anticipate and resolve potential technical issues with the recording device. Moreover, it provided an opportunity to reflect on qualitative research skills, including probing, assessing the relevance of responses (Young et al. 2018), and practising transcription, coding, and analysis.

5.3.6 Settings

All participants were offered the option of an in-person or virtual interview via Microsoft Teams® (Chapter 3, Section 3.5.2.4). The choice was based on participant preference and geographical location. In-person interviews, if chosen, were to be conducted in a private quiet room, e.g., meeting room in CSPPS or HB. For virtual interviews, participants were advised to join from a quiet location to minimise distractions and enhance clear communication (Hennink et al. 2020), and the researcher ensured the same. Virtual interviews carried the possibility of visual recording, and participants were given the option to have their camera on or off.

5.3.7 Data Processing and Analysis

The recorded interviews were transcribed verbatim by the researcher, manually for those conducted in-person and using Microsoft Teams® transcription for online interviews.

Verbatim transcription reports every spoken word, providing word-for-word records (Hennink et al. 2020), which helps minimise potential reporting bias. Upon completion of each interview, the researcher repeatedly listened to the recordings and quality checked them against the transcripts to ensure their accuracy. This process also allowed the researcher to assess the intended meaning of the written words, considering intonation. Identifiable information was removed during transcription to ensure de-identification of participants. When a second opinion was needed for unclear phrases, such as fast-spoken words, Welsh terms, and colloquialisms, the researcher consulted the project supervisor (RD), who speaks Welsh and has expertise in qualitative research.

Transcripts were analysed using reflexive thematic analysis (Braun and Clarke 2006; Clarke and Braun 2017). Thematic analysis was selected for its flexibility and ability to provide detailed, rich analysis (Chapter 3, Section 3.8.2.1) (Braun and Clarke 2006). Although the use of established theoretical frameworks was initially considered, this approach was not pursued. A hybrid approach was instead applied, combining deductive analysis guided by pre-determined, theory-driven themes with inductive analysis open to newly identified, data-driven themes (Fereday and Muir-Cochrane 2006; Proudfoot 2022). This was because, early in the study, considerable effort was made to align the interview schedule with the project's aim and objectives, covering priorities (i.e., practical issues such as barriers and facilitators to AMS interventions in OOH) and interests of key stakeholders who contributed to its development. At the same time, the study remained open to new insights from participants that could further enrich the analysis. NVivo, a qualitative data management tool, and Microsoft Excel were used for the analysis (QSR International Pty Ltd 2018).

Thematic analysis was conducted by one researcher to ensure consistency and followed the six stages outlined by Braun and Clarke (2006) (Chapter 3, Section 3.8.2.1). The analysis was carried out iteratively in a cyclical manner throughout, with each transcript examined as it was collected. A constant comparison method was employed, where new data were continually compared with existing codes and themes to identify patterns.

Thematic analysis started with data familiarisation, involving repeated reading of the transcripts and listening to the recordings. A new NVivo project file was created, into which all de-identified transcripts were imported for coding. Transcripts were thoroughly read and re-read line-by-line, and initial notes were taken to capture thoughts for further exploration.

Coding, as the second step, involved carefully examining the entire dataset to create initial codes, varying from specific to broader ones, in preparation for the subsequent step. The third step involved organising and grouping related codes that reflected patterns into potential themes and subthemes, where possible, to address key areas. Similar codes were merged, and those sharing a common concept were combined into higher-level themes. The following step involved reviewing and adjusting these themes to ensure they accurately represented the coded data and the narrative they were meant to convey. To facilitate this step, code and themes were exported to a Microsoft Excel codebook, where colour-coding enhanced visual organisation and thematic mapping. In the fifth step, each theme was further defined and refined to clarify its main concept. The last step involved writing the complete report, combining illustrative quotations with analytical comments.

5.3.8 Trustworthiness

To ensure trustworthiness (see Chapter 3, Section 3.5.5), several strategies were adopted (Shenton 2004). These included gaining familiarity with the study context and engaging in several discussions with field experts and experienced qualitative researchers, including the project supervisors. The researcher also made an effort to employ trustworthy research methods to address the project questions and minimise potential bias, e.g., by using purposive sampling and pilot testing the interview schedule. Furthermore, ongoing reflection was incorporated throughout. Following the pilot and each subsequent interview, the researcher critically assessed their interviewing skills and the interview session as a whole to enhance their skills for subsequent interviews (Halcomb and Davidson 2006). This reflective practice involved reviewing the recordings, note-taking to identify areas for improvement (e.g., topics requiring further exploration), assessing how questions were formulated and asked, considering how these could be improved, and recognising any personal perspectives or preconceptions that might influence analysis and interpretation.

During coding and analysis, considerable time was invested to develop and refine codes and themes, with the researcher questioning how their views and interpretations might shape their choices and repeating the process as needed to ensure accurate and constant comparison (Glaser 1965; Fram 2013). To enhance the quality, transparency, and methodological rigour of the analysis, the first transcript was analysed independently by the project supervisor (KH), and themes were discussed and compared to the researcher's

themes. A summary table of the themes and subthemes was maintained throughout to facilitate comparative review and discussion. The researcher also used quotes taken directly from the transcripts to support the analysis and provide evidence for the constructed themes. Furthermore, as discussed in Section 5.3.3, relevant stakeholders were actively engaged in developing and refining the interview questions, adhering to the principle of engagement and member checking to enhance trustworthiness. Additionally, the results were shared with the R&D departments of all HBs for their review. Findings were also presented to AWAPG for their input, including interviewed participants and other members, and were shared upon request. Finally, the researcher aimed to provide a reliable report by detailing the methods used, documenting any changes in approach with their rationale.

5.3.9 Information Governance and Data Management

To ensure confidentiality throughout, all procedures were completed in accordance with GDPR and Cardiff University's Data Protection Policy (Cardiff University 2018b). The University's Standard Operating Procedures (SOPs) for visual or audio recordings of participants and the use of gatekeepers were complied with (Cardiff University 2022b,c). Informed consent was obtained from the participants before the interview.

Cardiff University's OneDrive, a secure server accessed via password-protected computers, was used at all times for data storage. Participants were interviewed through a private, secured site on Microsoft Teams, where all the interviews were undertaken and recorded. This site was used to ensure secure storage of all data, including recordings, transcripts, and consent forms. Access to these materials was limited to the research team, all of whom were members of that specific Microsoft Teams site.

Codes were used as identifiers for the recorded interview and any written notes.

Transcription and de-identification were completed as soon as possible after each interview, and original recordings were deleted from the digital recording device and OneDrive once transcripts were completed and quality assured. Each transcript was de-identified using pseudonyms and numbers, which were also used for quotations. Study data, including de-identified transcripts and consent forms, will be retained for a minimum of five years following project completion or publication, whichever is later, in accordance with Cardiff University Records Retention Schedules (Cardiff University 2020).

5.4 Results

5.4.1 Interview Sample Overview

Seven participants were interviewed, achieving the desired sample with representation from each HB. All interviews were conducted virtually between 7 August and 12 October 2023. These lasted between 33 minutes and 30 seconds to 67 minutes and 30 seconds, with an average (mean) duration of 50 minutes and 39 seconds. Participants held different roles and had varying lengths of experience in their current posts. To maintain confidentiality and de-identification, each participant was assigned an interviewee number (P1–7). Additionally, detailed descriptions (e.g., sex, job title, HB affiliation, and length of experience) are not presented due to the small sample, as only one representative from each HB was included.

5.4.2 General Insights on Prescribing Patterns

The first objective of this study was to contextualise changes in prescribing patterns across HBs in Wales from 2015–16 to 2021–22 using monthly prescribing data obtained from CASPA (Chapter 4). These data were presented to participants as graphs, which illustrated an overall downward trend in oral antibacterial prescribing in most HBs. However, all participants were unable to link this trend to any specific intervention or action. Instead, they perceived the positive changes as a collective effort to meet primary care prescribing targets and the UK NAP objectives. Additionally, uncertainty remained around specific patterns, such as drop in HB G prescribing between 2017–18 in OOH services, which was speculated to be linked to changes in appointment booking processes, though no specific AMS interventions or major service changes had taken place at the time.

Participants conveyed that the presented data did not fully capture prescribing activities in OOH services. They mainly highlighted the absence of data on pre-packed items (those sometimes supplied directly to patients from A&E departments, GP OOH cupboards, or hospital stocks, without being dispensed through community pharmacies), as this information is not recorded in CASPA. Nonetheless, participants identified additional factors to consider when interpreting the data and that may help explain variations in prescribing across HBs. These included the phased introduction of NHS 111, which varied across HBs, demographic differences between rural and urban areas, socio-economic conditions (e.g., deprivation, industrial settings), and patient comorbidities. Differences across HBs in dispensing practices and supply logistics during OOH services were also discussed.

Specifically, some HBs favour direct provision of pre-packed medications from their stocks, while others rely more on prescriptions to be dispensed at community pharmacies.

Additional factors may have influenced OOH prescribing generally across all-Wales. These included the efforts made in IH primary and secondary care, ongoing education, and guideline changes, given that many HCPs work in both IH and OOH services. The availability of alternative services as substitutes for OOH services, e.g., private healthcare, was also identified as a factor to consider, as these are not captured in CASPA.

Participants emphasised the need for a broader perspective to better understand primary care and OOH services prescribing across Wales rather than examining individual HBs. They frequently suggested comparative analysis with England and other European countries who have more favourable prescribing averages, to identify areas for improvement. While such analyses have not been undertaken in this project, future research could use comparative benchmarking to highlight numerical trends and the underlying factors.

5.4.3 Thematic Analysis Results

Interview transcripts were analysed as described in Section 5.3.7. Figure 5.2 illustrates the colour-coding process used, while Figure 5.3 shows examples of codes, sub-themes, and their organisation into main themes. Data were mapped deductively based on the project objectives and stakeholders' priorities. Although no additional main themes were developed from the inductive analysis, most subthemes were constructed from the data. This may have resulted in certain topics, such as those related to data, appearing under multiple themes. Table 5.2 summarises the main themes and subthemes identified from the analysis.

Step 1 – Data familiarisation: read and re-read transcripts

A quote from P1

"I'd like a public health campaign, a very strong public health campaign. We've had some very, we've had scraped the surface, but we don't really tell people that you will die if you don't, if you don't stop your behaviour and understanding that it will change the face of modern medicine, you know. I, honest to goodness, do not believe that people understand what we use antibiotics for. And the vast majority of medicine happens because of antibiotics, and I think a huge public health campaign, akin to the 1970s seat belt campaign or the 1990 Smoking Campaign, would change things, and would make a difference, but I can't see any government making that investment. However, that's the negative [participant name]. That's what I think needs to happen. For prescribers. I think that we need to invest more in undergraduate programmes. I don't think that they understand antimicrobials at all. I don't think that it's taught very well. And then when they come out and practice in their junior years that they need to have the support from their health boards to challenge their more senior doctors who do things differently. We still see a lot of behaviour of, "well, my consultant told me to do it. My consultant told me to do it," and then they're trained in that manner and that's the practice that they then continue. So, there's a lot more that can be done to support junior doctors in decision-making and supporting them in reporting. And then actually the leadership within hospitals, I'm talking predominantly about hospitals now before primary care, but the medical leadership that actually if you don't follow the guidance, it's not OK, it's not OK. You can't. You can't do that and have medical directors tackle prescribers a lot more. And the same goes for GPs, you know, we have, we know in [geographical area] where our poorer performing practices are, the ones that don't follow guidance, the ones that prescribe antibiotics more and they should be kind of held to account really to understand what they're doing. But that goes along with information, a lot of what I get from GPs as well "I don't know what our resistance patterns are, I don't know". If we supply them with more data and data that they understand and they can interpret, that may change their way of practicing and you know what? Why not introduce things like refresher courses on antibiotic prescribing that people have to do and people have to understand and are monitored? But until we get more sophisticated data, more sophisticated monitoring tools, I'm afraid that won't change."

Step 2 – Label information

Codes

Patient behavioural change / accountability

Investment in undergraduate programmes

Appropriate training

Decision-making support and reassurance

Accountability / behavioural change

Data provision and understanding

Antibiotics refresher courses

Data provision

Step 3 – Merge, define, and rename emerging concepts:

An iterative process with each transcript

Sub-themes

- Data management and communication
- Decision-making support
- Training and education
- Promoting behavioural change and accountability

Step 4 – Compare, identify relationships and similarity

Main theme

- Potential Solutions to improve prescribing

Figure 5.2: An Example of Line-by-line Coding Process and Identifying Themes

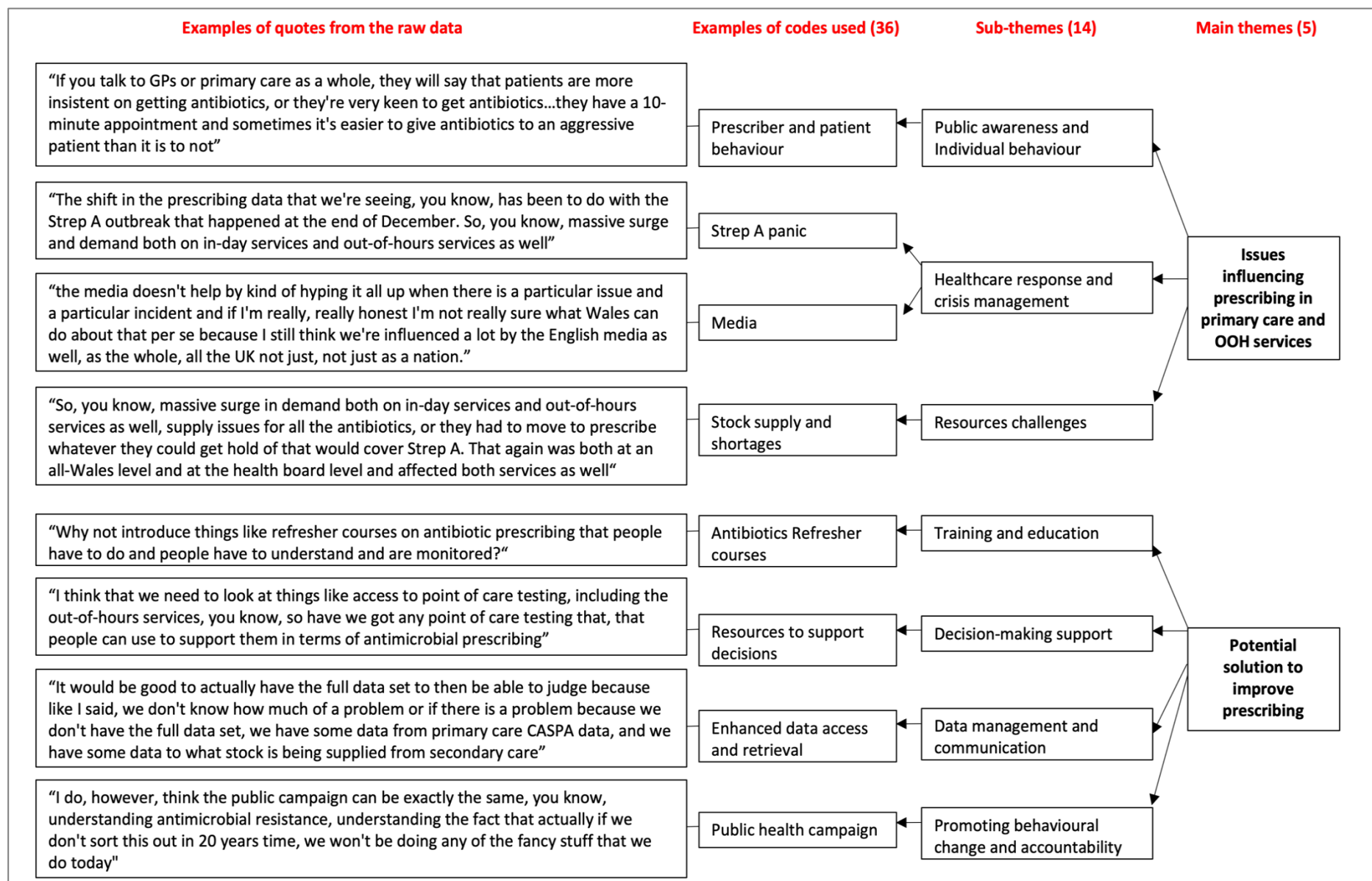


Figure 5.3: Examples of the Codes Used and Constructed Themes

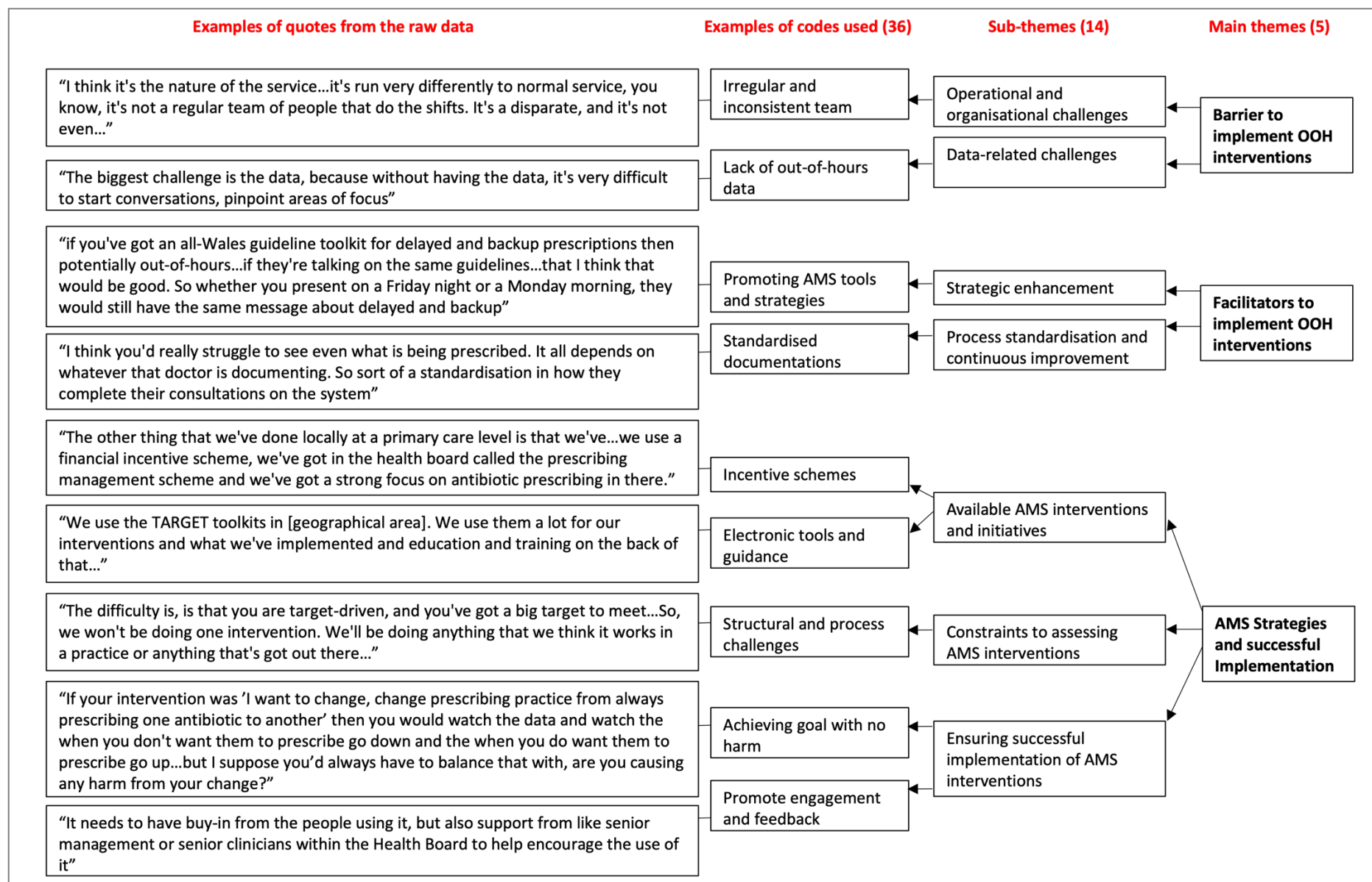


Figure 5.3: Examples of the Codes Used and Constructed Themes (continued)

Table 5.2: Main Themes and Subthemes

Main Themes		Subthemes	
1. Issues influencing prescribing in primary care and OOH services	Deductive	1.1 Healthcare response and crisis management 1.2 Resource challenges 1.3 Public perceptions and individual behaviour	Inductive
2. Potential solutions to improve prescribing	Deductive	2.1 Data management and communication 2.2 Training and education 2.3 Decision-making support 2.4 Promoting behavioural changes and accountability	Inductive
3. Barriers to implementing OOH interventions	Deductive	3.1 Data related challenges 3.2 Operational and organisational challenges	Inductive
4. Facilitators to implementing OOH interventions	Deductive	4.1 Strategic enhancement 4.2 Process standardisation and continuous improvement	Inductive
5. AMS strategies and successful Implementation	Deductive	5.1 Available AMS interventions and initiatives 5.2 Ensuring successful implementation of AMS interventions 5.3 Constraints to assessing AMS interventions	Deductive

Key: AMS: antimicrobial stewardship; OOH: out-of-hours.

The deductive analysis was based on priorities identified during discussions with stakeholders and their interests.

5.4.3.1 Theme I: Issues Influencing Prescribing in Primary Care and OOH Services

Participants discussed multiple issues that they perceived to have influenced oral antibacterial prescribing in both primary care generally and OOH services. These included external events such as large-scale health incidents, and how they impacted care delivery, resource availability, and the perceptions and behaviours of patients, caregivers, and HCPs.

5.4.3.1.1 Healthcare Response and Crisis Management

Although most participants were optimistic about the reductions in antibacterial prescriptions, especially in primary care, recent healthcare crises were believed to have disrupted this trend. For example, although beyond the timeframe examined, all participants discussed the GAS outbreak between late 2022 and early 2023, highlighting its substantial influence in reversing previous progress. They believed that prescribers tended to follow a more cautious approach during such outbreaks, lowering prescribing thresholds, particularly for vulnerable populations such as children and concerned parents. One participant noted that the incident revealed weaknesses in the system for regulating

prescribing, leaving services vulnerable to unexpected challenges. This incident likely contributed to increased primary care prescribing in IH and OOH services due to the perceived urgency.

“The Strep A [GAS] outbreak last winter has had a huge impact on antibiotic prescribing. There was obviously a lower threshold for prescribing antibiotics, and we were dealing with the paediatric population, so people always become a bit more nervous and happier to give prescriptions in that situation.” (P2)

Some participants also emphasised the UK media as a contributing factor. They believed that media coverage and exaggeration at times influenced public and healthcare practices especially in situations such as the GAS outbreak, leading to increased public concerns and higher demand for medical attention. One participant noted that this pressure overwhelmed GPs, who struggled to cope with the surge of patients presenting with common symptoms (e.g., rash and cough) that were not necessarily related to GAS. Participants expressed uncertainty about how media influence could be effectively addressed or regulated, noting that its impact extends beyond Wales to the wider UK media.

“The media doesn't help by kind of hyping it all up when there is a particular issue and a particular incident [...] I still think we're influenced a lot by the English media as well, as the whole, all the UK not just, not just as a nation.” (P1)

Participants also viewed COVID-19 as an important factor that altered prescribing patterns and thresholds in different ways, with mixed views. A few participants noted that COVID-19 resulted in a huge decline in prescription volumes in primary care due to fewer GP visits. However, most highlighted the tendency to increase prescribing during that period linked to the shift from face-to-face to remote consultations. Nevertheless, these views were based on participants' perspectives during the pandemic rather than the prescribing data presented to them later in the interview.

“So obviously COVID had a humongous effect on antimicrobial prescribing [...], antimicrobial prescribing has just dropped off, massively went down because patients weren't going to their GP.” (P4)

“COVID has definitely impacted in terms of prescribing. I think sometimes as well is that threshold for prescribing that's been lowered, and the telephone issues are definitely a big issue for us, I think.” (P5)

Remote healthcare delivery was particularly relevant for NHS 111 and OOH services, where consultations are primarily conducted remotely regardless of COVID-19, and in-person assessments occur only when necessary. Many participants pointed out that these settings lower prescribing thresholds as HCPs mostly rely on self-reported symptoms without the benefit of physical examinations. Therefore, some believed that overprescribing was more likely in these settings.

“There is much more prescribing of antibiotics over the phone, particularly with 111 [...] without the ability to make any clinical assessments. There are studies showing that this leads to a lower threshold for prescribing antibiotics.” (P7)

5.4.3.1.2 Resource Challenges

Antibacterial shortages and limited supply chains, especially during the high prescribing volumes seen with the GAS outbreak, were raised by a number of participants. They explained that reduced antibacterial availability impacted subsequent prescribing decisions across IH and OOH services, as prescribers were forced to adapt to stock limitations by prescribing available alternatives. In some cases, this involved prescribing broader-spectrum or more expensive antibacterials, even when these were not the most appropriate options or necessarily aligned with AMS principles.

“...it meant an exceptionally high volume of antibiotics being prescribed, which then made that stock run out [...] if the one that you want to prescribe isn't available, you prescribe something else, potentially a broader spectrum one.” (P6)

One participant also highlighted the role of financial limitations in prescribing decisions. Budget constraints led some prescribers to make cost-driven choices to manage their resources and prescribe affordable alternatives, which impacted on AMS efforts.

“...nitrofurantoin liquid is really expensive, it's like £400 a bottle, so that may deviate choice to a cheaper alternative if you are looking at budgets.” (P6)

5.4.3.1.3 Public Perceptions and Individual Behaviour

Several participants emphasised that perceptions of antibacterials, held by patients and prescribers, drove their behaviour. Misconceptions among patients were seen as a driver of demand and prescribing rates, with the belief that the benefits of antibacterials outweigh their risks leading many to request them. They viewed them as immediate cures for any ailment rather than as valuable resources requiring careful use and stewardship.

Participants also noted variation in prescribers' attitudes toward oral antibacterial prescribing. Some were perceived as more lenient, believing antibacterials would effectively cure patients. These prescribers were seen as more likely to opt for immediate prescribing rather than investing in alternative strategies, including watchful waiting or non-pharmacological advice (e.g., rest, hydration), attributing this to time constraints.

"I don't think they're treated as a diminishing commodity like perhaps they should be [...] and the prescribers, they think 'well, they'll work, so I'll give them'" (P3)

Most participants believed that HCPs' prescribing behaviour may differ between IH and OOH services. They explained that avoiding unnecessary prescribing and offering safety-netting advice is more feasible in IH services. In contrast, OOH prescribers were perceived to adopt a 'defensive prescribing' approach, driven by uncertainty, limited opportunities for safety-netting, or a sense of responsibility for patients deteriorating without treatment, potentially leading to life-threatening outcomes. This was seen particularly relevant during weekends or holidays, when other services are less accessible, or when patients present late at night, which may suggest more serious conditions warranting antibacterial drugs. Consequently, participants felt that OOH prescribers often issue precautionary prescriptions, sometimes even when these may not be clinically warranted.

"We go to the GP during hours, and it is easier to say no because there is always out-of-hours [...]. They'd definitely say at out-of-hours that they have a lower threshold for prescribing. There's definitely a fear that, you know, 'if I don't give it, then they might end up really sick and septic and die and that will be my fault, and I should have given the prescriptions'. It's a defensive way of practicing." (P1)

Changes in prescribing behaviour in OOH services were also attributed to perceived differences in patient groups compared with IH. Most participants explained that OOH prescribers often see patients who have already consulted their GPs but have not responded to treatment or whose condition has worsened after safety-netting advice, alongside those presenting for the first time with true urgent needs. These situations likely lead to more frequent prescribing. The remote nature of many OOH consultations, where prescribers cannot clinically examine patients, further contributes to a cautious approach and higher prescribing, as previously suggested. A few participants also highlighted that patient demand and health-seeking behaviour, which also apply to IH, can prompt prescribers to prescribe to manage patient load efficiently, especially within short

consultations. They suggested that, in some cases, prescribing is viewed as a practical way to conclude consultations and meet demanding patient needs.

“I think my perception is that prescribing is higher in out-of-hours services. Some of that will be for patient selection, but some of it will also be down to the way the system's run and some of that is entirely necessary for them to get through their patients. It's really something that does need to change.” (P7)

Several participants noted that expectations of receiving antibacterials influence individuals' health-seeking behaviour. OOH services are sometimes seen as an 'automatic supply' of antibacterials, and receiving a prescription there validates their belief and behaviour. This creates a recurring pattern in which patients return to OOH services when they feel they need antibacterials but have not received them from their regular GP. This cycle further strengthens their perception that antibacterials provide quick cures and that OOH services offer easy access, even when such treatment not clinically indicated.

“I think having worked in out of hours, patients seek, they do seek antibiotics, they ask for them. When you tell them that they're not getting them, I had people cry on the phone and say 'well, don't worry, I'll go to my GP in the morning anyway and get them'” (P1)

5.4.3.2 Theme II: Potential Solutions to Improve Prescribing

This theme explores areas for improvement and proposes strategies to enhance AMS practices. Participants discussed various solutions to optimise primary care prescribing overall, with some specific suggestions for OOH services.

5.4.3.2.1 Data Management and Communication

All participants indicated several challenges in collecting, analysing, and comparing data related to antibacterial prescribing, especially in OOH services.

The majority expressed that the lack of comprehensive, quality data made it difficult to assess prescribing appropriateness or compare practices across primary care generally. They noted that retrieving data for such processes involves difficulties, and these are amplified in OOH services due to system limitations. OOH systems rely heavily on free-text entries, making data extraction and analysis complex and inefficient compared with using more intuitive platforms that facilitate data collection, interpretation, and auditing.

“We certainly don't have any information on appropriateness then because that isn't on the prescription anyway and you'd have to trawl through out-of-hours notes and the Adastra system and it's just not that intuitive really.” (P1)

Many participants emphasised that prescribing volume alone, e.g., the number of prescribed items, is insufficient to fully understand issues or guide action, especially in OOH services. They advocated for thorough, practice-level audits to help those responsible (e.g., decision-makers) identify sites and HCPs who struggle with prescribing, enabling more targeted actions. However, the lack of clear denominators in OOH complicates efforts to conduct such meaningful audits, compare practices, and deliver feedback. Participants suggested using metrics, such as practice size (as in IH services) or the number of consultations as denominators, while acknowledging the difficulty of identifying these in OOH.

“Out-of-hours have done some audits with us looking at their UTI prescribing and more recently looking at their 4C prescribing [...] again, very difficult in terms of not having denominators to compare.” (P7)

“You can have big suspicions from your prescribing data that we've got inappropriate prescribing going on, but until you do the actual audit you don't know that.” (P5)

A number of participants also acknowledged the limitations of current data provision in primary care generally. For instance, they noted that data provided to HCPs sometimes fails to help them understand local resistance patterns. If such data were presented in easily understandable forms, it could support more informed prescribing, helping HCPs to select drugs with lower resistance rates in their geographical area.

They also noted that existing prescribing data, including for IH services, although useful, lacks key details such as patient age and sex, highlighting a need for data that goes beyond basic figures to enable complete understanding and deeper analysis. Only one participant reported that a pharmacist in their HB had reviewed data from CASPA, which showed that antibacterials accounted for about half of OOH prescriptions but only 1.7%–2% of total antibacterial prescribing. The commonly used drugs and durations aligned with the HB's overall prescribing, leading to the perception that OOH was not a local concern. However, they still acknowledged that the analysis lacked patient-level details, limiting full understanding. Such information could inform tailored interventions for specific patient cohorts. As one participant explained, identifying prescribing among paediatrics might lead to parent-focused education, whereas overprescribing in care homes would require targeted interventions for those settings.

“But that goes along with information, a lot of what I get from GPs as well ‘I don't know what our resistance patterns are, I don't know’. [...] the data that we get is excellent from Public Health Wales, but it's very basic. We need more than that.” (P1)

The need for improved communication and data sharing across services was emphasised by most participants. Some were unclear on how data and guidelines are disseminated to OOH staff. They called for more effective data linking and integration between IH and OOH services to ensure consistency and keep OOH staff informed and involved in activities available to IH staff. This could help OOH staff identify areas where they deviate from best practice and strive for improvement. Participants also discussed the value of easy data exchange between services, with one proposing an ‘antibiotic passport’ to transfer patient information, enabling prescribers to access patients’ medical history, including previous consultations and antibacterial use.

“I think we need to keep trying to bring them [out-of-hours] into the programme we've got going with the GP practices, you know, the audits, the education, the feedback, so that they can be aware of anywhere that they're kind of outliers in their practice and then work to improve it.” (P7)

5.4.3.2.2 Training and Education

The majority of participants identified AMS training and education as crucial areas for improving prescribing across all primary care settings, and proposed various delivery approaches. These involve refresher courses to keep all prescribers, including those in OOH services, up to date with current practice and guidelines, allowing them to review core AMS principles when needed. Rather than offering a traditional format focusing only on stepwise treatment (e.g., first- and second-line options), a few participants suggested translating detailed guidance into concise, digestible formats that support easy learning and clarify treatment choices and the underlying rationale.

Facilitating shared learning through peer review and educational sessions was also discussed, with incentives suggested to encourage attendance among OOH staff, given their challenging schedules. Some participants stressed the importance of involving experts, such as microbiologists, in delivering education, as their specialist knowledge can challenge prescribing practices and reinforce key messages. There was an agreement that all prescribers, even those without antimicrobial specialities, should understand appropriate

treatment approaches and the reasoning behind them to support better day-to-day practice.

“As an antimicrobial pharmacist, I could, and I have done this before, drill down the NICE guidance, all of the underpinning evidence and present it in a way that is much easier and palatable, like a bite-size learning idea for colleagues who are not antimicrobial pharmacists so that they can then know, not just what they should do to treat X infection, but why that is how they should treat X infection, which I think embeds learning slightly more than just robot style” (P6)

One participant suggested taking a proactive approach by emphasising AMS at earlier stages of education, noting that current undergraduate curricula may not provide adequate AMS knowledge, without referring to particular professions. Together with limited support for junior HCPs, this gap could lead them to adopt prescribing habits from senior colleagues, even when these deviate from best practices. Strengthening undergraduate programmes could better prepare new graduates by providing a robust AMS foundation to prioritise rational prescribing and confidently challenge established malpractices. Such preparation may minimise the influence of inappropriate practices from more experienced HCPs as juniors begin their careers.

“I think that we need to invest more in undergraduate programmes. I don't think that they understand antimicrobials at all, I don't think that it's taught very well. And then when they come out and practice in their junior years, they need to have the support from their health boards to challenge the more senior doctors who do things differently. We still see a lot of behaviour of, ‘well, my consultant told me to do it’ and then they're trained in that manner and that's the practice that they then continue.” (P1)

5.4.3.2.3 Decision Making Support

The importance of transparency and open dialogue, especially with those in OOH services was stressed by a few participants. One suggested that encouraging prescribers to comfortably share their thought processes and decision-making criteria may help them express concerns freely, justify their practices, and seek support when needed. Understanding their approach, particularly in OOH contexts, may represent a crucial step toward developing strategies that address their unique needs and challenges.

“You can send them the data but sending data on its own doesn't mean it's going to get to all those people that you want to see that data. So how do you get everybody around a table so you can really talk about it and actually listen to their views about why they do what they do.” (P5)

Some participants highlighted the need for leadership to create a supportive environment by providing strong backing and reassurance for prescribers. They emphasised empowering prescribers to make confident, informed decisions based on the information available to them, especially when deciding not to prescribe antibacterials. The focus should be on promoting open communication and continuous learning rather than creating fear of consequences for mistakes or refusals to prescribe.

“It is about that support that, you know, if you do make a mistake and someone doesn't get them [antibacterials] and end up in hospital very poorly, as long as your decision-making was sound and you've written everything down, we will support you.” (P1)

Most participants also stressed the necessity for resources to support prescribing decisions in OOH services. These involve access to full patient records including medical history, previous consultations, and prescriptions, in addition to microbiology advice, guidelines, and POCTs. Furthermore, moving to face-to-face consultations was also highlighted as essential for decision-making, particularly when considering antibacterial prescriptions. Such consultations allow for thorough evaluations and physical examinations that may identify issues not always revealed remotely.

“I think that we need to look at things like access to point-of-care testing, including the out-of-hours services, so have we got any point-of-care testing that people can use to support them in terms of antimicrobial prescribing.” (P5)

“There's a lot that you can glean from an examination, it might be like a physical examination to understand levels of pain or whatever, and so that something around being seen face to face is something that I'm starting to think more and more about.” (P3)

5.4.3.2.4 Promoting Behavioural Change and Accountability

A number of participants referred to the importance of accountability in promoting behaviour change. Some suggested strengthening HCP accountability by encouraging medical directors to adopt more vigilant strategies, holding those who overprescribe or deviate from guidelines responsible for their actions. This could encourage HCPs to reconsider their practices. One participant also called for national-level involvement, urging greater engagement from the WG to address prescribing challenges.

“We know in [geographical area] where our poorer performing practices are, the ones that don't follow guidance, the ones that prescribe antibiotics more and they should be kind of held to account really to understand what they're doing.” (P1)

A few participants highlighted the need to invest in public behavioural change to reduce inappropriate antibacterial use. They were concerned about the public's limited awareness of antibacterials, believing that current efforts have not effectively conveyed the seriousness of AMR and its life-threatening costs. One participant advocated for urgent public health campaigns with clear, impactful messaging to emphasise shared responsibility and the wider impact of inappropriate use. They highlighted the need to educate and hold patients and the public accountable by increasing awareness of how individual behaviours affect the wider field of medicine.

"I'd like a public health campaign, a very strong public health campaign. We've had scraped the surface, but we don't really tell people that you will die if you don't stop your behaviour and understanding that will change the face of modern medicine. I, honest to goodness, do not believe that people understand what we use antibiotics for." (P1)

5.4.3.3 Theme III: Barriers to Implementing OOH Interventions

This theme explores the barriers, as perceived by the participants, for implementing OOH AMS interventions. Most barriers centred on the absence of OOH data and the operational and organisational challenges related to the nature of the services.

5.4.3.3.1 Data-Related Challenges

While data were acknowledged as a potential solution, many participants highlighted the lack of OOH data as a major barrier to implementing AMS interventions. This absence makes it difficult to identify potential problems and determine appropriate actions. Participants also noted that manual audits in these settings are resource-intensive, time-consuming, and often yield limited data. As all participants noted, without a clear understanding of the situation in OOH services, designing and implementing effective intervention is challenging. More information regarding data has been reported in Section 5.4.3.2.1.

"I think data is our biggest thing. It's really difficult to decide what interventions need to be made until you know what's going on already." (P2)

5.4.3.3.2 Operational and Organisational Challenges

A number of participants noted that the varied schedules and irregular shift patterns of OOH HCPs, unlike the more consistent structure in IH services, makes it difficult to bring them together, creating a barrier to implementing interventions. The lack of a regular, consistent team structure, with some never having worked together, was also viewed to

contribute to communication complexity. These issues require additional time investment and coordination, including availability when OOH HCPs are working.

"It's a much harder group of people because you cannot gather them together in the same way that you do if you're going to work with a department or a community pharmacy or GP practice because they're all in the same building, whereas in out-of-hours it's a mix of people who may do one shift a month or those who do four or five a week." (P1)

"The out-of-hours nature of it makes it challenging as well because they're working when we're not, so getting people to meetings is challenging." (P7)

The perceived disconnect and lack of communication between IH and OOH services were identified by a few participants as barriers. One participant, though uncertain, articulated that challenges may arise from the organisational complexities, such as different governance structures, each with its own guidance and operational procedure. This disconnect was also seen to constrain establishing integrated guidance and harmonised practices across the two services.

"The fact that we are separate and not talking to each other and haven't got that joined up is probably the first huge barrier. Then I would say that's, in [Participant's HB] that something for me to look at, but I think, I believe there are separate governance structures and protocols and different things." (P3)

A few participants highlighted the lack of clear responsibility for prescribing in OOH as a potential barrier. Within IH services, HCPs are easily identifiable and held accountable for their prescribing, while OOH prescriptions are often issued under generic identifiers, making it challenging to track individual prescribing behaviours. This anonymity limits the ability to address inappropriate practices and hinders targeted OOH interventions.

"there's a bit of less care [in OOH services], [...] you can analyse when you're in a surgery down to prescriber level who's been prescribing. So you could see within a surgery if there's five GPs and one is prescribing loads, you'd be the outlier. Whereas in out-of-hours, it's just one pad, isn't it?" (P4)

All participants identified additional factors, mostly patient-related, as barriers to implementing interventions during OOH shifts. They emphasised that limited appointment time, which is complicated by high patient volume, could restrict HCPs' ability to engage in thorough discussions. Additionally, incomplete patient information and the absence of established relationships, since patients are usually unknown to HCPs, create further challenges. These factors, along with concerns about the perceived urgency of patient

conditions, could lead HCPs to prescribe rather than follow AMS strategies. Many suggested that these factors could make adopting existing interventions difficult in OOH services, as they may not align with their experiences.

“They [in OOH services] don't have the full information available to them about that patient at the time. There's often a huge list of patients to see. It's the same in the day, but I think you haven't got that relationship with the patient. [...] it's a lot quicker to give them a prescription than to have that conversation about why you're not prescribing for them and, the concern that it's middle of the night or weekend and patients wouldn't have got healthcare unless they're perhaps more unwell.” (P4)

5.4.3.4 Theme IV: Facilitators to Implementing OOH Interventions

The theme involves potential facilitators for implementing tailored interventions to OOH services. These were around the need for leadership engagement, AMS promotion, and standardisation of tools and procedures.

5.4.3.4.1 Strategic Enhancement

Several participants emphasised that leadership support is crucial for successfully implementing AMS interventions in OOH services. They highlighted the value of hierarchical leadership and the need to identify service leaders who can drive the process (distinct from antimicrobial pharmacists interviewed). Prioritising AMS and guideline adherence, promoting AMS tools and strategies (e.g., leaflets, delayed prescribing) to ensure consistent messages, and facilitating access to information and encouraging others to do the same were seen as essential responsibilities of these leaders. Participants also suggested that a collaborative, stakeholder-driven approach is vital for tailoring and implementing OOH interventions, with clear pathways for such collaboration and coordination seen as important.

“You'd have to find out who your lead clinicians are in out-of-hours because once you've got them onboard, I think they'd be very keen to support and will provide the information that's needed and then support their colleagues to do so. [...] you'd have to work with your lead clinician and your leads very closely to understand who you're targeting and what the intervention is and get them to support you to roll that out.” (P1)

Some participants emphasised the importance of data as a facilitator in developing interventions (as discussed in Section 5.4.3.2.1), reinforcing the perception that interventions supported by robust data are more likely to be adopted.

5.4.3.4.2 Process Standardisation and Continuous Improvement

A few participants highlighted variability in documentation among HCPs, which complicates the analysis of prescribing patterns. One participant believed that a consistent approach would facilitate data analysis and inform OOH interventions. Another highlighted the value of consultation templates in easing workflow and enhancing the consistency and reliability of data collection. They suggested that tools tailored to the specific needs of OOH HCPs could support adherence to best practices.

“We can't really do an audit because our system doesn't allow us to. There is an electronic system, it's all free type. I think you'd really struggle to see even what is being prescribed; it all depends on whatever that doctor is documenting. So, sort of standardisation in how they complete their consultations on the system.” (P2)

5.4.3.5 Theme V: AMS Strategies and Successful Implementation

This theme covers different facets of AMS interventions, highlighting useful strategies and tools, considerations for successful interventions, and challenges in evaluating their outcomes.

5.4.3.5.1 Available AMS Interventions and Initiatives

Various AMS interventions were discussed by participants, most of which were implemented in IH services, with some variations across HBs. These interventions aimed to promote responsible antibacterial use and enhance HCP's knowledge and prescribing practices. AMS sessions were among key educational strategies, in which HCPs could share their experiences and learn from others. These sessions promoted collaborative learning through teaching and feedback, case studies, peer review meetings, and discussions with GPs. Educational materials were also distributed to raise awareness. Additionally, training and education packages available through the TARGET toolkit and HEIW were recognised as valuable resources.

“We do a teaching session or a feedback session at every prescribing lead meeting, which is every three months with the lead GP from every practice. We do antimicrobial stewardship session where we highlight any changes or report back data.” (P2)

“Actually, use of the e-learning packages that give you a certificate and things I think is good, so it might be TARGET, it might be this HEIW one.” (P3)

All participants highlighted the benefits of incorporating electronic tools and guidance into clinical practice. The TARGET toolkit, in particular, was frequently praised for offering

comprehensive support for HCPs through its wide range of resources. Beyond its educational and training components mentioned earlier, it provided practical resources to support communication with patients, such as leaflets and counselling checklists, helping to guide discussion and education. They also noted the usefulness of its instructional videos and auditing tools that further supported AMS efforts.

“We use the TARGET toolkit in [geographical area]. We use them a lot for our interventions and what we’ve implemented and education and training on the back of that. We use the TARGET toolkit for primary care. That’s our main stewardship tools that we use in [geographical area] [...]. We quite like TARGET in here and that’s what we promote to our GPs.” (P1)

Most participants also acknowledged the positive impact of digital platforms, such as NICE and MicroGuide, in supporting prescribing. The development of regularly updated, HB-specific guidelines on MicroGuide was appreciated for its accessibility and ease of use, receiving favourable feedback from users, i.e., GPs. One participant also cited another tool, ScriptSwitch messages, which promote responsible prescribing among HCPs in GP practices. These messages served as useful prompts or reminders when prescribing broad-spectrum antibacterials.

“Developing guidelines and putting them on an app and sharing them with the surgeries, that’s made a massive input. A lot of the feedback we get from the GPs is it’s really, really useful to have and it’s updated.” (P4)

Most participants discussed additional AMS interventions, including financial incentives, auditing, and sharing of data-driven feedback, some of which were cited more frequently than others.

A few participants suggested that incentivising positive behaviours could drive change among HCPs by promoting adherence to best practices while acknowledging the pressures they face, such as high demand in OOH services. Existing prescribing incentive schemes were reported to effectively motivate HCPs to make responsible prescribing decisions during IH services; however, these are not extended to OOH services. Such schemes often include AMS elements that require individual GPs to audit their practices and meet specific targets to become eligible for incentives. Feedback from prescribing advisors is usually provided as part of this process. Moreover, participants noted that NPIs, which benchmark HB and GP practice performance, are viewed positively by GPs.

Many participants also highlighted conducting IH practice-level audits using national or local tools to monitor data, especially for high-prescribers, and providing targeted feedback to encourage improvement. However, one participant believed that these audits did not always achieve their intended purpose, citing hesitancy among some practices to allow audits (e.g., 4Cs use) on their premises.

"We use a financial incentive scheme we've got in the health board called the prescribing management scheme and we've got a strong focus on antibiotic prescribing in there so we've had that audit focus on antibiotics for a number of years, which then has meant every GP practice has looked at their prescribing, fed back, and made changes as a result of that. But out-of-hours aren't included in that programme at the moment, and so they always kind of fall outside of some of this work we've done." (P7)

Collaborating, networking, and engaging with others were also viewed as valuable approaches to strengthen AMS by many. One participant described their involvement in the AWAPG, where members regularly meet to share experiences and discuss antimicrobial-related issues. Another suggested working with commissioned services, such as microbiology, to support prescribers in making informed decisions. Collaboration was also seen in establishing dedicated antimicrobial posts, such as primary care antimicrobial pharmacists and HCAI leads, and involving experts who have cross-sector connections to bridge gaps between settings (e.g., those working in both IH and OOH services).

"We have a group of antimicrobial pharmacists across Wales, like a network which is really strong, and we can use ideas from each health board and something that they might have done [...] so we don't have to replicate the sessions, and it also means that any prescribers who move around Wales all get like a unified message." (P2)

Most participants expressed limited awareness of AMS interventions tailored specifically to OOH services. Only two described their AMS approaches for OOH services, which involved recently promoted educational sessions. However, attendance at these optional sessions by OOH prescribers was low. Additionally, of the two participants, one reported encouraging their GP OOH services, operating separately from NHS 111, to conduct audits, using the national Clinical Effectiveness Prescribing Programme (CEPP) or locally developed HB audit tools, to identify deviations from guidelines.

"There's a GP who's deemed to be prescribing lead in each GP practice and they come to these education meetings we put on around antimicrobial stewardship [...], we've extended out an invite to any out-of-hours staff to attend those meetings for CPD [continuing professional development]. [...]. We've had two turn up so far." (P7)

5.4.3.5.2 Ensuring Successful Implementation of AMS Interventions

All participants considered an intervention successful if it achieved its intended goal. Some illustrated this by referring to tracking shifts in data when the aim was to change prescribing behaviours or promote prudent use. Others suggested measuring success through observable reductions in prescribing over a defined period. However, two participants stressed that these changes should not lead to unintended consequences or patient harm, highlighting the ethical responsibility to balance effectiveness with safety.

“If your intervention was ‘I want to change prescribing practice from always prescribing one antibiotic to another’ then you would watch the data and watch the when you don’t want them to prescribe go down and the when you do want them to prescribe go up, but I suppose you’d always have to balance that with, are you causing any harm?” (P4)

Additionally, many participants emphasised that an ideal intervention should enable ongoing tracking and performance reporting. Continuous monitoring of progress and regular data communication would keep users engaged and motivated, encouraging further improvements and contributing to the intervention’s success.

“I guess regular updates, again around communication, but making sure people are updated on how the intervention is working. Because I think if you start to see some success that then leads to people wanting to make it even more of a success as well.” (P7)

A few participants believed that interventions should prioritise simplicity to produce sustainable changes. One noted that clear, easy-to-use interventions are more likely to become embedded into daily practice and eventually become ‘business as usual’, promoting long-term compliance and behavioural change. They highlighted that complex interventions, in contrast, may discourage adoption, causing individuals to revert to previous habits. Another participant suggested using behavioural change models, such as the EAST framework (Easy, Attractive, Social, and Timely), to support intervention design and implementation.

“Your interventions have got to be fairly simple. If you make them quite complicated, people won’t do them, and they won’t continue to do them. If you’ve got more than two steps to follow, they’ll just think ‘I can’t be bothered with this. What was wrong with what I was doing before?’ So, it’s got to be easy to follow, implemented well and that everybody just does it and it just becomes business as usual.” (P1)

Promoting collaborative stewardship for successful implementation was discussed by most participants. They emphasised the importance of working together toward shared goals and adopting mutually agreed approaches rather than imposing interventions. It was indicated

that active engagement from all stakeholders, including senior leaders and prescribers, are valuable to ensure awareness and informed participation. Furthermore, ongoing feedback and dialogue with prescribers were encouraged, with acceptance, positive user feedback, and peer recommendations to adopt such interventions regarded as indicators of an intervention's success.

"Stewardship to me is never about one person telling another what to do. It's around co-production and co-collaboration and working together to reach solutions that are acceptable to everyone because you can tell someone what to do till you are blue in the face, but they won't do it." (P1)

"The people using it [intervention] have to see the point of why you'd want it used." (P2)

5.4.3.5.3 Constraints to Assessing AMS Interventions

All participants indicated that they do not routinely or formally assess the success of individual interventions. Instead, they rely on broader indicators, such as changes in prescribing data and overall reductions. While more systematic assessment was viewed as desirable, insufficient resources and support were reported as constraints to such practice. These constraints exacerbate time pressures, competing demands, multitasking, and heavy workloads, all of which divert attention from completing full audit and feedback cycles. Moreover, securing engagement from stakeholders, particularly busy prescribers, to allocate time for auditing and feedback was deemed difficult, especially when feedback messages are repetitive. To improve sustained engagement, one suggested using data to clearly demonstrate the value and impact of feedback.

"Obviously with busy workloads, we don't always manage to achieve that, but we try to whenever we can. [...] resource doesn't always allow so it'll depend, if any additional priorities come up in the meantime that we have to prioritise, but that is the ideal thing. [...] I guess we could face challenges in terms of engagement from the practice in terms of their time if we'd already been in and fed back and then re-audited and needed to go back in again." (P7)

Structural and process-related challenges in evaluating AMS interventions were also reported by participants. Many adopted a collective, target-driven approach, implementing multiple interventions simultaneously to improve prescribing practices. This made it difficult to isolate the impact of individual interventions or determine which were most effective. Different participants also reported other challenges, including delays between

implementation and observable outcomes, slow feedback, and complex reporting mechanism.

“The difficulty is that you are target-driven, and you've got a big target to meet [...] So we won't be doing one intervention. We'll be doing anything that we think works in practice so that we can try and bring, claw back that poor prescribing back to an acceptable level”
(P1)

5.4.4 Key Point Summary

- Although understanding specific prescribing patterns over the study timeframe (Chapter 4) was a key objective, participants were uncertain how to explain the observed trends or identify the factors or initiatives driving changes in their HB data, as captured by CASPA. However, they attributed the improvements to collective efforts and multiple interventions aimed at meeting the UK NAP objectives and Wales improvement goals, rather than a single intervention being more effective than others. The interview data also highlighted important considerations when interpreting the HB graphs. In particular, the accuracy and interpretation of prescribing data, especially for OOH services, were potentially affected by unrecorded pre-packed items dispensed outside community pharmacies. This limited the ability to capture actual volumes across HBs, and consequently, restricted participants' ability to interpret the data.
- Participants had a lack of awareness regarding OOH services, with most discussions focusing on primary care more broadly, particularly with data and AMS interventions.
- Several potential factors influencing antibacterial prescribing were identified, including healthcare crises, media influence, available resources, and individual perceptions and behaviours.
- Limited data availability, especially in OOH services, posed significant challenges to understanding existing issues and implementing targeted interventions.
- To address concerns around antibacterial prescribing, improvements are needed across multiple areas, with particular emphasis on enhancing data systems, strengthening education and decision support, and encouraging behavioural changes and accountability across healthcare settings, especially OOH services.

5.5 Discussion

5.5.1 Main Findings and Relevance to Literature

This project explored the perspectives of key stakeholders in Wales on oral antibacterial prescribing in primary care, with a focus on OOH services. Participants demonstrated limited awareness of prescribing and AMS activities specific to OOH, often referring more broadly to primary care. The findings revealed multiple factors potentially influencing prescribing practices. Participants also highlighted challenges and opportunities for improving AMS, identifying core priorities from their perspectives and noting perceived barriers and facilitators to implementing AMS interventions in OOH services. They also shared examples of successful IH interventions, such as the TARGET toolkit and MicroGuide, outlining perceived factors contributing to their success and difficulties in evaluating their outcomes, which are critical for guiding future AMS strategies.

After analysing CASPA prescribing data (Chapter 4), which showed an overall decline and some notable trends across HBs, interviews were conducted to explore the underlying drivers (e.g., specific interventions). Participants were presented with their respective HB data but found it difficult to attribute the decline to any single intervention or event. They suggested that a multifaceted approach aimed at meeting national targets was more likely responsible. These targets include Wales improvement goals of a 25% reduction in prescribing by 2024 from the 2013 baseline (Welsh Government 2022a) and the 2019–24 UK NAP objective of a 15% reduction in human use (DHSC 2019b).

While these collective efforts likely achieved positive outcomes, they made it difficult to isolate the impact of individual interventions. This reflects a broader challenge in AMS, as highlighted in a narrative review by Suttels et al. (2022), which summarised literature between 2000 and 2022 on the nature and impact of AMS activities in primary care and the factors affecting their adoption. The review found that most AMS activities were implemented in combination, which, while effective, complicated measuring the impact of interventions separately (Suttels et al. 2022), a challenge also clear in participants' accounts in the present study.

Participants also highlighted variations across HBs in population characteristics, such as deprivation, likely resulting in higher prescribing. This claim is supported by multilevel analyses in Wales showing a significant association between deprivation, measured using

the Welsh Index of Multiple Deprivation score, and higher antibacterial prescribing among the most deprived patients (Adekanmbi et al. 2018; Adekanmbi et al. 2020). Similar patterns were observed in England and Scotland, using their respective deprivation indices (Covvey et al. 2014; Thomson et al. 2020). These studies, however, examined general primary care and were not specific to OOH services. Importantly, all HBs in Wales contain areas of deprivation, though the concentration and extent vary. For example, CTMUHB and CVUHB have a higher proportion of deprived areas, with 15% and 14% LSOAs (Lower-layer Super Output Areas, average of 1,500 people each) in the most deprived 10% in Wales, respectively, compared to PTHB (1%) and HDUHB (4%) (Welsh Government 2019d). These differences warrant further exploration of deprivation's influence on prescribing at the HB level.

Rural versus urban settings and patient comorbidities were also perceived as factors contributing to prescribing differences across HBs. In Wales, no HB is entirely rural or urban, as each covers a mixed population; however, some are predominantly rural (e.g., BCUHB and PTHB) while others more urban (e.g., CVUHB). Although no published evidence has specifically examined this issue in Wales, international studies have reported higher prescribing in rural areas (de Jong et al. 2014; Thomson et al. 2020). Rural populations in Wales also tend to be older, with HCPs there managing those with multiple chronic diseases (Gartner et al. 2007). A narrative review has further highlighted higher, often inappropriate, antibacterial prescribing in rural areas (Yau et al. 2021). This could be attributed to the limited access to services, resource allocations, workforce shortages, and different patient populations (e.g., poorer health and greater co-morbidity), which may collectively create pressure to prescribe.

Participants suggested comparing prescribing in Wales with countries showing more favourable profiles. Although this study did not include a formal international comparison, such analysis could reveal policies or practices that reduce prescribing and contextualise local performance. Primary care data indicate that Sweden, the Netherlands, and Finland have greater control over prescribing than the UK (Nuffield Trust 2025; European Centre for Disease Prevention and Control n.d.), likely reflecting cultural attitudes, stricter policies, and long-standing AMS commitments despite already low prescribing averages. Cronberg et al. (2024) provided possible explanations for Sweden's reduction, including the introduction of

pneumococcal vaccination in 2009, financial incentive-based targets, public awareness of antibacterial risks, and stewardship. While Wales-specific figures are limited, higher primary care antimicrobial use compared with England (AWMSG 2022a) suggests that local strategies may be insufficient or poorly implemented. This highlights the need to evaluate current practices and consider lessons from countries with more effective stewardship.

Participants highlighted a notable shift in prescribing during the winter of 2022–23 secondary to the GAS outbreak. However, as the data investigated in this study preceded the outbreak (April 2015–March 2022), this surge was not captured in the dataset presented to participants. Participants' emphasis on the outbreak and its consequences may reflect its substantial impact on practice, or could result from recall bias, as it was the most recent challenge after COVID-19. Differences in participants' length of experience, with some newly appointed, may also have limited their awareness of earlier influences. Notably, upsurges in GAS cases have occurred previously in England, with over 14,000 cases in 2014 and around 30,000 in 2018, particularly among children aged 2–8 years (UKHSA 2023c). National surveillance shows that GAS infections follow a cyclical trend, with peaks occurring approximately every four years (UKHSA 2023c).

Several European countries, including France, the Netherlands, Sweden, Ireland, Denmark, Spain, and the UK, reported unusual increases in GAS cases between late 2022 and 2023 (WHO 2022; Cobo-Vázquez et al. 2023; Johannesen et al. 2023; Lassoued et al. 2023).

Antibacterial prescribing also rose across Europe and the UK during this period, especially among children and adolescents, coinciding with surges in GAS, influenza, and respiratory syncytial virus before stabilising or exhibiting some fluctuations through 2023 and 2024 (Kostev et al. 2025). The ESPAUR reports also attributed increased prescribing in England to these surges (UKHSA 2023b; 2024a). In Wales, this led to an out-of-season rise in prescribing exceeding previous years' rates, especially among children under 10 years, with five deaths among those under 15 years (Public Health Wales 2023b; Public Health Wales Health Protection 2024).

The UK Health Security Agency (UKHSA) released interim guidance in December 2022, advising HCPs to lower their prescribing threshold for children with a FeverPAIN score of three or more (NHS England 2022). This guidance was withdrawn in February 2023 as infection rates reached similar levels to previous years, with prescribers instructed to revert

to standard practice while remaining vigilant for GAS complications (NHS England 2023a). It would be interesting to see whether the rise in prescribing was sustained after the guidance was reversed. Further investigation into HCPs' decision-making is therefore needed, as adherence to the reversed guidance may have been inconsistent due to challenges in changing prescribing behaviour and concerns about accountability for unforeseen cases. Evidence from OOH services is also lacking, representing a gap in understanding the full impact of such outbreaks on antibacterial prescribing.

The surge in GAS cases increased demand for antibacterials, causing medicine shortages and supply issues, as reported by the study participants, across the UK and Europe (DHSC 2022; European Medicines Agency 2023). In England, dispensing antibacterials for children, particularly penicillin V, reached 308% and 436% higher than comparable weeks in 2019 and 2021, with increases in alternate formulations and antibacterials for respiratory infections, and delays between prescribing and dispensing (UKHSA 2023a). This problem allowed pharmacists to legally supply alternative medicines or formulations in the UK without patients returning to prescribers (DHSC 2022). Such shortages are a recurring problem across Europe, including the UK, regardless of GAS outbreaks (Miljković et al. 2022), with hospitals commonly substituting antibacterials to manage stock (Miljković et al. 2022; Lőrinczy et al. 2023). These substitutions may increase AMR risk, especially when broad-spectrum drugs replace narrower-spectrum options.

Study participants reported that media coverage amplified concerns rather than relieving them. Mass media reports, particularly those on child deaths and antibacterial shortages, may have heightened public anxiety, especially among parents, and potentially influenced their attitudes toward antibacterial use (BBC news 2022; Fricker et al. 2022; Guo 2022; iNews 2022; Sky news 2022). The media's impact on public perceptions of medicines and policy has been reported in the literature, such as those on illicit drugs (Gunther 1998; Lancaster et al. 2011; Cohn et al. 2020). A key concern was selective and exaggerated reporting, which omits other perspectives (Ramsay 2013; Larsson et al. 2019).

Such impact was seen in Wales during the drop in measles, mumps, and rubella vaccination rates in 2002–03. The decline was influenced by a 1998 Lancet study suggesting a link between measles, mumps, and rubella vaccine and autism, which received wide, uncritical media coverage (Wakefield et al. 1998). This claim was later disproven in a 2004 report

(Institute of Medicine Immunization Safety Review Committee 2004), and the study was withdrawn in 2010 (Wakefield et al. 2010). Its author, Dr Andrew Wakefield, was removed from the medical register by the General Medical Council (GMC) for misconduct (Boseley 2010). This received less media attention than the original report, demonstrating biased reporting of discredited claims (Laurance 2013; Robbins 2015). However, the initial media coverage had already shaped public opinion, contributing to a significant drop in vaccination uptake that resulted in a measles outbreak in 2013 (Ramsay 2013; Wise 2013).

Balancing media coverage remains challenging, particularly with the rapidly evolving platforms. A lack of medical knowledge has been reported as a barrier to delivering messages between scientists and reporters. To address this, Larsson et al. (2019) suggested offering accessible networks for cross-checking information, media training, and regular meetings to facilitate communication. Greater engagement with journalists and providing reliable resources could also counteract irresponsible behaviours (Leask et al. 2010), such as dealing with public health crises. Launching strong campaigns, similar to the UK Government's 'Don't Feed the Beast' initiative during COVID-19, could empower the public and mitigate inaccurate or exaggerated news, reassuring the population and addressing their concerns (UK Government 2020). This highlights the need to explore how media can be utilised to reinforce AMS messages, with a coordinated national media campaign emerging as a priority for future action.

The rise in GAS infections has also been linked to the COVID-19 pandemic, identified in this study as a critical time affecting prescribing. It was suggested that pandemic restrictions, including lockdowns, limited social interactions, self-isolation, and preventative measures such as hand hygiene, mask-wearing, and vaccination, lowered infection incidence and delayed pathogen circulation, including influenza and respiratory syncytial virus. This was reflected in Chapter 4, where prescribing reached its lowest levels during this period. Such decrease was reported in primary care and outpatient settings during the initial phases of the pandemic in the UK, including Wales (Wasag et al. 2021), England (Andrews et al. 2021; Hussain et al. 2021; Zhu et al. 2021a; Zhu et al. 2021b), Scotland (Malcolm et al. 2020), and Northern Ireland (Devine et al. 2021; Girvin et al. 2021; Aldeyab et al. 2023). Similar findings were documented globally, with studies examining COVID-19's impact on primary care antibacterial prescribing in the USA (King et al. 2021), Canada (Kitano et al. 2021), Portugal

(Silva et al. 2021), the Netherlands (Hek et al. 2022), Germany (Akmatov et al. 2022), Spain (Guisado-Gil et al. 2022), and Malaysia (Lim et al. 2023). Several studies have also explored antibacterial prescribing specifically in OOH services during the same period reporting similar reductions, including those in the Netherlands (Hek et al. 2022), England (Zhu et al. 2021b), Belgium (Colliers et al. 2021b), and Ireland (Shah et al. 2024).

Delayed pathogen circulation and reduced exposure to infections during the pandemic (as discussed in Chapter 4) may have created an immunity gap, particularly in children (Messacar et al. 2022; Shaw et al. 2023), and altered seasonal transmission patterns for non-vaccine preventable infections such as GAS (Hayes et al. 2023). As social mixing resumed, increased transmission and pathogen circulation likely contributed to increased prescribing after COVID-19 (UKHSA 2023b). Post-pandemic analyses from England (Kurdi et al. 2024; UKHSA 2024a) and Scotland (Al Balushi et al. 2024) in primary care (March 2019–23) have documented these increases, with more recent data indicating a slight decline in primary care and OOH services (Section 5.2). Nonetheless, data on published primary care OOH prescribing in Wales remain limited, with most available data focusing on primary care as a whole and resistance trends (Public Health Wales 2025), highlighting the need for further investigation. While PHW has recently produced reports on GP OOH and NMIP prescribing, they are not publicly available and thus could not be reviewed (Phillips 2025).

Changes in healthcare delivery during COVID-19, especially the shift to remote care, possibly influenced prescribing behaviours. Remote care may have led to more frequent prescribing compared to in-person consultations (Vestesson et al. 2023), partly due to limited diagnostic procedures. A systematic review of pre-COVID-19 studies on the impact of remote consultations on antibacterial prescribing found mixed results, with four studies reporting higher prescribing, five reporting lower, and three showing similar rates compared to face-to-face consultations (Han et al. 2020). However, a UK report during COVID-19 indicated that GPs believed remote care had changed their practices, with about half feeling it increased their diagnostic test ordering and two-thirds believing it increased their antibacterial prescribing (Beech et al. 2023). These data suggest a need for further work to understand the factors preventing a return to their original practices. Beech et al.'s 2023 findings are also relevant to OOH, where HCPs frequently manage acute cases remotely under added pressures, such as limited diagnostics, constrained safety-netting, and

challenging patient attitudes (e.g., anxiety, aggression). These pressures may compel HCPs to prescribe cautiously, as highlighted by the study participants. Such challenges are consistent with those reported in other countries (Colliers et al. 2018; Williams et al. 2018).

Health-seeking behaviour has also been altered by COVID-19. Some individuals, particularly those with chronic diseases, avoided medical care due to fear of infections, voluntarily missing their appointments (Malhotra et al. 2020). Some were also reluctant to access care even when experiencing symptoms suggestive of serious conditions such as cancer (Quinn-Scoggins et al. 2021). While this initially may have reduced antibacterial prescribing, it could have led to disease progression, requiring more advanced treatment which may include antibacterial therapy.

To influence public beliefs and behaviours around antibacterial use and resistance, national awareness campaigns (e.g., Antibiotic Guardian, Keep Antibiotics Working), media and digital tools, and community engagement events (e.g., in school, museums, and art centres) have been used (Redfern et al. 2020). Such strategies are being embedded in the UK NAP to raise public understanding of the scale and risks of AMR and to encourage individual actions to address the crisis (UK Government 2024), emphasising their value. However, further evaluation is needed to assess their impact and whether tailoring public engagement and behavioural interventions to OOH contexts could promote more prudent antibacterial use.

The need for effective AMS education and training was reinforced by participants in various contexts, particularly early in HCPs' careers. Although participants were not directly involved in undergraduate teaching, they perceived a gap in AMS education and preparedness at this stage. While no specific professional group was specified, their perceptions reflect concerns that could be relevant across multiple healthcare disciplines, including medicine, pharmacy, and nursing. This view supports the WHO's recommendation to integrate AMS as a fundamental element of undergraduate education and training, ensuring future HCPs gain early exposure to adequate knowledge and understanding (WHO 2015).

Evidence suggests considerable differences in AMS teaching across undergraduate programmes. Although antimicrobial courses (or elements) are included in UK healthcare curricula, a 2013 survey identified variations in AMS teaching and evaluation approaches, allocated hours, and principles covered across disciplines (e.g., pharmacy, medicine, nursing) and universities, highlighting the importance of standardised courses (Castro-

Sánchez et al. 2016). Similarly, a European survey examining AMS teaching in medical schools in 13 countries revealed inconsistencies between and within countries, with certain essential prescribing principles inadequately covered (Pulcini et al. 2015). More recently, Hamilton et al. (2023) explored the delivery of AMS competencies⁶ in UK undergraduate pharmacy programmes, finding notable gaps and institutional variations. None of the responding schools covered all 54 national competencies outlined by Courtenay et al. (2018). The authors recommended using such a national framework to support curriculum development (Hamilton et al. 2023). Students' feedback in the same study suggested that AMS and infection were considered essential yet complex subjects. This finding is supported by an earlier evaluation of students' AMS knowledge and attitudes across health disciplines in 25 UK universities, involving 255 participants (Dyar et al. 2018). Dyar et al. (2018) found that, despite recognising the importance of addressing AMR, only one-fifth of participants expressed sufficient antibacterial use knowledge for their professional future. Employing standardised teaching principles and national undergraduate AMS competencies, such as those developed by Courtenay et al. (2019) for nursing, McMaster et al. (2020) for medicine, or Courtenay et al. (2018) for HCPs generally, could unify messaging, ensure consistency across disciplines, and better prepare future HCPs for AMS activities.

It should be noted that all these studies preceded the 2021 updates to the GPhC Standards for Initial Education and Training of Pharmacists and the GMC learning outcomes, which ensure newly qualified professionals have the knowledge, skills, and behaviours to practice safely and effectively (General Medical Council 2018; General Pharmaceutical Council 2021). These updates align with changing practice needs, including the eligibility of all newly qualified pharmacists to prescribe independently upon registration from 2026. Participants' perceptions of educational gaps may, therefore, reflect the experiences of older graduates whose education predated recent curriculum updates and national competency frameworks, or limited awareness of current undergraduate provisions to meet GPhC revised outcomes. For example, at CSPPS, an antimicrobial pharmacist currently runs a series on AMS within the undergraduate programme to support high-quality education

⁶ Competency-based education prioritises learners' capacity to successfully perform tasks (e.g., solve problems, communicate effectively, make good clinical decisions) in real world rather than their ability to absorb and recall content. Competencies can be developed using various methods, such as Delphi, nominal group techniques, and hybrid or modified methods.

(Hodson 2025). However, continuous evaluation of curricula remains essential to ensure future HCPs are adequately prepared, especially in AMS.

The role of senior HCPs in the training and career development of juniors holds significant importance. This study highlighted that much of junior HCPs' learning comes from observing and interacting with their seniors. Such interactions provide valuable opportunities for informal and interprofessional learning, which have been perceived as effective for acquiring knowledge and skills across various settings (Noble et al. 2017; Charlotte et al. 2018; Frearson 2019; Daunt et al. 2025). However, informal learning does not always ensure adoption of best practice and may lead to continuation of poor ones, especially when seniors lack optimal management approaches. In hierarchical medical teams, more pronounced in secondary care, juniors may find it difficult to challenge inappropriate practices (Lewis and Tully 2009). Even when they recognise inconsistencies with evidence-based guidance, they may conform to norms set by seniors (Lewis and Tully 2009), which over time may lead them to adopt similar practices when working autonomously, as suggested in the current study.

Participants in the present study emphasised the necessity of continuing education and training across care settings, especially for OOH and early-career HCPs. They recommended refresher courses, active learning, peer review meetings, and greater engagement to enhance knowledge. However, their suggestions may reflect limited awareness of existing OOH training and education, as staying current with developments across services beyond their focus can be challenging. For example, while participants seemed unaware of activities in NHS 111 as part of OOH services, discussions with the Professional Lead for NHS 111 Pharmacists revealed that peer review sessions for staff are regularly held (Gibbins 2024). Additionally, induction training is already in place, and PIPs are required to complete a transition portfolio to document learning and development to practice in NHS 111 (RPS 2021). Moreover, ad-hoc training is occasionally funded by HEIW and delivered by external providers. When training sessions for pharmacists have available capacity, remaining spaces will be offered to other CSH team members (e.g., GPs). Monthly call audits are also conducted to support quality assurance and may lead to a performance appraisal and development review (PADR) with the individual involved, if issues arise (Gibbins 2024).

Despite these opportunities in NHS 111, the extent to which AMS is emphasised in these sessions remains unclear, highlighting an area for exploration. Additionally, the mismatch between perceived and actual training availability highlights the need for improved communication between the services. It also raises questions about whether deficiencies or variations in training exist across GP OOH staff, NHS 111 CSHs, and different HBs, warranting further investigation.

Refresher and training courses have been shown to improve antimicrobial knowledge and prescribing practices, as suggested by the study participants and existing literature. For instance, targeted refresher courses on rational antimicrobial use, combining lectures with interactive communication training using role-playing and vignette-based evaluations, reduced the intention to prescribe antibacterials among older practitioners with over 20 years of experience (Yamamoto et al. 2018). However, benefits may decline over time, as shown by an Australian study where education sessions improved antimicrobial prescribing significantly in 2018 (Neels et al. 2020), but compliance with guidelines, drug choice, and duration declined the following year (Sangwan et al. 2023). Sustaining improvements may therefore require continuous education, reinforcement, and monitoring, including tracking participation, assessing content and uptake, gathering feedback, and keeping HCPs informed. Accordingly, OOH education and training should be reviewed by mapping provision across services, capturing staff experiences and perceived gaps (via interviews or surveys), and analysing training uptake, content, and outcomes. Such an approach may help assess effectiveness, identify unmet needs, and determine whether additional support and resources are required.

The study highlighted the scarcity and limitations of data available, particularly in OOH services, as a key area requiring improvement. Participants noted that access to meaningful data would help identify existing issues and guide tailored AMS interventions. For example, current data often lack essential information, such as patient age, sex, comorbidities, ethnicity, socioeconomic status, and consultation reason, needed to justify and accurately evaluate prescribing practices. Access to this information could help stakeholders and HCPs understand the populations using these services and the reasons for consultations. The absence of a robust, centralised system for recording OOH consultations and prescriptions also hindered effective record-keeping, monitoring, auditing and feedback provision for

HCPs on their practices. In contrast, some of these mechanisms, such as auditing and feedback and data management, may receive more focus in IH services. For instance, while feedback on prescribing data has been reported as beneficial, only one-third of Clinical Commissioning Groups in England provide such feedback to OOH services (Allison et al. 2020). Such information for Wales is limited, making it unclear how widely feedback is provided. Developing an enhanced, centralised data system could improve documentation, enable more efficient and reliable analyses, support benchmarking and problem identification, and facilitate targeted feedback to help HCPs improve their practices.

The need for better data was also accompanied by an acknowledgement that the distinctive setup of OOH services complicates data quality and representativeness. For instance, one HB may commission external providers to manage its OOH services (e.g., Shropdoc (Shropdoc 2025)), while another may serve areas from multiple HBs, potentially complicating accurate interpretation. Additionally, the three NHS 111 CSHs cover all seven HBs in Wales, adding further complexity. Consequently, estimating prescribing or consultation rates per population in OOH services, particularly at the HB level, becomes difficult due to unclear denominators. These complexities, together with previously described issues with pre-packed volumes, limit fair comparisons of prescribing patterns between HBs and between OOH and IH services, where practice sizes and registered patient numbers are available. Such factors may also have impacted participants' ability to interpret the prescribing data presented to them toward the end of the interview. Therefore, OOH data should be interpreted with caution.

Other essential elements were discussed in this present study for effective implementation of AMS interventions. Most of these were also thoroughly acknowledged by the WHO's 2021 policy guidance on integrated AMS activities, requiring a comprehensive national approach that extends beyond individual settings (WHO 2021b). The guidance involved key elements, including producing locally relevant antimicrobial use guidelines, establishing leadership teams that oversees all efforts, and implementing clear reporting and communication mechanisms across different levels. Additionally, it emphasised the significance of monitoring and evaluation, raising awareness, and securing sufficient human and financial resources before implementation (WHO 2021b). Encouraging collaboration and collective agreement among individuals to work together was similarly stressed for

ensuring sustainable actions and efficient resource use (WHO 2021b). Aligning with this guidance, the study reinforces the value of these collaborative, multifaceted approaches in achieving successful and durable AMS implementation to combat AMR.

This study highlights the central role of leadership in driving improved practices. Participants emphasised the leaders' value in providing reassurance and direction, championing initiatives, endorsing AMS activities, and motivating others. Leaders may hold formal managerial or supervisory roles within services or exert informal influence within clinical teams. Their significance lies in the ability to promote strategies and secure wider acceptance of AMS interventions, facilitating active implementation. Evidence from hospital settings in Scotland similarly identified leadership as a fundamental element for AMS success, helping initiate and legitimise interventions in ways that influenced others (Currie et al. 2020). Although resource constraints were found as a barrier to AMS activities (Currie et al. 2020), they were not the sole factor influencing the scope and frequency of these activities (Ness et al. 2022). Some less-resourced HBs in Scotland reported a wide range of activities regularly compared to better-resourced ones, suggesting that leadership style, enthusiasm, and commitment, are influential factors for AMS (Ness et al. 2022).

The importance of leadership in AMS is supported by wider evidence. In a literature review, empowering leadership has been shown to potentially increase HCP engagement and help overcome barriers to successful AMS interventions (Steinmann et al. 2018). A systematic review also found associations between leadership styles and the measures of care quality and multiple patient outcomes, recognising effective leadership as an essential part of integrated care delivery (Sfantou et al. 2017). Conversely, in a study from Latin America, Fabre et al. (2023) identified the absence of leadership as a key barrier to AMS implementation. Similarly, a scoping review of studies from LMICs, reported that 11 out of 22 studies cited absent leadership as a barrier to implementing AMS programmes in hospital settings (Harun et al. 2024).

Although participants in this study were not directly involved in implementing OOH interventions, they identified leadership support, stakeholder engagement, and securing buy-in as key factors for successful interventions, consistent with evidence from secondary and primary care. A qualitative study by Huddy et al. (2021) on barriers and facilitators to adopting POCT in the UK highlighted challenges such as insufficient awareness and buy-in,

resistance to change, and resource constraints, including budget and workloads, as barriers to POCTs adoption. In contrast, endorsement and enthusiasm from key leaders were perceived as drivers of adoption. The study also highlighted the importance of providing concrete evidence, such as sharing patient-level data and outcomes from successful pilot programmes, in demonstrating an intervention's effectiveness and facilitating its implementation (Huddy et al. 2021). Moreover, the value of conversation in understanding HCP challenges and identifying solutions has been highlighted in the literature (Jordan et al. 2009; Parchman et al. 2022). Engaging in productive dialogue with site members and fostering collaboration may support successful and sustained implementation (Jordan et al. 2009).

Greater clarity regarding leadership and the role of antimicrobial pharmacists in OOH services is needed. The interviews revealed a disconnect between the original purpose of these roles (i.e., strengthening AMS by, for example, optimising prescribing, leading audits, developing policy), their current remit in Wales HBs, and how those in post perceive their responsibilities. Antimicrobial pharmacists interviewed did not seem to position themselves as the leaders they felt were needed in OOH services. This raises uncertainty about whether these posts were ever intended to lead OOH AMS as part of their role, or to support stewardship more broadly across settings. They were articulating a gap in leadership without recognising that they may already be serving in that capacity, suggesting ambiguity over where professional responsibility for OOH AMS should lie. The fragmented OOH structures and the blurred lines of accountability make it difficult for anyone to claim ownership. Addressing this ambiguity is essential for effective leadership in this area.

In addition to adequate resources, accessible data, active engagement, and strong leadership, this study emphasised the need for easily adaptable interventions for all staff, including those working OOH. Ease of adoption is essential for reaching and engaging HCPs facing diverse stressors and limited support. A review exploring the barriers to AMS implementation by Suttels et al. (2022) highlighted that the difficulty of reaching primary care staff and their tight workflow may limit the uptake and use of AMS interventions. It stressed the necessity of providing HCPs with concise, easy-to-access, and understandable tools and information to be actively used (Suttels et al. 2022). While relevant to primary

care, these challenges may be even more pronounced for OOH staff. Designing OOH interventions with these factors in mind is essential to avoid unnecessary pressure.

The study participants were unaware of AMS interventions developed specifically for OOH services, with only two reporting recent education sessions offered for OOH staff. The lack of OOH-specific guidance has been documented in the literature, stressing the need to understand this context to inform tailored training and resources (Alves et al. 2021).

However, a few OOH interventions have been studied. In Ireland, an educational intervention was provided for GP OOH, with electronic pop-up messages displayed after decision was made in the patient management software serving as a nudge for prescribers and data collection tool. This approach reduced prescribing of antibacterials to avoid and increased the use of preferred agents (O'Connor et al. 2020). In the UK, an online OOH AMS programme was also developed to support HCPs managing common infections, focusing on managing expectations, self-care advice, delayed prescribing, and safety-netting (NHS England elearning for Healthcare 2021).

Meta-analyses have shown that diagnostic support using CRP testing in primary care can reduce antibacterial prescribing (Martínez-González et al. 2020; Zhang et al. 2022).

However, few studies have examined its use in OOH services, where the benefits appeared limited (Rebnord et al. 2016; Van den Bruel et al. 2016; Dixon et al. 2022). In Norway, CRP did not significantly reduce antibacterial prescribing or hospital referral but rather resulted in increased prescribing (Rebnord et al. 2016). Similarly, studies in England found no overall reduction in prescribing (Van den Bruel et al. 2016). Nonetheless, as discussed in Chapter 2, Dixon et al. (2022) reported that CRP supported OOH clinicians' decision-making and helped them communicate non-prescribing decisions, noting that its limited impact was due to low uptake and inconsistent use.

While implemented in GP practices, one participant highlighted the usefulness of ScriptSwitch, first implemented in SBUHB. ScriptSwitch alerts prescribers at the point of prescribing, encouraging adherence to recommended short courses of antibacterial therapy and suggesting quantity switches, achieving an acceptance rate above 20% (Ahmed 2025). This intervention has been scaled nationally across Wales through collaboration between AWTTTC, PHW, and AWAPG, contributing to reduced exposure to antibacterials and alignment with AMS. It also supports the new NPI targets for 2025–28, promoting

appropriate antibacterial course durations for RTIs (AWMSG 2024b). Expanding ScriptSwitch or developing similar decision-support tools for OOH could enhance antimicrobial prescribing consistency and stewardship.

Across the wider UK, initiatives similar to the NPIs have been developed in England (Quality Premium) (NHS England 2016; Bou-Antoun et al. 2018) and Scotland (SAPG Quality Indicators) (Sneddon 2017) to reduce unnecessary antibacterial prescribing in primary and secondary care. However, as in Wales, OOH services were not reported specifically or separately from primary care, requiring further clarity around the need for specific indicators to assess and improve stewardship in this setting.

5.5.2 Implication and Future Research

Ensuring appropriate prescribing practices is complex, requiring consideration of numerous factors. An essential consideration is to compare prescribing across peers, services, or locations with similar characteristics, such as patient demographics, resource availability, and workload, when feasible. This approach is likely to be more acceptable and convincing to HB and practice leaders and individual prescribers, than comparisons perceived as imbalanced or unfair.

Furthermore, a comprehensive understanding of prescribing patterns, particularly in OOH services, is currently limited by the lack of robust data collection. Existing systems, such as CASPA, do not capture all prescribing activity, including drugs dispensed from hospital stocks (pre-packed items) or those issued through private services, potentially affecting observed trends. This may restrict the ability to accurately assess and understand the full scope of oral antibacterial prescribing and stresses the need for cautious interpretation of the findings. Addressing this will require the inclusion of these unrecorded volumes in future monitoring efforts. Integrating OOH data into existing systems, or developing a dedicated platform, would enhance data visibility and analysis in this context. Such systems should include all dispensed medicines, whether pre-packed or supplied via community pharmacy, to ensure data are complete and reliable. An intuitive, easy-to-use system could also facilitate benchmarking, auditing, and monitoring of prescribing and resistance patterns.

Efforts were made by the researcher to obtain data on the volume of pre-pack items dispensed during OOH services (Appendix 5.8). This included consultations with members of the AWAPG, who suggested contacting the Lead for Antimicrobial Surveillance for PHW. The

Lead for Antimicrobial Surveillance explained the challenges in accessing OOH data. They discussed a transition to a new pharmacy stock control and management system, CareFlow Medicines Management formerly WellSky, in 2022, suggesting that data prior to this date were unavailable. Additionally, limitations in the data from this system were noted. Further consultation with the Divisional Director of Primary, Community Care, and Complex Care in ABUHB revealed variations in medicine supply approaches and documentation across HBs.

Additional guidance from the Divisional Director of Primary, Community Care, and Complex Care in ABUHB also led to engagement with Medicines Procurement and Optimisation Wales within NWSSP and meetings with the Medicines Value Unit Negotiating Principal. During these meetings, the project and the issue of incomplete data were discussed to explore the nature of CareFlow data and the potential for obtaining pre-packed item volumes. To facilitate this, a list of oral antibacterial drugs was shared initially to test the feasibility of generating such data. However, it became clear that procurement data required significant manipulation to obtain the volume of pre-pack items during OOH services. For example, items not linked to specific patients were excluded, as they were either returned to stock or had not been dispensed yet. Additionally, data were reported by pack size, unit dose, or liquid volume, rather than by number of items as used in the CASPA and Choose Pharmacy data. Due to these inconsistencies, a separate analysis of pre-packed items was planned to estimate their contribution to overall prescribing volumes, even though the intended one-year data dataset (January–December 2023) fell outside the study timeframe (2015–16 to 2021–22). After numerous meetings, it was found that distinguishing between items dispensed in primary care OOH and those used in hospital wards was impossible, as location labels were not always clearly defined. Consequently, despite extensive efforts, the data could not be obtained.

Difficulties have been highlighted in the literature in the secondary use of hospital electronic prescribing and pharmacy data to support AMS, including data access, accuracy, completeness, and extraction across multiple systems or sites (Micallef et al. 2017).

However, the complexities encountered in extracting OOH prescribing data do not appear to be reported in published studies, possibly because researchers in other settings have more accessible datasets. For example, iCAREdata in Belgium provides a linked research infrastructure integrating data from GPCs, emergency departments, and pharmacies

involved in primary care OOH services to support quality and improvement in OOH (Colliers et al. 2016). However, Creavin and Creavin (2025) suggested that the fragmented OOH services in the UK makes it difficult to collect comprehensive data on care quality and patient outcomes, highlighting the need for more robust and standardised data collection and sharing systems.

Understanding the decision-making processes behind prescribing oral antibacterial drugs, particularly among those working in OOH services, is essential for improving prescribing practices and care delivery. This involves exploring their clinical reasoning and assessing local needs. Engaging directly with OOH HCPs in meaningful conversations helps ensure their needs and the challenges they face are acknowledged and addressed rather than being blindly judged without context. For example, supporting HCPs in managing situations such as dealing with aggressive or demanding patients may promote better prescribing. Additionally, raising public awareness of antibacterial use and AMR threat is crucial. The public must also understand how their behaviours can impact clinical practices, individual patients, and the community.

5.5.3 Key Recommendations

- Collecting and utilising intelligent data is essential for defining population characteristics and identifying prescribing issues across IH and OOH services. Such data could enable targeted interventions tailored to effectively address specific issues within each setting.
- Improving communication and connectivity among different healthcare sectors, including IH and OOH services, should be prioritised, especially in the context of AMS. Additionally, greater involvement of lead and primary care antimicrobial pharmacists is needed in OOH services to ensure they are informed, actively engaged, and contributing to AMS efforts in these settings.
- Evaluating the impact of individual interventions and allocating sufficient resources to support such assessments is crucial. Assessing and reporting their impact may encourage wider adoption of effective interventions by others and promote continuous improvement.

5.5.4 Strengths and Limitations

This study is the first, to the researcher's knowledge, to explore key stakeholders' perceptions on prescribing oral antibacterial drugs in primary care and OOH services,

investigating potential actions to improve prescribing practices. It also attempts to understand oral antibacterial prescribing patterns in Wales by examining their interpretations of seven years of national primary care prescribing data, including OOH prescribing. The study has further expanded the researcher's understanding of the unique challenges involved in evaluating and improving OOH prescribing specifically and measuring it accurately and fairly within these settings.

One limitation of the study was the absence of a lead or primary care antimicrobial pharmacist post in one HB. To address this, a knowledgeable representative from that HB was included to ensure a perspective came from each HB. Although this could be seen as a limitation, their input enriched the study, especially in highlighting differences across HBs (e.g., commissioned services and available resources), raising important points similar to those discussed by others.

In addition to the absence of pre-packed volume data in the prescribing trend graphs, which may have limited participants' explanations, the varying lengths of time they had held their roles could have further impacted their ability to provide detailed knowledge or recall possible drivers of prescribing. For instance, one participant had been appointed as a primary care antimicrobial pharmacist less than a year before the interviews. As the data analysed span several years, not all participants had direct experience of earlier prescribing practices, potentially limiting their awareness of past influences. Despite these differences, most participants shared similar insights and concerns, particularly around OOH services. Their views were mostly centred around primary care IH services, believing that any effort or interventions made for IH services likely influenced OOH prescribing, given that many OOH staff also work IH. However, their perspectives on OOH services were limited or based on assumptions.

While antimicrobial pharmacists offered important perspectives given their role in AMS, engaging with a broader range of stakeholders could have further enriched the findings. For instance, input from PHW, particularly the antimicrobial surveillance lead, would have been beneficial, as they were also collecting OOH prescribing data and were familiar with the challenges of data infrastructure in Wales OOH services. However, their work in this area was not known to the research team until after the study had concluded. This individual was later approached to discuss the project in an attempt to obtain data on pre-packed items

(Section 5.5.2) and was able to explain some of the difficulties in capturing OOH data, including those related to pre-packed items.

As a service evaluation, this project was not intended to produce findings transferrable beyond the specific context of Wales. Differences between HBs and healthcare systems across and outside the UK mean that these results should be interpreted with caution and within the study's time and setting. The findings only capture the views of the antimicrobial pharmacists interviewed and are not representative of all professionals in the field.

However, while context-specific, the study offers insights that may be relevant to other, similarly structured healthcare systems. It highlighted the limited awareness and prioritisation of OOH services compared to IH services, suggesting a gap in AMS engagement and oversight. This may also apply in other countries, where research in OOH services has been limited and has only recently gained attention. These findings point to opportunities to strengthen AMS by embedding dedicated stewardship roles, improving access to and use of data, and building stronger integration across services.

All interviews were conducted virtually, which some may view as a limitation compared to face-to-face interviews. However, this approach was cost-effective, saving time and travel expenses for the researcher and participants. It also offered flexibility, allowing participants to choose their preferred interview mode. This likely enhanced the response rate, by accommodating those with work commitments and were interested in participating.

5.6 Conclusion

This chapter contributes to the complementarity and expansion aims of MMR (Chapter 3, Section 3.3) by providing possible explanations for the prescribing trends identified in Chapter 4 and exploring broader aspects of prescribing practices in Wales. The study identified several influences on oral antibacterial prescribing in primary care including OOH services. These ranged from health events and crisis management to resource limitations and individual perceptions and behaviours. While the findings highlighted areas where improvement is needed, particularly in data quality and availability, they also revealed insufficient knowledge of prescribing practices in OOH services. This gap is largely attributed to the lack of comprehensive data to identify issues and inform actions to optimise prescribing in these settings.

The study also highlighted important barriers and facilitators to implementing AMS interventions in OOH services and acknowledged some of the unique challenges faced by HCPs working in these services. A better understanding of how HCPs manage the complexities of OOH services and make clinical decisions is needed, particularly in NHS 111 CSHs, where remote assessment and decision-making are required. Recognising these challenges is essential for evaluating current practices and designing tailored interventions that are feasible and effective in such stressful environments.

**Chapter 6 A Qualitative Interview Study Exploring
Decision-Making around Oral Antibacterial
Prescribing in NHS 111 Clinical Support Hubs during
Out-of-Hours Periods**

6.1 Overview of the Chapter

After exploring stakeholders' perceptions of oral antibacterial prescribing in primary care OOH services (Chapter 5), this chapter delves into the experiences and decision-making process involved. It aims to understand the factors influencing prescribing decisions, the resources available to prescribers, and the strategies that support those working in OOH services, particularly within NHS 111 CSHs in Wales.

6.2 Introduction

AMR is a major threat to global health, and inappropriate use of antibacterials accelerates the crisis (WHO 2023a). Prescribers' behaviours when delivering healthcare services could considerably contribute to AMR (Butler et al. 2007), particularly through unnecessary prescriptions. However, the decision as to whether or not to prescribe antibacterials is complex, multifactorial, and may vary across healthcare settings (Thompson et al. 2019).

Earlier chapters (Chapters 2 and 5) highlighted how working in OOH services may shape antibacterial prescribing decisions. Literature has also shown that patients consulting OOH services are more likely to receive antibacterial prescriptions than those accessing IH services (Debets et al. 2017; Baker et al. 2020; Cronberg et al. 2020). This difference could be attributed to more lenient or defensive prescribing commonly perceived in OOH services. For instance, Colliers et al. (2018) found that prescribers in OOH services tend to have a lower prescribing threshold, a perception reiterated by several antimicrobial pharmacists in Chapter 5. Studies from England (Williams et al. 2018) and Belgium (Colliers et al. 2018) identified that factors, such as service urgency, case acuity, and pressures imposed by limited safety-netting options, could influence OOH antibacterial prescribing. Most of these points were also raised in Chapter 5. However, understanding of prescribing experiences and decision-making in Wales OOH services is limited, mostly based on assumptions about practices, or extrapolated from research conducted elsewhere rather than robust, context-specific data.

Given the differences in healthcare systems and policies, findings from OOH services in other countries may not directly apply to Wales. For example, prescriptions in Wales have been free of charge since 2007 (Welsh Government 2017), whereas charges still apply in England. While this may theoretically influence prescribers' decisions and patients'

willingness to collect medicines, long-term data from Wales showed a 33.6% increase in prescribing volumes over the 15 years following the policy, a slower rise than the 80.8% increase in the preceding 15 years (Welsh Government 2022c). OOH models also vary within and across countries (Chapter 1). In Wales, NHS 111 CSHs are a central component of OOH services, where prescribers work remotely, which may impact their usual practices. This OOH model has not been studied.

This chapter was informed by insights from interactions with antimicrobial pharmacists (Chapter 5), who highlighted the need to understand the processes prescribers follow and the challenges shaping their prescribing decisions. Given that prescribers' actions when making prescribing choices may have the potential to either help combat or exacerbate AMR, particularly when managing self-limiting conditions or deviating from guidelines, exploring these aspects is essential. Understanding this decision-making process can help inform the design of tailored AMS interventions, quality improvement programmes, or behavioural change strategies specific to their needs (Chapter 5). Examining the unique factors in each setting is crucial for developing effective stewardship interventions and tackling the underlying issue (Livermore 2005; Teixeira Rodrigues et al. 2013). Therefore, this study was conducted to fulfil the thesis objective 6.

6.2.1 Aim and Objectives

The aim was to explore the experiences and decision-making processes of prescribers when prescribing oral antibacterials in Wales NHS 111 CSHs during OOH periods. This was done through the following objectives:

- Examine factors influencing oral antibacterial prescribing decisions.
- Investigate resources and strategies supporting prescribing decisions.
- Identify prescribers' needs and explore potential solutions to optimise prescribing.

6.3 Methods

6.3.1 Overview of the Methodology Approach

Based on the philosophical approaches in Chapter 3, this chapter adopted a constructivist phenomenological approach. A qualitative methodology using individual semi-structured interviews was employed to explore participants' experiences and decision-making in-depth (Chapter 3, Section 3.5.2), providing a framework to guide discussion toward the study's aim

(DeJonckheere and Vaughn 2019). While alternative methods (e.g., focus groups), could facilitate collecting a broader range of perspectives, they usually lack the depth of individual interviews (Morgan 2019). The unpredictable recruitment and attendance in group formats also made individual interviews a more practical choice (Baillie 2019).

The study lasted about 16 months, from conceptualisation and protocol development to completion. During the time, several amendments were made to refine the methodology and incorporate feedback to maximise access and participation (as detailed below). Delays in receiving responses from key contacts, due to conflicting priorities, staff availability, or leave periods, further contributed to the extended study duration.

6.3.2 Ethics, Sampling, and Recruitment

The initial structure of the methodology involved presenting ethics, sampling, and recruitment in separate sections. However, these processes were complex, ran concurrently across study phases, and involved overlapping timelines with iterative adjustments. Given the project complexity and the number of amendments made, an integrated approach has been adopted to thoroughly describe the methods. Therefore, approval processes, sampling, and recruitment are discussed together, with amendments detailed within the relevant phase to ensure clarity for readers.

6.3.2.1 Initial Ethics Application

This section describes the initial process of obtaining ethical approval and recruiting the intended sample. As these did not proceed as planned, amendments were made to improve recruitment, and these are also discussed in the respective sections.

6.3.2.1.1 Original Application to the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

This study was initially classified as a service evaluation based on the HRA tool definition (HRA 2022b). As such, an application was submitted to the CSPPS-REC, which issued a favourable opinion on 8 January 2024 (reference number: 2324-16; Appendix 6.1).

Recruitment originally relied solely on the Professional Lead for NHS 111 Pharmacists to act as the primary gatekeeper for sharing study documents with eligible participants. The initial inclusion criteria involved GPs and PIPs with past or current experience in NHS 111 CSHs in Wales during OOH periods. These two HCP groups were identified, in collaboration with the

Professional Lead for NHS 111 Pharmacists, as the only staff working in the CSHs at the time. Inclusion was restricted to staff not in training or probation, i.e., those who had completed their training portfolios (Chapter 1, Section 1.4.1), regardless of their IH experience. These individuals were expected to have practical knowledge and real-life experience of the setting, including factors influencing prescribing decisions and practices. Completion of the training portfolio ensured they were clinically competent to manage patients remotely and could reflect on their independent practice and decision-making. The training portfolio criterion was applied to pharmacists, as GPs were not required to complete any training to join NHS 111 (Gibbins 2023a). However, it was later found that the gatekeeper lacked access to those meeting the criteria, requiring another layer of gatekeeping (a direct gatekeeper) and further approval. A minor amendment was therefore submitted and approved by the CSPPS-REC before proceeding (Appendix 6.2). With this approval, the researcher was in a position to seek guidance from the HBs involved and address their specific requirements.

6.3.2.1.2 Engagement with Health Boards

Since the study involved interviewing NHS staff, permission from the relevant HBs was required. In Wales, staff employment in NHS 111 CSHs is overseen by three HBs: SBUHB, BCUHB, and ABUHB. Accordingly, all three HBs were contacted for permission (Figure 6.1). Each was provided with the CSPPS-REC approval, HRA decision tool outcome, study protocol, and all supporting documents, including the interview schedule, information sheets, consent forms (Chapter 3, Section 3.9), and planned communications (emails) for gatekeepers and participants. All individual HB requirements were subsequently addressed (Table 6.1). This successfully resulted in securing permission from two HBs. However, ABUHB R&D considered the project as research rather than service evaluation and therefore could not provide a favourable opinion, as it lies outside their remit. They advised instead contacting Cardiff University Joint Research Office (JRO) for further support and guidance on undertaking the project within the NHS.

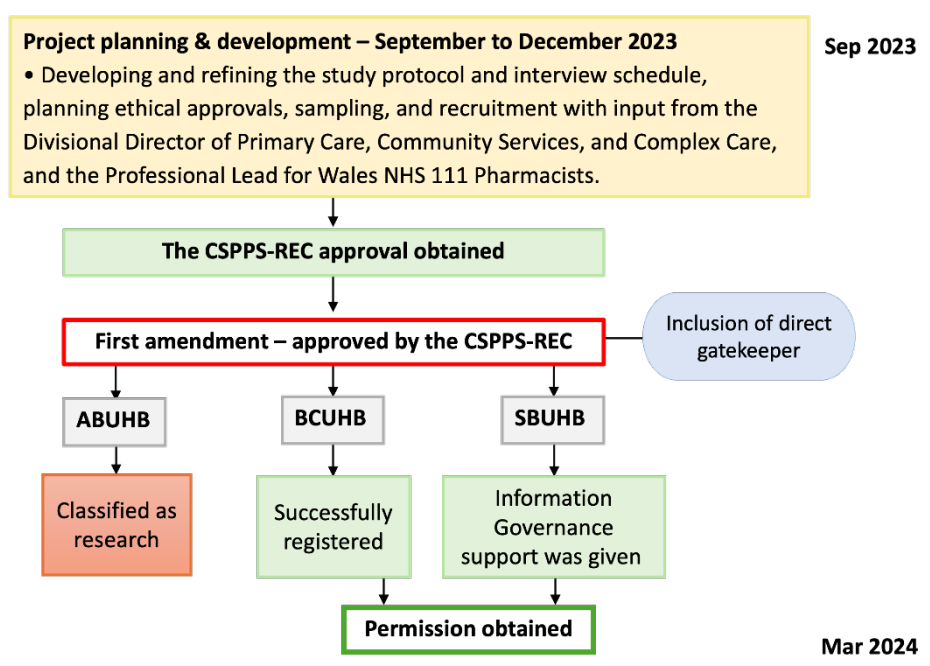


Figure 6.1: Project Development and Securing Initial Approvals

Table 6.1: Health Board Requirements to Secure Permission

HB	Requirement(s)*	Permission
ABUHB	- Support from a pharmacy lead within the HB, identified and contacted by the HB team on the researcher's behalf. - Filling out service evaluation form provided by ABUHB R&D team to be reviewed by the HB R&D along with study supporting documents.	Rejected – classed as research
BCUHB	- HB R&D requested confirmation that the project did not align with research characteristics (e.g., intended for broader contexts), and clarification on participant inclusion (BCUHB employees). - Support from a pharmacy lead within the HB, identified and contacted by the HB team on the researcher's behalf. - Project registration in the HB e-tool. As this tool is only accessible via BCUHB laptops/desktops, the researcher was asked to complete an Excel spreadsheet with project details to be registered on their behalf by the clinical effectiveness team, who handles service evaluation projects.	Obtained
SBUHB	- Service evaluation projects are managed by the HB Information Governance team, not R&D. After reviewing the study documents, they requested clarification that the project was not research, as the Cardiff University information sheet templates used the term 'research'. This was resolved by replacing it with alternative term (e.g., study or project). - Confirmation was also required that participants were informed Cardiff University, not the HB, is the data controller, and that participation is voluntary, which was already stated in the information sheets.	Obtained

Key: ABUHB: Aneurin Bevan University Health Board; BCUHB: Betsi Cadwaladr University Health Board; HB: health board; R&D: research and development; SBUHB: Swansea Bay University Health Board.

*Study documents, HRA tool outcome, and CSPPS-REC approval were initially shared with all HBs.

6.3.2.1.3 Recruitment of Gatekeepers

Due to the lack of accessible staff lists for NHS 111 CSHs, and the difficulties of identifying staff training status and contacting them, recruitment was facilitated through gatekeepers (Section 6.3.2.1.1). This approach has been proven effective in locating and accessing individuals willing to participate (Hennink et al. 2020). The primary gatekeeper, the Professional Lead for NHS 111 Pharmacists, was a known contact of the research team who had contributed to project development and helped inform its direction. They were contacted in advance to discuss the study more broadly and showed interest in being involved. Their position enabled them to liaise with the NHS 111 National Clinical Hub Supervisor (i.e., hub coordinator) and coordinate the sharing of invitation and reminder letters. The hub coordinator, responsible for managing all three CSHs, acted as the direct gatekeeper (Section 6.3.2.1.1), distributing invitations and reminders to potential participants in collaboration with the researcher and primary gatekeeper.

Gatekeeper recruitment started after CSPPS-REC approval, while awaiting HB approvals. On 31 January 2024, the researcher emailed the primary gatekeeper a personalised invitation letter, information sheet, and consent form (Appendix 6.3). The primary gatekeeper was asked to return a signed consent form either electronically or as a scanned copy via email. When no response was received, a reminder email was sent 14 days later (Appendix 6.3). Once consent was obtained, the researcher sent the primary gatekeeper a direct gatekeeper (hub coordinator) invitation letter, an information sheet containing the research team's contact details, and a consent form (Appendix 6.4), with a request to forward these to the hub coordinator. The hub coordinator was also asked to return a signed consent form electronically or by scanning and emailing it back to the researcher using the provided contact details. If no response was received within two weeks of the initial contact, the primary gatekeeper was to send a reminder (Appendix 6.4) along with the same documents. However, this was unnecessary as the hub coordinator provided consent.

6.3.2.2 Phase I – Initial Recruitment

Since only two HBs had provided permission at this point, a pragmatic decision was made to begin recruitment with potential participants from these HBs while the approval process for the third HB continued, as a four-month delay was anticipated.

As the primary gatekeeper had implied that they could distribute the study information to all HCPs in the NHS 111 CSHs, purposive sampling was used to approach pharmacists who met the inclusion criteria, with interviews conducted with the first respondents. For GPs, the initial plan was to invite all staff (as no training portfolio was required), interviewing those who first volunteered. However, when the request reached the direct gatekeeper, this was not possible, and therefore no communication was sent to GPs.

The number of participants in qualitative studies typically becomes clear as the study progresses to data saturation (Chapter 3, Section 3.7.1). Data saturation is commonly achieved within the first 12 interviews (Guest et al. 2006), and as few as nine in homogeneous populations with narrow objectives (Hennink and Kaiser 2022). Information power further suggests that fewer participants are required with samples highly relevant to the study's aim (Malterud et al. 2016), allowing a small, targeted sample to produce rich findings. Considering this, the study initially aimed to interview 12 participants due to time constraints and anticipated recruitment challenges. Although a balanced representation of GPs and PIPs was desirable, this was beyond the researcher's control, as inclusion depended on the first 12 eligible individuals who came forward, with limited access to GPs. A plan was in place to email anyone expressing interest after reaching this target, appreciating their willingness to participate and informing them that the recruitment was ended upon reaching the pre-defined number, as specified in the PIS (Appendix 6.5). A similar email was prepared for those who may contact the researcher but were still in training (Appendix 6.6).

Initial participant recruitment commenced on 18 March 2024, following permission from BCUHB R&D on 29 January 2024 and SBUHB Information Governance on 1 March 2024, which oversee HCP employment in two NHS 111 CSHs. As outlined in their information sheet, the direct gatekeeper was asked to email potential participants an invitation email that included a PIS, consent form, and the study advert provided by the researcher (Appendix 6.7). The advert summarised the project and participation requirements and was used to attract interest, acknowledging that the heavy workloads of HCPs may prevent them from reviewing detailed documents unless initially interested. Participants were given at least 14 days to review the information, ask questions, and decide whether to participate. Although a reminder (Appendix 6.7) was scheduled 14 days after the invitation, it was delayed by one week due to the Easter break. Consequently, the direct gatekeeper was

asked to send the reminder approximately 21 days after the initial contact, with a note asking those who had already responded to ignore it.

Before sending the reminder, the direct gatekeeper informed the researcher of additional potential participants who had completed their portfolio. Their corresponding HB was later confirmed not to be ABUHB, making them eligible at this point. These individuals received invitation and reminder emails at separate times, with 14 days between each. Those who had already contacted the researcher were asked to ignore the reminder. If no response was received within 14 days after the reminder, it was assumed they did not wish to participate, and no further contact was made.

Due to poor recruitment, with only one participant responding and being interviewed, and only a few identified as having completed their training portfolio, the study protocol was amended, particularly regarding sampling and recruitment strategies. The inclusion criteria were revised to include HCPs, either GPs or PIPs, advancing in their training portfolio or probation period who had completed at least 30 hours of training in NHS 111 CSHs during OOH periods. These amendments were made to broaden the pool of potential participants. The revision was informed by consultation with the primary gatekeeper, who advised that decision-making skills are likely established after 30 hours of training and practice.

The strategy for informing potential participants about the study was also adjusted to reach a wider audience and address the inability to access GPs via gatekeepers. A snowball sampling technique was therefore used (Chapter 3, Section 3.7.1), allowing recruited participants to share study information with other individuals in similar roles (Bernard 2006; Bowling 2014), including GPs and pharmacists, who were asked to contact the researcher directly if interested. The amendments also included advertising the study across multiple social media platforms accessible to the research team (Chapter 3, Section 3.7.2) to cover all possible avenues for recruitment. These included CSPPS X (formerly Twitter) and Facebook pages, RPS Wales X (formerly Twitter) and Facebook pages, CSPPS past students' page, and a community pharmacy independent prescribing WhatsApp group. These amendments were submitted to CSPPS-REC on 2 May 2024, approved on 21 May 2024 (Appendix 6.8), and subsequently communicated to and approved by BCUHB and SBUHB the following day.

To implement these changes, the revised inclusion criteria were explained to the direct gatekeeper. Updated participant-facing documents reflecting the revised criteria were

provided with the invitation email, which clearly stated ethical approval had been granted only for BCUHB and SBUHB. Recruitment was repeated as described earlier by contacting all potential participants within NHS 111 CSHs, as the gatekeeper did not have information on the pharmacists' completed training hours and could not distinguish their HBs, requiring pharmacists to self-select. Therefore, eligibility, defined as completion of at least 30 hours of training, and affiliated HBs were confirmed when individuals contacted the researcher. Additionally, the one participant interviewed at this stage was asked to share the study documents with other eligible colleagues, following the snowball sampling approach.

Since the study was to be advertised on social media platforms, including the official CSPPS pages on X (formerly Twitter) and Facebook, a new study advert was created. To comply with Cardiff University's bilingual policy, which requires all content to be available in Welsh and English (Cardiff University 2018a), the advert content was translated into Welsh. The English content was sent to the Widget translation service available on the Cardiff University staff intranet, where the Welsh translation unit provided the Welsh translation. The advert's final version was then produced in both languages (Appendix 6.9) and posted either by the supervisors or a known contact of the research team, and reposted two to three weeks later where possible. Further information on social media advertising and recruitment during this phase, which resulted in two interviews, is provided in Table 6.2 and Figure 6.2, respectively.

Since ABUHB approval had not yet been obtained and the application was in progress during this phase, these amendments were incorporated into the ABUHB required applications (Section 6.3.2.3). As such, recruitment was limited to participants from the two HBs with secured permission. To ensure compliance, individuals who contacted the researcher were emailed to confirm their eligibility and HB affiliation.

Table 6.2: Social Media Platforms Used During Phase I

Social media platform	Posted by	Frequency of posting
CSPPS X (formerly Twitter) page	School staff member	Twice
CSPPS Facebook page	School staff member	Once*
CSPPS past students' page	One of the supervisors	Twice
Community pharmacy WhatsApp group	One of the supervisors	Twice
RPS Wales X (formerly Twitter) and Facebook pages	A known contact	Twice – reposting CSPPS's post

CSPPS: Cardiff School of Pharmacy and Pharmaceutical Sciences; RPS: Royal Pharmaceutical Society.

*The school staff member deemed Facebook an unsuitable audience for this study, as such content is rarely shared, and therefore agreed to post it only once (Appendix 6.10).

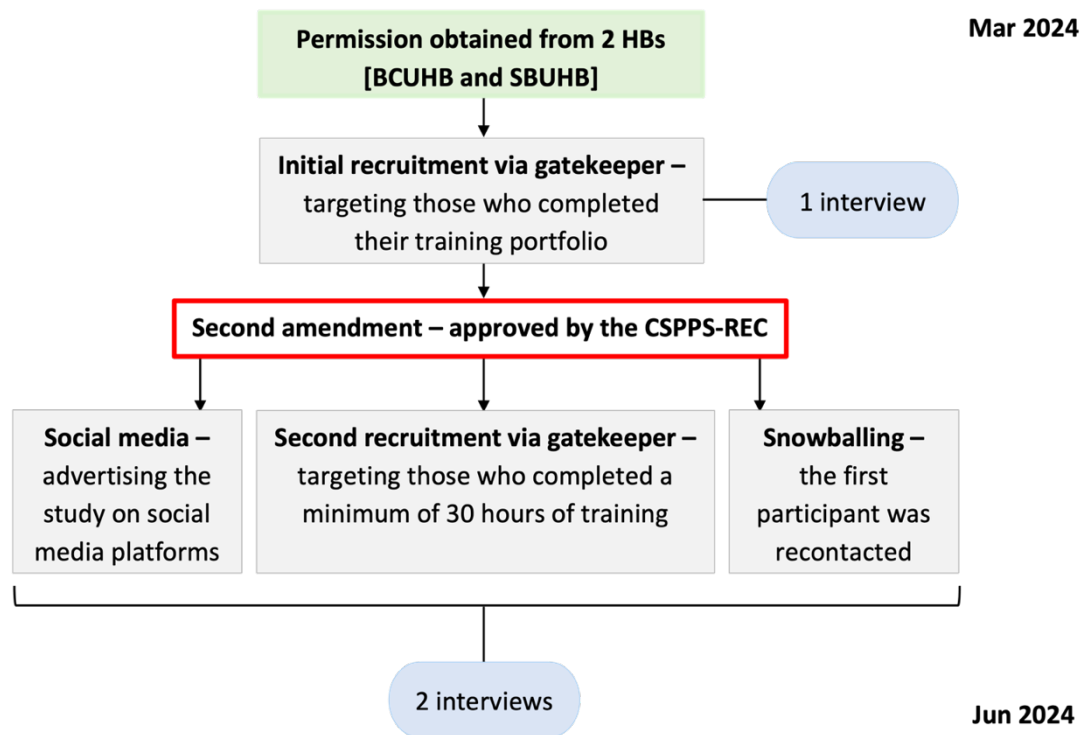


Figure 6.2: Recruitment Processes During Phase I

6.3.2.3 Phase II – Processes to Secure ABUHB Approval

This phase ran concurrently with Phase I and focused on the steps taken to obtain ABUHB approval. The researcher first consulted the JRO research governance officer regarding ABUHB's decision and was advised to secure HRA/HCRW approval via IRAS, followed by ABUHB local C&C confirmation. The HRA/HCRW is a review process for all research involving the NHS in England and Wales to ensure governance and legal compliance (Integrated Research Application System 2022). The first step in obtaining such approval was to set up the study as NHS research and designate Cardiff University as the Sponsor. This involved submitting a Sponsorship Application Form naming Cardiff University as Sponsor, along with the study documentation (e.g., protocol, interview schedule, information sheets) and supporting documents (e.g., research integrity training and Good Clinical Practice (GCP) certificates) to the research governance officer. After reviewing the submission, Cardiff University issued a Sponsorship in Principle letter and insurance certificate on 23 May 2024, both required for the IRAS application.

The HRA/HCRW approval was subsequently sought through the IRAS form, with ABUHB listed as the central study site. The application required authorisation from the chief investigator/academic supervisor and the sponsor's representative (Cardiff University's research governance officer). The latter recommended changing the data retention period to 15 years due to NHS involvement. They also advised updating the data protection statement in the information sheets, although accepted at Cardiff University level, to align with the GDPR-compliant wording approved by the HRA. Consequently, a non-substantial amendment was submitted to CSPPS-REC to reflect these changes. Following approval on 5 June 2024 (Appendix 6.11), all required documents were uploaded to the IRAS application.

The IRAS application (Project ID: 341187) was first submitted on 24 June 2024. It involved completing the online IRAS form and uploading required documents, including the Sponsorship letter and insurance certificate, CVs of the supervisor and researcher, Organisation Information Document, schedule of events, and any study scientific review reports. Study documentations were also uploaded, including the protocol, advert, interview schedule, information sheets, and consent forms for participants and both gatekeepers.

The HRA/HCRW review raised a few points requiring clarification and confirmation. These included ensuring data storage aligned with Cardiff University's data protection policy, that participant information complied with the Welsh Language Act, and confirming that the audio recording device was encrypted. Reviewers also requested the addition of the organisation's logo to the protocol and study documents, along with a clear statement in the protocol defining the end of the study. After these revisions, the application was resubmitted on 15 July 2024 and received approval on 18 July 2024.

After receiving HRA/HCRW approval, a local information pack was sent to the ABUHB R&D on 19 July 2024 via email for the local C&C assessment. The pack included the HRA/HCRW assessment letter, study documentation, schedule of events, and Organisation Information Document (to be localised and agreed upon with ABUHB), and a copy of the IRAS application form. A meeting with the ABUHB governance contact was scheduled for 26 July 2024 to discuss study logistics. Additional documents were requested, including the researcher's CV and GCP certificate. As the project was classified as research, a Letter of Access (LOA) was also requested for potential site visits. ABUHB R&D provided the LOA application form,

which the researcher and primary supervisor completed and forwarded with supporting documents to Cardiff University Registry Support for completion. Completing the LOA form, collecting supporting documents, and identifying the responsible Cardiff University unit to finalise the form took approximately two months.

While the LOA form was being completed by Cardiff University Registry Support, ABUHB R&D contacted the researcher on 15 August 2024, requiring an amendment to the IRAS application using the IRAS amendment tool. This was necessary because the NHS local collaborator (who supports the study setup and conduct within the HB) listed in the application had changed jobs and was no longer employed by ABUHB. The amendment involved updating the collaborator's contact details and extending the project's end date to 31 December 2024 to align with the intended LOA date. Following guidance available on the IRAS webpage, the amendment tool was completed, authorised by the sponsor's representative on 12 September 2024, and submitted to IRAS the next day. As the changes were non-substantial, no further HRA/HCRW review was required. Similarly, no amendments were made through CSPPS-REC as the updates did not impact the initial approval.

The local information pack was updated to reflect these changes and sent to ABUHB R&D on 13 September 2024. The LOA application form, completed by Cardiff University Registry Support, was returned to the researcher on 23 September 2024 and forwarded directly to ABUHB R&D for processing alongside the C&C assessment. ABUHB R&D also requested localising the study documents by adding their logo and providing the study's insurance certificate. Permission to proceed with the study was obtained on 3 October 2024 following the ABUHB R&D C&C confirmation. The LOA, granted on 24 September 2024, was shared with the final approval. At this stage, permission from all three HBs had been successfully secured. A summary of processes undertaken during this phase is presented in Figure 6.3.

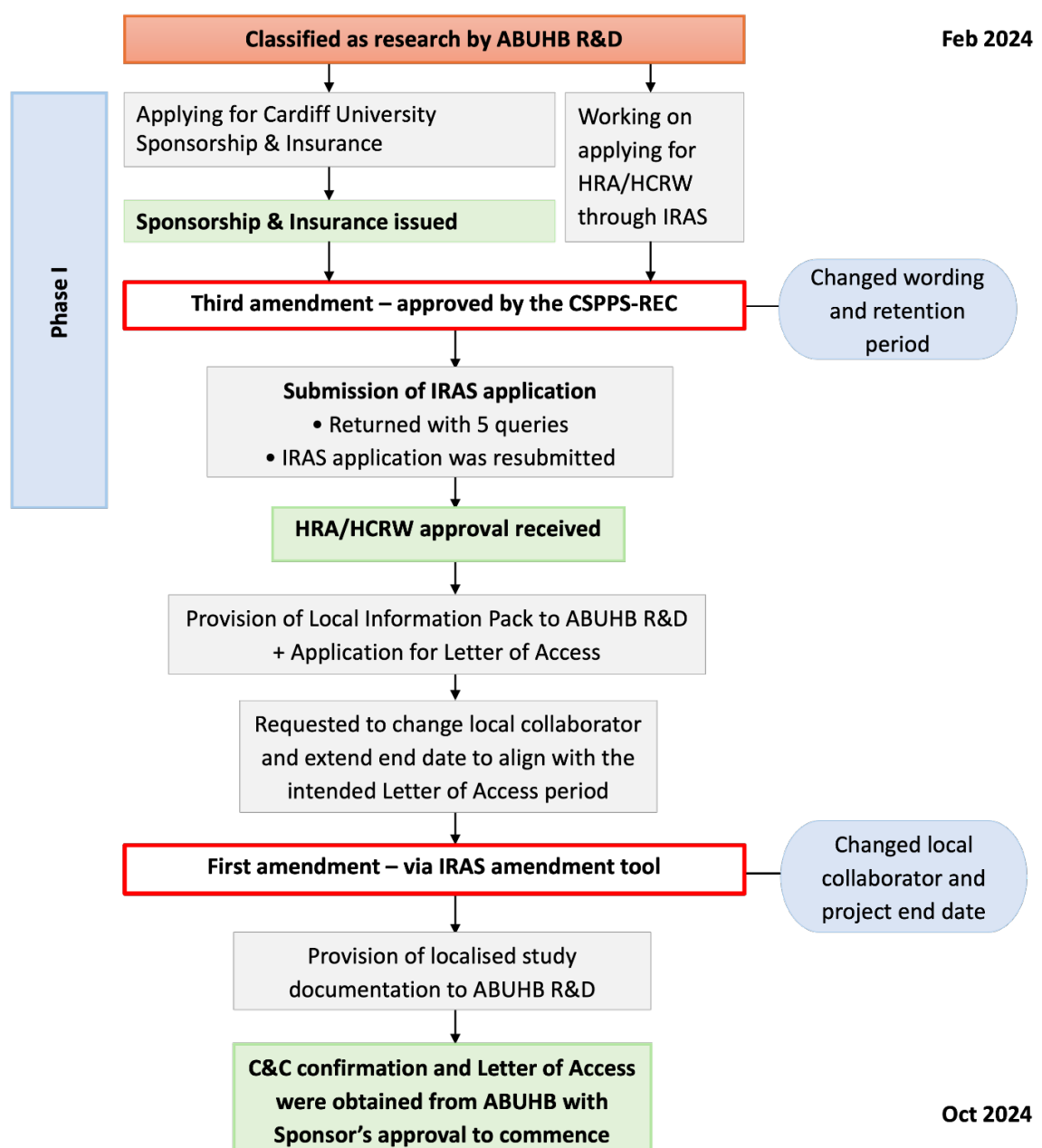


Figure 6.3: Steps Undertaken to Secure ABUHB Permission

6.3.2.4 Phase III – Recruitment Following ABUHB Approval

After HRA/HCRW approval, C&C confirmation from ABUHB R&D, and the Sponsor's formal approval to proceed, eligibility checks were needed for those who could now be recruited from ABUHB (as discussed in Phase I) via the strategies used at that point. The study advert was posted for the third time in the community pharmacy WhatsApp group by one of the project supervisors to update members, particularly those from ABUHB, on the study's approval status. This was relevant as a potential participant from that group had previously expressed interest but could not be interviewed until approvals were in place.

The researcher followed up with this eligible participant via email and included the localised study documents to confirm their interest. Since the direct gatekeeper had already shared the study information with all potential participants (Section 6.3.2.2), and the social media posts were general rather than targeted to the HBs with secured approval, these strategies were not repeated at this stage. Despite these efforts, no new participants were recruited from any HB during this phase.

6.3.2.5 Phase IV – Expanded Recruitment Efforts

As recruitment remained poor despite the actions taken, the researcher consulted the Director of Primary Care, Community Services, and Complex Care for ABUHB, outlining the issue and steps taken, and sought further advice on any unexplored recruitment approaches. On 15 October 2024, the Director reviewed the recruitment process and, while praising its thoroughness, noted the difficulty of securing commitment from a largely locum-type workforce without financial incentives. Nonetheless, they suggested advertising the study in two NHS 111 Pharmacists WhatsApp groups (North and South) and offered to act as an additional gatekeeper (Appendix 6.12) by posting the advert on the researcher's behalf.

The protocol was amended to include posting the study advert in the two WhatsApp groups. Supporting documents were developed, including an additional gatekeeper information sheet and consent form (Appendix 6.13). The change was submitted to the CSPPS-REC as a minor amendment on 17 October 2024 but was classed as substantial by the committee and scheduled for review on 14 November 2024, when it was approved (Appendix 6.14).

Another amendment was then submitted to IRAS the same day, involving completion of the amendment tool, sponsor authorisation, and uploading the tool and supporting documents. As this was deemed non-substantial by the tool, it was approved without HRA/HCRW review. The approved changes were communicated to the HB R&D.

The additional gatekeeper was then provided with the study documentation (Appendix 6.13) and the advert and was asked to give consent. Once provided, they were requested to post the advert in the NHS 111 Pharmacists WhatsApp groups on the agreed dates for the initial and reminder posts. One potential participant contacted the researcher expressing interest. After confirming their eligibility and sharing the study documents, they did not respond or provide consent, even after a reminder email. After two weeks without a reply,

they were considered no longer interested, and the study was concluded. A summary of this phase and all amendments throughout the study is provided in Figure 6.4 and Table 6.3.

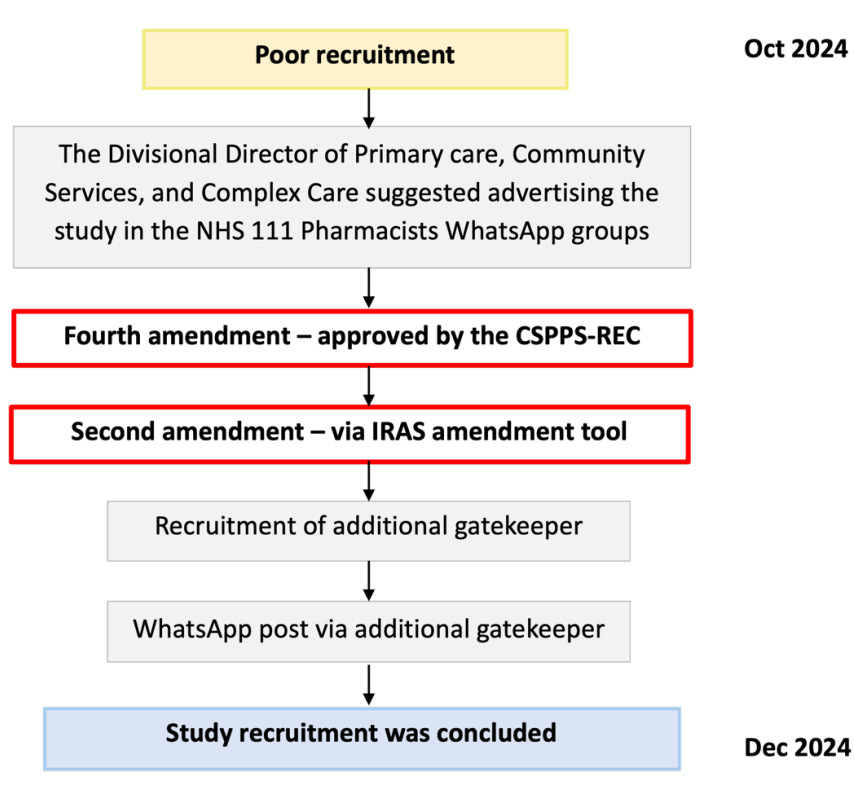


Figure 6.4: Processes Undertaken During Phase IV

Table 6.3: Summary of Study Amendments

Body	Amendment	Description of amendment
CSPPS-REC	1 st non-substantial	• A need to include direct gatekeeper to share study documents
	2 nd non-substantial	• Changed inclusion criteria from completion of training portfolio to a minimum of 30 hours training in NHS 111 CSHs • Use of snowballing • Advertising the study on social media platforms
	3 rd non-substantial	• Changed data protection statement and retention periods and use GDPR data protection wording approved by Health Research Authority as advised by the University research governance officer
	4 th substantial	• Additional gatekeeper to post the study advert in two NHS 111 Pharmacists WhatsApp groups
IRAS	1 st non-substantial	• Changed the ABUHB local collaborator's name and the end date
	2 nd non-substantial	• Additional gatekeeper to post the study advert in two NHS 111 Pharmacists WhatsApp groups

Key: ABUHB: Aneurin Bevan University Health Board; CSHs: clinical support hubs; CSPPS-REC: Cardiff School of Pharmacy and Pharmaceutical Sciences-Research Ethics Committee; GDPR: General Data Protection Regulation; IRAS: Integrated Research Application System; NHS: National Health Service.

6.3.2.6 Eligibility Confirmation and Consent Process

Throughout Phases I–IV, interested potential participants from all avenues (via gatekeepers, social media, or snowballing) were instructed to contact the researcher directly via email. The researcher responded to everyone to confirm their eligibility based on inclusion criteria, including the CSH they worked for, training portfolio completion status, and, if incomplete, hours completed. Those eligible were then provided with the PIS and consent form (Chapter 3, Section 3.9).

All communications and documents were in English. Participants were informed that the study would be part of the researcher's PhD thesis, that participation was voluntary, and that no incentives were offered. They were also informed they could withdraw at any time without giving a reason, up until their interview transcript had been de-identified, as outlined in the PIS. Participants were encouraged to ask questions about their participation before providing consent and starting the interviews. Those who agreed were required to provide written consent. Once consent was received, participants were asked to share their availability and preferred mode of interview (Section 6.3.4) via email, after which a mutually convenient date, time, and location were arranged.

6.3.3 Data Collection Tool

Following Kallio et al.'s (2016) approach (Chapter 3, Section 3.5.4), an interview schedule was developed using information from Chapter 5 and a review of prescribing decision-making literature. It was reviewed by the project supervisors and adjusted as necessary. Expert stakeholders in Wales OOH services (the Director of Primary Care, Community Services, and Complex Care, a former OOH pharmacist, and the Professional Lead for NHS 111 Pharmacist) also reviewed the questions to ensure they were clear, relevant to the NHS 111 CSH context and able to obtain meaningful data (Kallio et al. 2016; Ray and Miller 2017). They identified areas needing further exploration, which was discussed with the supervisors and incorporated into the final version (e.g., exploration of HCPs' actions when guidelines recommend the use of diagnostics, specifically midstream urine for UTIs, prior to prescribing). The schedule was then piloted in the first interview, with no changes made. The interview schedule primarily consisted of open-ended questions with probes and prompts to facilitate exploration and clarify participants' responses (Appendix 6.15). The questions addressed different aspects of prescribers' decision-making, including their

experiences, factors influencing or considered when prescribing oral antibacterial drugs, available resources, and needs to support more informed decisions. An adapted version, excluding probes and prompts to avoid leading or restricting responses, was shared with participants a week before their interview. This gave participants an overview of the topics, allowing time for reflection and familiarisation with the content. It also promoted transparency about the study's scope, enabling informed decisions about participation (Haukås and Tishakov 2024). Additionally, this approach aimed to encourage deeper engagement while reducing anxiety, potentially leading to more thoughtful responses (Haukås and Tishakov 2024).

6.3.4 Settings

Participants were given the option to be interviewed in person or virtually via Microsoft Teams®, based on their preference and location, following the approach described in Chapter 5, Section 5.3.6.

6.3.5 Data Processing and Analysis

Interviews were transcribed verbatim. For online sessions, the Microsoft Teams® transcription function was used during the interview. If face-to-face interviews were conducted, the researcher listened to the recordings and transcribed these manually. A quality assurance process followed, involving repeated listening to the recordings and cross-checking them against the transcripts to correct errors and consider intonation (e.g., uncertainty or questioning). For unclear parts (e.g., fast-spoken phrases), clarification was sought from the project supervisor (RD). Transcripts were then analysed inductively and deductively using thematic analysis following Braun and Clarke's approach (Chapters 3 and 5). NVivo software was used for coding and analysis (QSR International Pty Ltd 2018). Themes and subthemes were visualised in a tree mind map to aid discussion with the project supervisor (KH), who independently analysed all transcripts. All coding, analysis, and trustworthiness procedures were conducted as described in Chapter 3, Section 3.5.5 and Chapter 5, Section 5.3.8.

6.3.6 Information Governance and Data Management

Informed consent was obtained from all gatekeepers and participants. Participants were instructed not to disclose any identifiable patient information, focusing on general principles and processes involved in making oral antibacterial prescribing decisions. A plan was in

place to consult the Professional Lead for NHS 111 if any safeguarding issue arose to determine how to best manage the situation.

All procedures complied with GDPR and Cardiff University's Data Protection Policy (Cardiff University 2018b) to maintain confidentiality. Audio and video recordings were conducted in accordance with Cardiff University's SOPs, and those for utilising gatekeepers were followed (Cardiff University 2022b,c). For online interviews, Microsoft Teams[®] was used, and participants could choose audio-only or both audio and video recording. Study data will be retained for at least 15 years after project completion or publication, whichever is later, in alignment with the University Records Retention Schedules (Cardiff University 2020).

Throughout the project, measures were taken to ensure secure storage of consent forms and raw data, including recorded interviews and transcripts. These were stored on the researcher's Cardiff University OneDrive, a secure password-protected server accessed via password-protected devices, at all times. A dedicated Microsoft Teams[®] channel was created specifically for this study to host interviews and store all data (Cardiff University 2023). Interview sessions were scheduled within the channel via diary invitations with participants who were external (non-team members) to that channel (Cardiff University 2023). With participants' consent, interviews were recorded and automatically saved to the channel when the sessions ended. As external users, participants could not access any recordings or documents, with access restricted only to the researcher and supervisors (channel members) (Cardiff University 2023). This approach represented a new development from Chapter 5, informed by updated guidance on conducting online interviews via Microsoft Teams that had been released.

Transcription and de-identification were completed soon after the interviews. Codes replaced participants' names in all files (e.g., transcripts, and written notes during coding, analysis, quotation). Recordings were deleted after quality checks and de-identification.

6.4 Results

6.4.1 Participants and Interviews

Five individuals who met the inclusion criteria expressed interest in participating. However, two did not respond despite repeated follow-ups, leaving three who were interviewed and included in the study. One participant was recruited through the gatekeeper strategy, and

two after utilising social media and snowballing in Phase I (Figure 6.5). All three participants were PIPs with no GPs included. Of these three, two worked in the same NHS 111 CSH. All interviews were conducted online in May and June 2024 and ranged from 49 to 54 minutes (average 52 minutes). Participant demographics are described in Table 6.4.

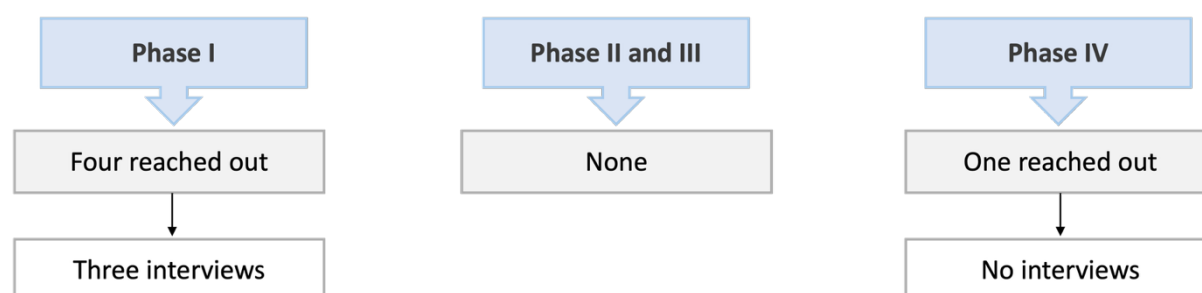


Figure 6.5: Participants Recruited After Each Phase

Table 6.4: Participants' Demographics

Participant	Sex	Current Experience	Current IH Experience	OOH Shifts/Hours	Portfolio Status
P1	Male	OOH	None	10-15 hours a month	Completed
P2	Female	IH and OOH	Community pharmacy	2 shifts a week • Evening: 6:30pm to 11:00pm • Weekend: 8:00am to 1:00pm	In progress (at time of interview)
P3	Female	OOH	Strategic, non-patient facing role	3 shifts a month on weekends only (10-15 hours a month) • One full-day: 8:30am-1:00pm and 1:00pm-6:00pm • Half a day: 8:00am-1:00pm	In progress (at time of interview)

Key: IH: in-hours; OOH: out-of-hours.

6.4.2 Thematic Analysis Results

Four main themes were identified using inductive and deductive thematic analysis. Figure 6.6 summarises these themes, indicating inductive (blue) and deductive (green). Unless otherwise stated, most ideas presented in the results were reported by at least two individuals. The process of coding and analysis is illustrated in Figures 6.7 and 6.8.

Before discussing the themes, it is important to describe the participants' work environment and the types of queries they received to understand the context. While participants had

slightly different accounts of staffing number per shift, a general description is as follows: NHS 111 CSHs operate within a shared workspace, typically arranged in an island-style with approximately six desks. These are usually occupied by one or two administrative staff, two or three pharmacists, and one or two GPs at any given time, with GPs sometimes working remotely.

Pharmacists in the CSHs handled various queries. Alongside clinical questions about diagnoses and treatments of infectious and non-infectious conditions, they addressed medicine-related inquiries, such as concerns about potential drug allergies, treatment failures, and requests for alternative drugs or formulations. They also managed requests for lost or missing medications, repeat prescriptions, emergency supplies for patients who had run out of regular medicines (including those travelling), and medication queries from care homes.

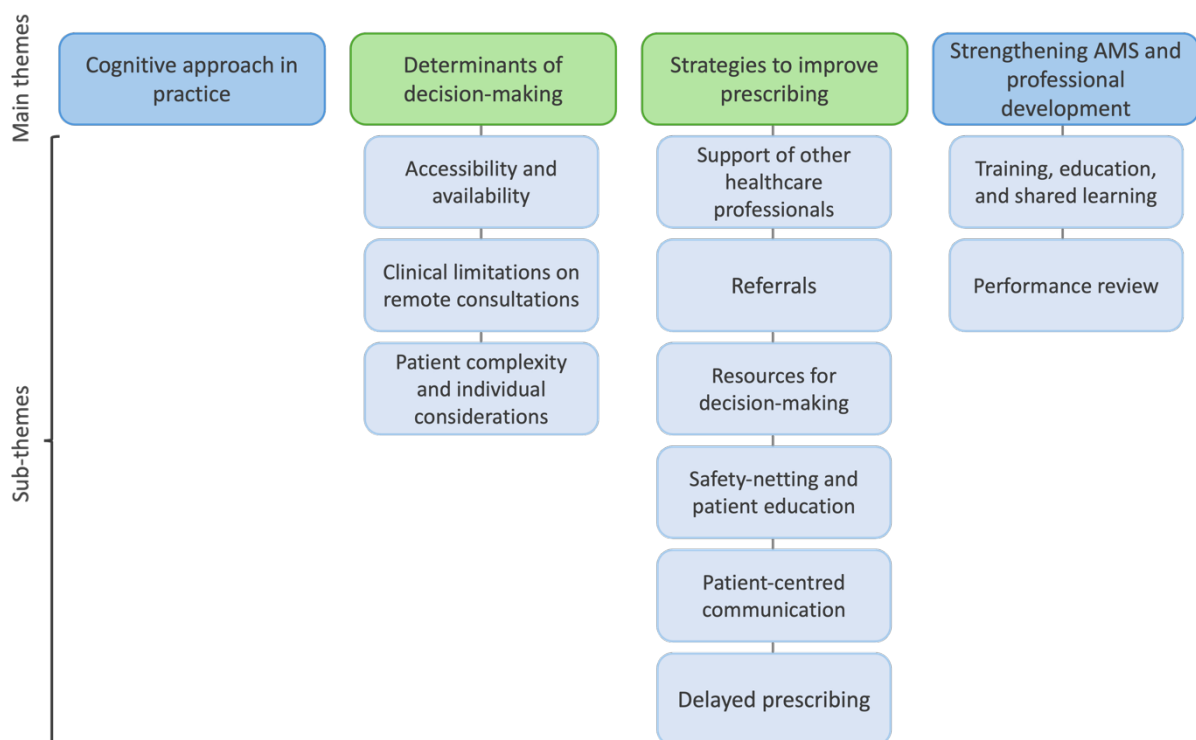


Figure 6.6: Main Themes and Subthemes

Note: Green indicates deductive themes while blue represents inductive themes

Step 1 – Data familiarisation: read and re-read transcripts

Quotes from P2

“Depends on the illness. For tonsillitis and sore throats, I use FeverPAIN score, so I go from that, but I don't just use that blindly. I think about the patient, the patient's expectations, previous experiences, current circumstances, and the day of the week, because that makes a difference.”

“If it's a Friday saying to the patient, ‘yes, you're on the borderline. See how it goes with normal home remedies and if it gets worse, then return.’ That's easy on a Monday in the shop. Because they can just return back. In 111, if it's a Thursday or a Friday, saying see how it goes for two days is not easy. So it depends on the circumstances as to whether I say ‘call back 111 on Saturday morning’ or ‘I'll give you a backup prescription’. I tend not to give back up prescriptions if I can avoid it. I try and get them to return for re-examination.”

“The decision-making is exactly the same. But the decision not to prescribe and to re-examine in a couple of days is so much easier in community because you just say ‘oh I'm here pop back on Wednesday’. But that's not so easy in out-of-hours because you can say ‘if it gets worse from your own GP’, but the chances of them getting an appointment with their own GP on the day are slim. So I ask about how does your surgery arrange appointments? Do you need to join the queue? Is it easy to get in? Is it [GP surgery name] because it's not easy to get in, so I've got a personal knowledge of a lot of the areas that I work or cover in [Participant's HB] so I know from experience that some surgeries are harder to get into than others, so circumstances might say I'll give you a back-up prescription on this occasion. But it is rare.”

“The severity of the condition, the symptoms that I see. So insect bites, I tend not to prescribe antibiotics for inflammation and heat, but I examine either in person or the photographs very carefully, to see if there's any tracking, if there's any pus. And usually it's very rare for it to be infected, so I usually go hydrocortisone and antihistamines to be fair, but if there's clear evidence of pus, clear evidence of infection, clear evidence of tracking, so say with paronychia, and you can see it all happening and you understand what they've already done for themselves, then I'm more likely to prescribe than not in those circumstances.”

Step 2 – Label information

Codes

- Medical conditions
- Patient's experience/expectations
- Day of the week
- Watch and wait – backup prescribing
- Ease of access
- Available appointment
- Backup prescribing
- Severity of conditions
- In-person/use of photos
- Severity of conditions

Step 3 – Merge, define, and rename emerging concepts:

An iterative process with each transcript

Sub-themes

- Accessibility & availability
- Patient complexity and individual considerations

- Delayed prescriptions
- Resources
- Referral

Step 4 – Compare, identify relationships and similarity

Main theme

- Determinants of decision-making
- Strategies to improve prescribing

Figure 6.7: An Example of Line-by-line Coding Process and Identifying Themes

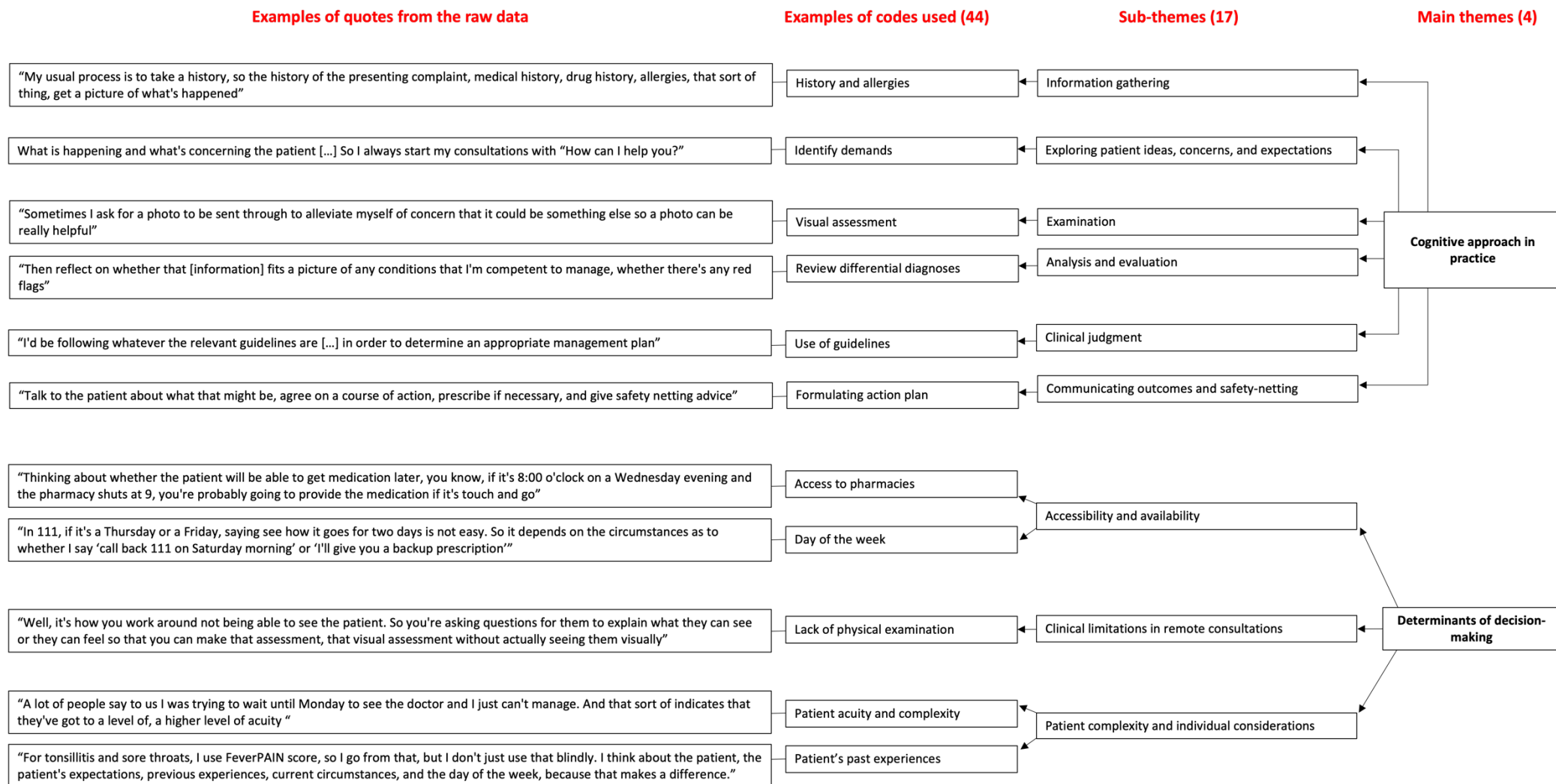


Figure 6.8: Examples of the Codes Used and Constructed Themes

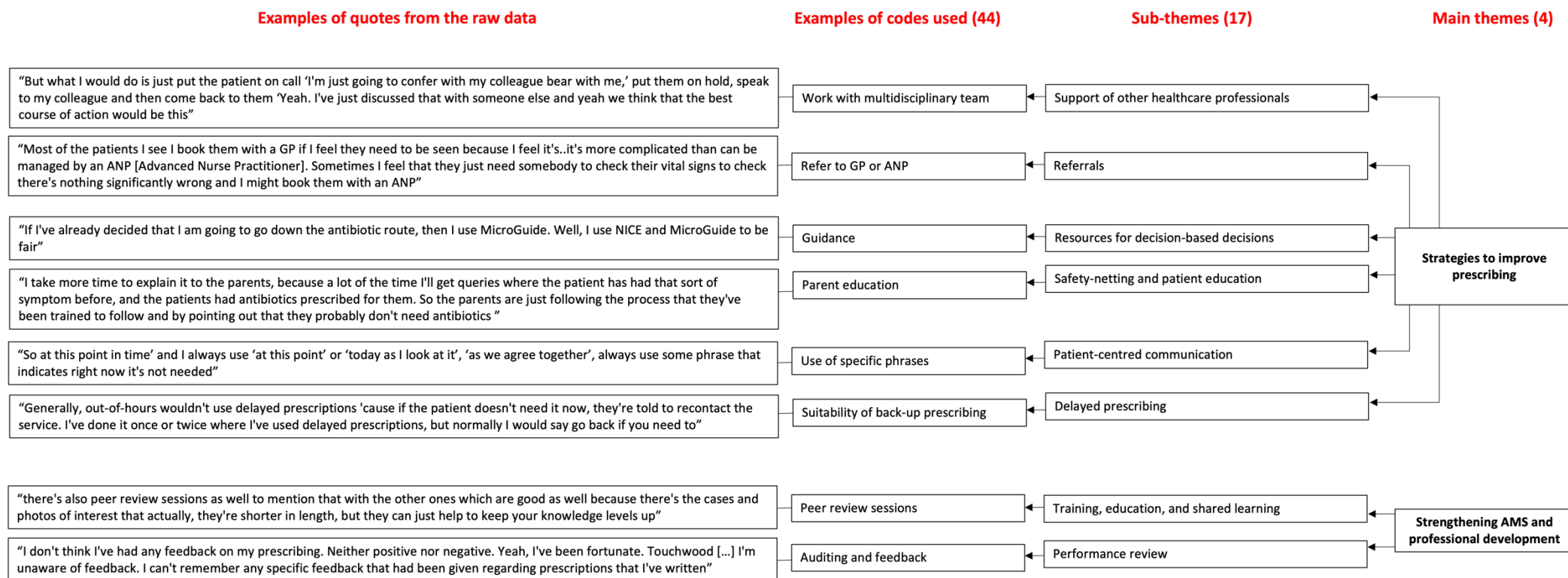


Figure 6.8: Examples of the Codes Used and Constructed Themes (continued)

6.4.2.1 Cognitive Approach in Practice

Participants consistently adopted a cognitive approach that prioritised patient-centred care when making prescribing decisions (Figure 6.9). All participants described following a broadly similar stepwise process, beginning each consultation by identifying the patient's problem and exploring their ICEs through open-ended questions, such as “How can I help you?”. They actively listen to patients’ viewpoints without making early judgments before systematically gather relevant information, including the history of the current illness, past medical and medication history, and any known allergies. Considering the remote nature of the NHS 111 service, they often incorporate elements of examination by using photographs supplied by the patient or asking them to assess specific findings themselves that would normally be examined in person, such as swelling suggestive of lymphadenopathy, with detailed verbal queries.

“My decision-making process is about listening to the symptoms to get a gauge as to what their concern is, their narrative around that, their ideas and expectations. I would be starting at ‘why have you called the service today?’ And unpacking it from there.” (P3)

Following this, they assess and analyse each case individually, drawing conclusions based on the patient’s unique circumstances and clinical context. This involves reviewing and evaluating the collected information thoroughly while applying prior knowledge and consulting clinical guidelines to follow best practices for that specific case. They also reflect on whether the condition falls within their competence or necessitates referral to alternative services. As part of their assessment, they identify any red flags that may require urgent action, such as escalation. They carefully weigh the benefits of prescribing based on clinical cues while remaining attentive to potential patient biases in how symptoms are reported. Throughout the process, they remain mindful of ruling out differential diagnoses and considering alternative possibilities to inform contextually sound clinical judgment. They conclude the consultation by clear explanation of the assessment and discussion of potential diagnoses and management options with the patient. They engage patients in their care plan and decision-making by agreeing on the most suitable course of action at that moment. Each consultation ends with what they considered clear and comprehensive safety-netting advice, ensuring patients understand when and how to seek further care if needed.

“The thing that I keep in the back of my mind is the alternative differential diagnosis as to what it could be and the severity of the illness because sometimes people can downplay it when they're actually really ill, and other times people can over-egg it when actually their symptoms maybe are self-limiting” (P3)

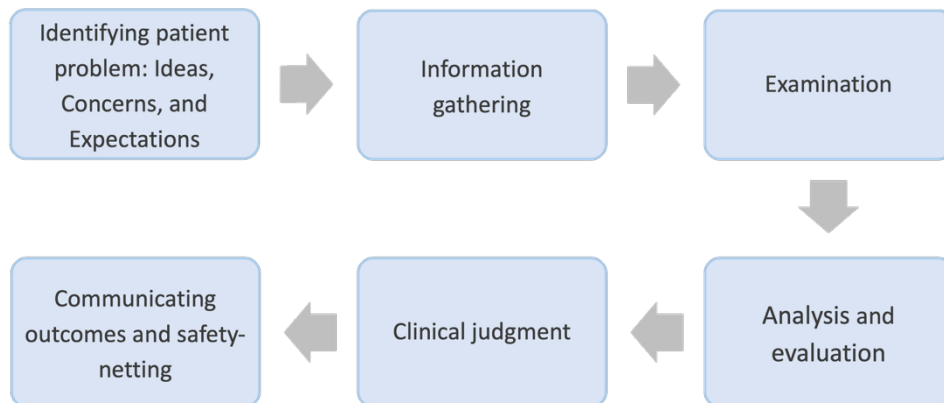


Figure 6.9: Cognitive Process

6.4.2.2 Determinants of Decision-Making

Participants described that working in the NHS 111 CSHs did not directly affect their core decision-making processes but introduced unique challenges and considerations to keep in mind. These considerations (discussed below) are important for ensuring continuity and quality of care in the remote, resource-limited, NHS 111 environment.

6.4.2.2.1 Accessibility and Availability

Participants discussed many aspects of service accessibility and availability that they consider when making prescribing decisions. Patient access to healthcare facilities and follow-up (e.g., GPs or pharmacies), especially in rural or underserved areas, and logistical factors (e.g., pharmacy opening hours) affect whether medications can be obtained promptly. This may influence decision-making, as limited access could impact continuity of care and clinical outcomes. One participant explained that if a pharmacy was about to close, they would prescribe immediately to ensure timely treatment, whereas longer pharmacy hours might allow them to delay prescribing safely, if needed.

“So obviously if somebody rings me and they live near a pharmacy that's open for another three or four hours, I can tell them to call me back but if they live near a pharmacy that closes in half an hour, I might need to prescribe now” (P1)

Access to diagnostics may also influence how cases requiring testing are managed. They described that consultation day and timing, as well as delays in test processing over

weekends and holidays, sometimes determined whether diagnostic tests were feasible, making empirical treatment necessary to balance timely care with diagnostic accuracy. For example, for UTIs requiring a midstream urine (MSU) sample, one participant considered advising patients to collect and properly store the sample until IH services reopened to avoid sample sterilisation before treatment. Another preferred referring patients to GP OOH for face-to-face assessment, especially when pyelonephritis was suspected. However, if a patient declined referral, empirical treatment might be initiated, with careful documentation to ensure decisions aligned with the patient's best interest and clinical accountability.

"If it's a Sunday, I will say that the guidance says that we should do an MSU, but it's a Sunday, I say, 'before you take the antibiotics, do a sample, label it, keep it in the fridge and drop it in at your surgery tomorrow'. [...] If it's a Friday, they can't do the sample and leave it till Monday, so I treat empirically" (P2)

Participants also reported challenges arising from the lack of onsite diagnostics, such as swabs, dipsticks, and cultures, which frequently necessitated empirical treatment without prior testing. While this approach may be appropriate in some cases and does not directly influence their assessments or prescribing decisions, they acknowledged that the inability to test and review results before prescribing antibacterials may impact long-term patient care. This limitation may lead to difficult or suboptimal treatment when patients return with worsening conditions and no prior culture results, or when empirical treatment sterilises cultures, complicating further management.

Participants emphasised the importance of recent laboratory results, particularly culture and sensitivity tests, in guiding antibacterial choices. When available, these results are reviewed to adjust empirical treatments based on resistance patterns. Additionally, participants stressed prioritising patient safety during OOH care by focusing on symptom management until IH services resume. If a serious underlying condition (e.g., cancer), is suspected, they address the acute issue (e.g., UTI) and arrange timely referral for further investigation to maintain care provision without overstepping what is feasible in remote or urgent care contexts.

"If you have a recent culture and sensitivity test which then shows that the bacteria is resistant to the antibiotic you were going to prescribe, it would be inappropriate to prescribe that antibiotic even although that is the empirical choice" (P3)

6.4.2.2.2 Clinical Limitations in Remote Consultations

A major challenge discussed by participants was the restriction in performing visual assessments in remote consultations. In contrast, in-person consultations allow HCPs to observe non-verbal cues, such as breathing patterns and body language, offering a glance at the patient's overall wellness and support quicker, more confident judgments. Despite these limitations, participants noted that their decision-making process remains consistent, with one stating that the likely reduced quality and amount of information in remote consultations could lead to a more cautious prescribing approach.

"The information available to me is different [...] I am always checking that the patient isn't more ill or has red flags whereas when you see a patient you're relieved of that to a certain degree. So potentially you may be more inclined to prescribe because you can't relieve yourself of some of the worry" (P3)

Participants reported that diagnoses in remote consultations are usually provisional, based on clinical impressions rather than firm diagnoses. Without the ability to physically examine patients, they rely heavily on patient-reported symptoms, which can affect confidence in assessment accuracy. This requires strong communication skills, advanced questioning, and careful interpretation of ambiguous details, adding to the uncertainty they experience. To compensate for the lack of physical assessment, prescribers use open-ended and probing questions to gather as much information as possible. They also emphasised the importance of using technology when feasible, such as requesting photos of symptoms (e.g., sore throat) to support diagnosis.

"It's how you work around not being able to see the patient. You're asking questions for them to explain what they can see or feel so that you can make that assessment, that visual assessment without actually seeing them visually." (P3)

6.4.2.2.3 Patients Complexity and Individual Considerations

Participants noted that patients consulting OOH services are often more acutely unwell than those attending IH services. This may increase the likelihood of prescribing due to the condition's complexity, severity, and acuity, and the need to intervene either with immediate or delayed prescribing as a precautionary measure. Furthermore, the impact of symptoms on quality of life (e.g., significant pain or discomfort) may drive prescribers to initiate treatment even when prescribing thresholds are not fully met.

Participants also discussed patient-related aspects they consider when making prescribing decisions remotely, including age, clinical presentation, comorbidities, and medical history. For instance, one pointed out that diabetic patients may be more prone to infections such as UTIs, which require prompt antibacterial treatment to prevent serious complications related to their underlying health status.

“The type of patients you get [in OOH] tend to be less well; it's my perception. A lot of people say to us I was trying to wait until Monday to see the doctor, and I just can't manage. That sort of indicates that they've got to a higher level of acuity [...] therefore, there's perhaps a bit more onus on prescribing, even if it's a delayed prescription” (P1)

Another factor participants discussed was patients' past experiences and individual circumstances. They described balancing adherence to prescribing guidelines (e.g., MicroGuide) with the circumstances of each patient. While guidelines typically direct management, certain constraints sometimes required a more flexible approach. Patients might refuse specific medications due to previous disturbing experiences, difficulty swallowing tablets, intolerance, or poor compliance, particularly with children due to taste. In such cases, prescribers weighed guidelines against patient needs and sometimes chose more acceptable alternatives to ensure compliance, even if not the first-line option. External factors, such as medication shortages, may also necessitate deviations from guidance.

Participants emphasised the need to document and justify any deviations and to communicate these clearly with patients, so they understand the implications. This ensures accountability and transparency, especially with subsequent HCPs who may later be involved in the patient's care, while upholding professional standards.

“‘My child will not take flucloxacillin.’ Well, if they won't take it, it's not going to do any good anyway. So I gave amoxicillin 'cause they like the banana flavour one, but again explaining that that's not the best choice [...] but it will be better than not taking the Fluclox or just spitting it out” (P2)

“The only fly in the ointment is when there's massive shortages of different antibiotics, and we may have to make different decisions then. But that's based on local issues and what is available at the time, we haven't had that many issues recently.” (P2)

6.4.2.3 Strategies to Improve Prescribing

This theme examined the strategies used within the NHS 111 CSHs to optimise care and prescribing decisions, and to mitigate some of the challenges, rather than proposing changes for future improvement.

6.4.2.3.1 Support of Other Healthcare Professionals

Participants highlighted the value of working as a multidisciplinary team (MDT), which offers mutual support for GPs and pharmacists and helps refine clinical decisions. The setup of NHS 111 CSH shifts (outlined in Section 6.4.2) enhances this collaboration by facilitating opportunistic support. They frequently reported consulting one another on complex or ambiguous cases, such as interpreting unusual presentations (e.g., unexpected tonsil appearance in a photograph) or exploring different perspectives on diagnoses and treatments based on prior knowledge or experience. This approach strengthens confidence and reassurance in decision-making by incorporating second opinions, validating choices, and using collective expertise.

“It's very easy in 111 to put the patient on hold and speak to a GP, another pharmacist, or sometimes ring a specialist. I had a patient the other week with shingles, and I rang ophthalmology before prescribing an antiviral because it was on their face. So it is relatively easy to actually get that support when I'm looking for somebody to sense check my thinking or give me another perspective” (P1)

6.4.2.3.2 Referrals

Referral was reported as an important strategy to ensure optimal and timely treatment while minimising the risks of improper management. Participants described assessing each case to determine its suitability for remote management, referring patients when necessary based on case complexity, patient vulnerability, and appointment availability. For instance, elderly patients on multiple medications, very young children, and cases too complex for phone management were often referred for face-to-face GP OOH consultations. Referral also applied when physical examinations were needed, such as otoscopy for suspected ear infections or vital signs assessment. Although they remained open to assessing symptoms and initiating treatment remotely, they noted sometimes referring patients to other HCPs, such as GPs or NPs, particularly when a condition fell outside their expertise.

“Unless it's a baby from the age of about four or five, I'm happy to talk to parents and or children about their symptoms. But I specifically exclude babies, and I'm more cautious, with the very elderly or those on multiple medications, but I will still start and see how the symptoms present and how things go. But I may hand it over to a GP if I feel I'm out of my depth.” (P2)

Referral also helped manage patient expectations, particularly regarding requests for antibacterial drugs. Prescribers sometimes advise face-to-face consultations to mitigate risks

when patients insist on these drugs despite unclear clinical indications. This approach ensured that prescribing decisions are based on thorough assessment rather than patient demand and helped address unnecessary antibacterial requests.

"If I can't manage them in the hub, I make decision to have them seen in person for any number of reasons, if they are very difficult about demanding antibiotics, for example, I will say, 'well, if you feel that poorly, maybe you're better to be examined in person and I'll book you in with a doctor'" (P2)

6.4.2.3.3 Resources for Evidence-Based Decisions

Participants emphasised the role of evidence-based guidelines and clinical tools in supporting safe, effective prescribing and adherence to best practices. While acknowledging the challenges of remote OOH work compared to IH services, they agreed that the same guidelines are relevant in both settings. They reported relying on a range of resources, with NICE guidance and MicroGuide most commonly cited. One participant even described the latter as their 'local Bible', for its relevance to local practice and resistance patterns. Other widely used resources included CKS, British Medical Journal Best Practice, BNF Open, and TARGET resources, alongside clinical tools, such as FeverPAIN. One participant reported using a self-created checklist to assess conditions, like tonsillitis, ensuring a thorough and consistent patient evaluation.

"I base everything on NICE guidance; I use that as my Bible. I can't think of an example, but I never go for the antibiotic that NICE recommends without checking MicroGuide. For common stuff, I know what MicroGuide recommends, and they tell us when they update it, so I double-check, but MicroGuide is the local Bible because of local resistance patterns." (P2)

One participant also noted that they generally found the available information sufficient for managing acute conditions. This was particularly true with their ability to access platforms like the Welsh Clinical Portal, with patient consent, to review records when needed and make informed decisions in OOH where detailed patient histories may not be fully accessible.

"GP in-hours may be able to look back in the patient's record and their history, so there might be a more extensive history, but actually the information that I need for dealing with acute infection, I have that information available through Welsh clinical portal." (P3)

6.4.2.3.4 Safety Netting and Patient Education

Safety netting was emphasised as a crucial part of consultations, especially when making conservative prescribing decisions. Participants routinely provide patients with clear guidance on symptoms to monitor, ensuring they could recognise red flags and understand when further attention is needed. This practice is also used to withhold unnecessary prescribing, offering an opportunity to educate patients about the limitations and risks of antibacterials and explain why they may not be beneficial. This approach ensures patients feel heard and supported while promoting AMS.

“When I prescribe, I would prescribe with the intention of them taking it, or I wouldn't prescribe but would give safety netting advice: ‘if you deteriorate or your symptoms worsen at any point, call the service back and we'll reassess you based on those new symptoms, but at this time, I don't think an antibiotic is needed based on the symptoms you've given and a thorough clinical check’” (P3)

6.4.2.3.5 Patient-Centred Communication

Participants reported frequently discussing patients' perspectives on needing antibacterial drugs. They avoid making immediate assumptions or promises about prescribing at the start of a consultation, using statements like “we'll go through a few questions and come up with a plan”. By doing so, they guide the conversation toward shared decision-making. This approach helps manage expectations, especially when patients begin the consultation strongly demanding an antibacterial prescription or base their expectations on past experiences. By encouraging patients to share their reasoning, prescribers can challenge and correct misconceptions with evidence-based information while maintaining a supportive dialogue.

“When you've assessed a patient and you've found that actually it's a self-limiting condition, it hasn't crossed the threshold of needing an antibiotic and you explained to them why that is. I've never had an issue with anybody being overtly aggressive with regard to not having antibiotics” (P3)

Participants also described using specific communication techniques and carefully chosen language to reduce unnecessary prescribing, such as sharing personal experiences or using phrases like “at this point” rather than being confrontational and directly refusing requests. This approach conveys that management decisions are based on the patient's current condition, which minimises potential conflict. It also informs patients that reassessment

may be required if symptoms change or worsen. By openly discussing diagnostic uncertainty and explaining the rationale for withholding antibacterial drugs, prescribers build mutual trust with patients, reduce frustration and dissatisfaction, and increase acceptance of non-prescribing decisions. They also highlighted that most patients were generally receptive to non-prescribing decisions, though some occasionally resisted alternative management plans, requiring additional reassurance and explanation.

"The doctors laugh at me sometimes and say, 'how did you get away with saying that?' Because I tend not to get any abuse at all from patients when I say no.[...] I'm older, over the years I've explored techniques of how to speak to people, how to explain to people and how to say no without saying no. 'Cause, I never say no. I say 'at this point in time they are not needed in my opinion. If things change, by all means call back'. So I give them options." (P2)

"With the explanation, I think generally they accept that. The only times that they haven't accepted that haven't been in relation to antibiotics, believe it or not, it's usually in relation to salbutamol" (P3)

6.4.2.3.6 Delayed Prescribing

While participants valued delayed prescribing as an AMS tool, especially in high-prescribing practices, they noted its limited application in OOH settings. They explained that, because OOH care usually involves acute and urgent presentations, patients typically need immediate treatment or advice to seek reassessment if symptoms worsen, leaving little scope for delayed prescriptions. Participants were sceptical of its effectiveness in these settings, believing that most patients, particularly parents of unwell children, would likely fill the prescription immediately despite instructions to wait. As a result, they usually either prescribe immediately when clinically necessary or rely on safety-netting and reassessment when antibacterials are not warranted. However, two participants noted that delayed prescribing may occasionally be considered in specific cases, such as when a child's symptoms may fluctuate overnight, giving families timely access to treatment if the condition deteriorates.

"I don't use it [delayed prescriptions] very often because generally by the time people have got through to 111, they've spent a few hours trying to get through and either somebody's improving, in which case I'm generally not going to give antibiotics, or they're not improving or getting worse, in which case I'm much more likely to give antibiotics." (P1)

6.4.2.4 Strengthening AMS and Professional Development

This theme explored existing opportunities and mechanisms that support prescribers in improving decision-making, AMS, and professional development. It also highlighted a few areas where these systems could be strengthened.

6.4.2.4.1 Training, Education, and Shared Learning

Participants appreciated the training sessions offered regularly by NHS 111 in various areas, such as minor illness management, sepsis, and telephone triage, to maintain a level of competency among prescribers. They also acknowledged the benefits of peer reviews, case discussions, and other educational sessions delivered either by the NHS or external medical education providers. Training led by subject-matter experts with practical experience (e.g., microbiologists or GPs with relevant experiences) was specifically highly valued, as it supported knowledge refreshment and practical learning. Preference for expert-led sessions was particularly strong in areas where guidance on antibacterial prescribing decisions is not always clear-cut, such as dermatology and otology, providing insights into complex real-life scenarios. However, one participant noted variability in training quality, describing some sessions as outdated or inadequate due to trainer selection and content.

“There's been odds and ends of training but nothing specific that I can think of. They do arrange online training with different groups. They've got external groups but they're not always high quality. I can think of a skin session that I did, and it was appalling” (P2)

Beyond structured training, informal learning played a role in participants' professional growth. Spontaneous debriefs among team members, such as case discussions and image reviews with colleagues, which extend beyond supporting one another during telephone consultations, were valued for promoting continuous learning environment. These interactions facilitated the exchange of perspectives and supported decision-making. However, one participant noted that larger meetings were often less effective, with some attendees reluctant to speak up and contribute.

Participants also observed variation in self-directed learning. One described taking additional evening courses and online training in their own time, recommending these opportunities and sharing their learning within the CSHs. Additionally, experience gained outside the service was seen as contributing to professional development in OOH settings.

“Often the GP will call us over and show us a photo and we’ll talk about what’s going on or one of us will share a case we’ve just had and we’ll talk about it. So we do sort of rapid debrief type case studies in the hub itself when we’ve got time between cases.” (P1)

While participants felt confident in managing common conditions, they sometimes found differential diagnosis more challenging in telephone consultations. They expressed a desire for training better suited to the demands of remote assessments to improve patient care and safety. Suggestions included how to elicit information and identify red flags without visual cues or physical examination. One participant specifically highlighted cognitive bias as a concern, noting a tendency to focus too narrowly on a recurring diagnosis while overlooking alternative or less obvious conditions.

“I know how to treat a UTI in accordance with the empiric guidelines but what I need to make sure is that I am mitigating against my cognitive bias as much as possible, so if I’m used to only seeing UTIs, I’ll see UTIs everywhere. It’s the same as when you buy a new car, you don’t see that car on the road ever and then when you’re driving your car, you’re like there’s billions of them because you’re then aware of it, that cognitive bias I am conscious of when I’m on the phone” (P3)

6.4.2.4.2 Performance Review

Participants highlighted a lack of adequate feedback on their prescribing practices, with two noting that they received no audits or formal evaluations. Despite this, they felt confident in their prescribing and adherence to guidelines. One participant, who had audited 1% of other pharmacists’ cases, described pharmacists as “good prescribers” who follow guidelines carefully, demonstrate strong diagnostic reasoning, and prescribe meticulously, with no major concerns identified. Pharmacists whose cases were audited could be queried if issues arose. This audit process involved reviewing prescribing choices and checking adherence to diagnostic pathways, treatment selection, and justification as part of the quality assurance process within the service. The same participant also noted that the annual appraisals provided opportunities to review staff practice and training needs, helping align future training with identified areas for improvement.

“We get very few complaints or instances involving anybody in 111 to be honest, but the pharmacists generally are not ‘Mavericks’ in their prescribing. They’ve got quite sensible approaches, good diagnostic skills, very diligent and thorough. I think we’re already in a good place” (P1)

One participant expressed a need for a feedback loop, particularly to review patient outcomes following prescribing decisions. They felt that insights into patient outcomes, whether a prescription was issued or not, would support reflective learning, improve clinical decision-making, and promote ongoing professional development. They also noted that such feedback mechanisms are also lacking beyond NHS 111, including IH services. Another participant viewed reflection as informal self-assessment process of clinical practice that supports their learning and development.

"I don't actually know what happened to that patient after they have left me and gone on to another part of the system [...]. There's no feedback or opportunity for reflection of was that an appropriate referral that I made or did the patient worsen or deteriorate or any of that, so actually that reflective learning perhaps is the missing piece" (P3)

"It's more difficult for me because we never reflected. I spent 30 years without. You move forward; you don't reflect back. I can understand it as a technique and I suppose to some degree I do because if I think 'oh, that could've gone better' that's reflection, isn't it?" (P2)

Discussion of auditing and feedback highlighted the challenges of applying NPIs in OOH services, including the NHS 111 CSHs. All participants agreed that NPIs are unsuitable in these settings, as they do not account for the complexity of OOH care or the patient mix, where most present with acute infections rather than long-term prescription needs. This cohort is more likely to receive higher volumes of antibacterial prescriptions, making reduction targets less applicable and potentially producing unfair or misleading assessments of prescriber performance. Instead, participants suggested that the evaluations should focus on reviewing the appropriateness of individual prescribing case-by-case against clinical guidelines, rather than relying on numerical metrics.

"I think the service that we offer self-selects patients with infections, so the treatment is generally going to be antibiotics or no antibiotics. I guess, you could do how many patients have you seen, how many antibiotics have you prescribed, but it will be different from a general population when analysing prescribers' antibiotic usage. I would say interesting, but probably limited in its [NPIs] application because of the self-selection nature" (P2)

6.5 Discussion

6.5.1 Main Findings and Relevance to Literature

To the researcher's knowledge, this is the first study within the UK NHS 111 CSHs to explore HCPs' experiences and decision-making when prescribing oral antibacterials during OOH periods, including the factors influencing these decisions. The study expands understanding

of the complexities of antibacterial prescribing in such environments. Participants described these factors not as direct influences but as considerations and challenges to manage, many arising from the limitations of remote, telephone-based care.

Participants systematically described their approach to decision-making, involving identifying patient problems and ICEs, gathering information, reviewing and analysing data, conducting examinations when feasible, making diagnoses, and communicating outcomes. Their accounts offered valuable insights into the types of information used to reach prescribing decisions within NHS 111 CSHs, which may differ from the usual IH clinical settings. While participants described what information informed their decisions, limited understanding was gained into the underlying clinical reasoning models through which this information was prioritised and interpreted, an aspect beyond the scope of this study. Understanding these models, and how they are incorporated into educational development is an important area for future research, particularly given the increasing recognition of the need to strengthen decision-making within pharmacy as pharmacy graduates become prescribers.

Various models have been proposed to explain clinical reasoning (Yazdani et al. 2017). A widely accepted model is the dual process theory, which differentiates between intuitive (System 1) and analytical (System 2) modes (Croskerry 2009). The intuitive mode is unconscious and automatic, relying on pattern recognition, which enables rapid decisions based on experience, but has the potential to increase cognitive biases. In contrast, the analytical approach is deliberate, slow, and hypothetico-deductive, involving careful reasoning and evidence evaluation. This theory suggests that HCPs can integrate both modes, switching between them depending on case complexity.

While existing models provide useful frameworks to understand clinical reasoning, they may not fully capture the unique complexities of remote OOH consultations, where HCPs rely heavily on verbal communication and, when available, digital resources. Therefore, further research is needed to explore the underlying clinical reasoning processes in these contexts to develop strategies that support HCPs in improving practice and mitigating cognitive biases. Techniques such as the think aloud method, where participants verbalise their thoughts while completing tasks (e.g., clinical vignettes), could be useful for this aim

(Ericsson and Simon 1980; Noushad et al. 2024), as interviews alone do not allow direct observation of decision-making or easy articulation of participants' approaches.

Of interest, only one participant in this study acknowledged the potential for cognitive biases, especially the fear of missing diagnoses due to availability bias, where recent or frequently encountered experiences influence decision-making. This may reflect the challenges in articulating internal reasoning or a lack of awareness of how cognitive biases affect clinical judgement. It also highlights the importance of HCPs being mindful of, and reflecting on, how they process information and make decisions, for example, through metacognition, a key debiasing strategy which involves awareness of one's own thought processes (Church and Carroll 2023). Evidence from a systematic review found that metacognition improves decision-making in HCPs by supporting cognitive bias identification, facilitating systematic and holistic approaches, and promoting creative thinking (Church and Carroll 2023). Enhancing metacognitive skills among OOH HCPs could therefore minimise biases that impact diagnostic accuracy and patient care.

Studies in other settings have suggested that tools, such as checklists and mnemonics, can support metacognition (Staal et al. 2022). One such example is the TWED tool (T: Threat, W: What else, E: Evidence, D: Dispositional factors), which helped students and clinicians reflect on their cognitive errors, improving their decision-making (Chew et al. 2016; Chew et al. 2019). Similarly, one participant in the present study described developing a personal checklist as a cognitive aid to ensure systematic evaluation and reduce the risk of missing key details. Although less formal than validated tools, this example illustrates how HCPs take steps to support reflective practice in OOH contexts and highlights opportunities to integrate such tools more formally into practice.

Prescribing antibacterial drugs in the NHS 111 CSHs is influenced by many factors, most of which are context-dependent and contribute to clinical uncertainty. These include the urgent and remote nature of the service, patient acuity and complexity, vulnerability, absence of diagnostic tools, reliance on patients' accounts, and the variable access to other healthcare services depending on the time and day. In these settings, prescribers primarily rely on reported symptoms without the ability to observe or examine patients directly. Research has shown that HCPs and patients perceive remote technologies as lacking key aspects of in-person interactions, including the safeguards of physical examination, which

increases the potential of missing important symptoms (Abdelaziz et al. 2024). This absence of direct contact may heighten the pressure to prescribe, especially if symptoms are exaggerated, intentionally or not, leading to potential misinterpretation and unnecessary prescriptions. Even in in-person OOH consultations, a study has shown that patients sometimes present their concerns in a way that influences GPs' thinking and decisions, creating pressure to issue prescriptions (Colliers et al. 2020). Prescribers should therefore carefully weigh whether to adopt a watchful waiting approach, prescribe, or refer, all while minimising unnecessary burden on other services, taking into consideration the purpose of NHS 111.

In the present study, prescribers tended to adopt a cautious approach when managing vulnerable groups, such as very young children, which often resulted in referral or issuing immediate prescriptions. This aligns with earlier OOH studies, which reported that prescribers were more cautious and likely to prescribe more easily when managing vulnerable patients, particularly due to limited diagnostics and follow-up opportunities (Colliers et al. 2018; Williams et al. 2018). Similarly, the perceptions of managing different group (Colliers et al. 2018), or sicker patients in these services have been reported (Williams et al. 2018). However, participants in this study also used an alternative strategy by referring these patients for in-person assessment at GP OOH services or other appropriate services when available.

Collaboration between HCPs with different experiences and the presence of an easily accessible MDT within NHS 111 CSHs was believed to enhance patient assessment and build confidence in clinical decision-making. HCPs could place a patient on hold to seek advice from the GP OOH, consult colleagues for a second opinion or reassurance, or discuss complex or vague cases, fostering a culture of shared learning and teamwork across professional backgrounds. Pharmacists, for instance, were frequently consulted by nearby GPs on appropriate antibacterial choices. This collaborative environment was considered valuable in managing diagnostic uncertainty, which could be amplified in remote settings, and is a recognised driver of antibacterial prescribing in primary care (Lum et al. 2018; Jeffs et al. 2020; Laka et al. 2022; Kasse et al. 2024) and OOH services (de Bont et al. 2015b). This contrasts with the OOH model in Belgium, the GPC, where GPs are the sole prescribers and often feel isolated and disconnected (Colliers et al. 2018). Evidence further suggests that co-

located HCPs engage in more interprofessional interactions than those working separately (Jenkins et al. 2016). Interventions (e.g., education on managing clinical ambiguity and POCTs) have been proposed to reduce uncertainty (Kasse et al. 2024) and may be considered to complement existing MDT support to further improve patient care.

Another factor that may have influenced prescribing decisions is the professional role and scope of practice. PIPs are required, under the GPhC standards, to work within their area of expertise and qualification (General Pharmaceutical Council 2019,2025). This principle shaped the cases triaged and managed by participants in this study, all of whom were pharmacists. When faced with cases beyond their scope or requiring further assessment, they typically referred patients to other HCPs for a more specialised evaluation. The same principle has been reported in secondary care, where NMIPs reported adherence to their defined competence and role (Maddox et al. 2016). While such adherence demonstrates professional responsibility and mitigates patient safety risks, it may also limit pharmacists' contribution to the service, where timely access is critical. This does not suggest that pharmacists should work beyond their scope but rather highlights how cautious adherence to defined roles and boundaries can influence decision-making and service delivery in OOH contexts. Although not specific to antibacterial prescribing, a systematic review of qualitative studies stressed the importance of clearly defining and communicating NMIP scope in primary care OOH services, and providing appropriate training, support, and mentoring to enhance confidence (Lyness et al. 2021). These measures could help pharmacists maintain professional boundaries while maximising their contribution to timely patient care, supporting safe practices.

Although participants in this study reported employing a consistent approach to prescribing antibacterials across settings, literature have shown that employment type and role perception may impact HCP practices. Locum prescribers in primary care, for example, found it easier to recommend alternative management approaches, such as advising against antibacterial prescriptions (Borek et al. 2022). This may relate to the fact that locums are not permanently based in one practice and therefore face no concerns about negatively affecting ongoing relationships with patients they might not see again, a challenge often faced by regular GPs (van der Zande et al. 2019). A similar pattern has been reported by some OOH GPs in Belgium, who feel less accountable in OOH work compared with their

usual GP setting and primarily see their role as performing triage, treating urgent cases and referring patients to their regular GP (Colliers et al. 2018). This made it is easier to refuse antibacterial prescriptions or recommend a watchful waiting approach (Colliers et al. 2018). These observations highlight a need to consider how role interpretation in different contexts may shape prescribing decisions.

The present study emphasised the importance of effective communication in eliciting patients' concerns and reducing unnecessary prescribing. Colliers et al. (2021a) found that in most primary care OOH consultations, patients did not explicitly state the underlying reasons for their visits, leaving GPs to infer their concerns rather than clearly communicating them. By attentively engaging with patients' narratives, however, GPs were able to elicit their ICEs, thereby enhancing understanding (Colliers et al. 2021a). Participants in the present study reported using similar strategies, including active listening, empathy, reassuring language, explaining clinical decisions, and offering appropriate safety-netting advice. These approaches, according to participants, fostered trust and created a space where patients felt heard and empowered, promoting shared decision-making, satisfaction, and acceptance of clinical decisions. In turn, this was seen to reduce demands for antibacterial prescriptions when not clinically warranted. Evidence has supported this, showing that when implemented effectively, shared decision-making can enhance patient satisfaction, understanding, and confidence in clinical decisions (Edwards and Elwyn 2006).

Participants acknowledged delayed prescribing as a useful AMS strategy to reduce unnecessary antibacterial use but reported rarely using it in OOH settings, where clinical urgency often requires prompt action. Immediate prescribing seems to arise from prescribers' confidence in their diagnostic judgment, leading them to provide immediate prescriptions only when clinically needed. Evidence from Australian primary care found that GPs applied delayed prescribing very selectively, for example when patients were travelling or faced difficulties accessing a GP (Sargent et al. 2017). Despite recognising its potential to reduce AMR, concerns about misuse, such as patients using prescriptions immediately or storing them for future, led many GPs to favour reassessment (Sargent et al. 2017). Similar concerns have been reported in England's OOH services, where prescribers perceived patients as unlikely to follow advice on delayed prescriptions, a perception conveyed in the present study (Williams et al. 2018). This suggests that the effectiveness of delayed

prescribing depends on patient behaviour and understanding. Nonetheless, delayed prescribing has been valued for facilitating shared decision-making, providing a safeguard, and helping manage patient demand (Williams et al. 2018). Colliers et al. (2021a) further highlighted its use in OOH services to accommodate patient expectations for antibacterial prescriptions.

This study identified a lack of specific resources and guidelines for OOH services. This is consistent with Alves et al. (2021), whose review noted a similar gap in training and guidance tailored to OOH. However, participants noted that resources available for IH services were accessible and useful for OOH practice, with local guidelines playing a central role in guiding prescribing decisions. Among these resources, the digital MicroGuide app was particularly appreciated for its ease of access and provision of up-to-date local guidance. This aligns with findings from a UK hospital-based study which reported that clinicians viewed the app positively for its convenience, accessibility, and reliability, as it helped validate their decisions, enhanced confidence and autonomy, and supported AMS (Hand et al. 2021). In 2024, however, MicroGuide was replaced by the Eolas platform, which a mixed method evaluation found to be less efficient compared to MicroGuide among hospital HCPs (Waldock et al. 2025). While Eolas was recognised for supporting antimicrobial prescribing, participants highlighted a need for improved content and closer alignment with national standards (e.g., NICE). Many users in that study reported that the platform was difficult to navigate, with excessive steps and technical barriers limiting usability (Waldock et al. 2025). This suggests that ease of use is a key determinant of HCP engagement and the effectiveness of digital decision-support systems, an aspect that may be a particularly relevant in OOH environments.

While participants in the present study reported using existing resources and adhering to guideline recommendations, others did not. For instance, GPs in Belgium OOH services advocated the development of tailored guidelines to enhance decision-making (Colliers et al. 2018). Findings from England indicated that GPs in OOH services sometimes deviated from guidelines, relying on clinical intuition, whereas NPs tended to follow established protocols (Williams et al. 2018). These findings suggest differences between HCPs, with some able to adapt and integrate existing resources, while others encounter challenges in the absence of dedicated guidelines. This raises the question of whether GPs in the NHS 111

CSHs demonstrate similar patterns to the pharmacists interviewed and whether tailored guidance could reduce such variability.

The study also highlighted a lack of adequate audit and feedback on individual prescribing practice, with two participants stating they had never received either positive or negative feedback. Performance reviews were typically conducted only in response to adverse incidents rather than as part of ongoing professional development. Although the absence of feedback may suggest that participants adhere to best practices and make well-informed treatment choices, prescribers felt that audits and feedback were needed. Despite confidence in their approach, these mechanisms were seen as important for supporting reflection and continuous improvement. Similarly, GPs in Belgium OOH services suggested receiving personal feedback on their antibacterial prescribing, allowing them to compare their performance with peers (Colliers et al. 2018). In England OOH services, Williams et al. (2018) found that GPs and NPs regarded audit, feedback, and supervision as essential for guiding future prescribing. Additionally, prescribers highly valued peer discussion and educational opportunities, acknowledging their role in supporting decisions and providing a platform to discuss alternative approaches and validate decisions (Williams et al. 2018), aligning with the results of the present study.

Previous studies on antibacterial prescribing in OOH services have identified additional factors influencing prescribing decisions, such as workload and time pressure (Colliers et al. 2018; Williams et al. 2018), inconsistent staffing and varying shifts (Williams et al. 2018), limited or lack of access to medical records (Colliers et al. 2018; Williams et al. 2018), managing unknown or demanding patients (Colliers et al. 2018), patient anxiety (Williams et al. 2018), and the desire to satisfy patients (Colliers et al. 2018). While these factors have been reported to influence prescribing in OOH contexts, they did not appear in the present study. This may be attributed to the NHS 111 CSHs setup, where prescribers operate within a remote triage system that may reduce the impact of time pressure and direct patient influence, suggesting that prescribing mechanisms in NHS 111 CSHs may differ from GP OOH environments. Additionally, as all participants were pharmacists, their scope of prescribing and the cases they manage likely differ from GPs. Williams et al. (2018) identified that GPs are perceived as better equipped to manage complex cases compared to NPs due to their

broader clinical training and diagnostic expertise. This further emphasised the need to explore GP prescribing in NHS 111 CSHs.

It should be noted again that the OOH model explored in this study differs from those studied by Williams et al. (2018) in England and Colliers et al. (2018) in Belgium, which may limit comparability. Variations in service structure, accessibility, and workforce composition, based on the model adopted, could shape HCPs' approaches and the influences encountered. In Belgium, as previously outlined in Chapters 1 and 4, OOH care is delivered exclusively by GPs through a GPC model without triage, with several GPs obligated to collaborate at one central site distinct from their regular practice. Patients can walk in or call the GPC in advance to access the service via in-person appointments only (Smits et al. 2019). While in the UK, OOH services involve a mix of HCPs, including GPs, nurses, and pharmacists, primarily accessed via NHS 111 telephone triage (The Practice of Health n.d.) or online symptom checker in England (NHS England 2025c), with in-person GP OOH consultations arranged when needed. These differences emphasise the need for caution when making cross-country or cross-settings comparisons and for consideration of local operational and cultural contexts.

6.5.2 Ethical and Recruitment Challenges and Implications

The researcher faced challenges obtaining ethical approvals due to differing views on whether the study should have been classified as a service evaluation or research. Although the UK HRA and other bodies provide guidance on distinguishing audits, service evaluations, and research (HRA 2022a), applying these classifications in practice proved difficult. Based on the HRA definition, the research team classed the study as a service evaluation, which was not accepted by one HB. This lack of consensus caused delays in securing approvals and required additional time for planning and submitting supplementary applications, including Cardiff University sponsorship and insurance, HCRW/HRA review via IRAS, and HB C&C approval.

The complexity of distinguishing study types has been discussed in the literature. Wade (2005) noted that differentiating between audits and research can be challenging, and ethical judgment may vary across institutions (Wade 2005). Similarly, Chen and Fawcett (2019) described the distinction between research and service evaluation as a grey area that may create confusion over ethical oversight and the approvals needed for a study to go

forward (Chen and Fawcett 2019). They reported that the South East Scotland Research Ethics Services reviewed around 1,300 studies over six years, classifying 70% as not research (Chen and Fawcett 2017; Chen and Fawcett 2019), highlighting the difficulty of distinguishing research from other study types. Concerns have also been raised about potential mislabelling of projects to bypass rigorous ethical review required for research studies (Chen and Fawcett 2019). This emphasises the importance of expert advice when classification is uncertain.

One reason for this ambiguity is that while service evaluations may not always require research ethics committee approval, they must still follow ethical principles and protection laws concerning consent, anonymity, data protection, and privacy (Chapter 3, Section 3.9) (Twycross and Shorten 2014). Because research and complex service evaluations often share methodological elements, classification based on methodology alone is difficult (Twycross and Shorten 2014; Chen and Fawcett 2019), making the study's scope and intent the key differentiators (Twycross and Shorten 2014). In this study, the purpose was to define care provided to inform local decision-making rather than derive transferrable knowledge, aligning with the definition of service evaluations.

On reflection, repeating the process would involve consulting Cardiff University's Research Integrity, Governance, and Ethics Team earlier, before contacting the study sites. This would likely have clarified the study classification and approval requirements, potentially allowing a single HRA/HCRW review application through the IRAS for all involved HBs rather than securing approval from each. Such an approach could have increased efficiency, saved time and effort, and standardised the process by avoiding multiple approval routes simultaneously. This experience, however, highlighted the challenges researchers may face when working across multiple sites, where procedures designed to protect research can sometimes become barriers, especially for time-sensitive studies.

A key learning point from the recruitment process was the difficulty of relying on gatekeepers for accessing eligible participants. The research team were unaware of the lead for NHS 111 GPs to engage with and had worked under the impression that the identified gatekeepers could reach all GPs and pharmacists working in the hubs. This restricted direct access to potential GP participants and likely contributed to poor recruitment. If conducting a similar study, it would be important to clarify recruitment pathways, identify all relevant

professional leads in advance, and define the scope of their involvement to engage wider HCP groups.

The number of interviews in this study remained lower than anticipated despite all efforts to enhance recruitment. The researcher used multiple approaches to increase the response rate, including offering flexible scheduling and location options, revising inclusion criteria, working with different gatekeepers, sending reminders, and using social media to increase visibility. This required frequent amendments and updates to the CSPPS-REC and HRA/HCRW applications and coordination with involved HB teams. While time-consuming, these adjustments were necessary to attempt to tackle poor recruitment and sustain study progress, with little success. Looking back, although interviews were limited to a maximum of 60 minutes, offering shorter, more focused interviews that balance data richness with the availability and convenience of busy HCPs might have encouraged greater participation. In hindsight, widening inclusion criteria from the start might also have facilitated higher recruitment.

One potential barrier that may have further limited participation was the inability to offer financial incentives due to budget constraints. This was particularly relevant in these settings as the workforce predominantly consisted of locum staff, who may be less motivated to participate without compensation, as noted by the Director of Primary Care, Community Services, and Complex Care (Appendix 6.12). While the study was advertised in the NHS 111 Pharmacists WhatsApp groups, the Director suggested raising awareness to attract more staff by discussing the study at the HB OOH Clinical Reference Group meetings. However, this was not pursued, as securing slots on multiple HB agendas was not possible within the PhD timeline. There were also concerns that such an approach could compromise researcher neutrality, possibly influencing participants' decisions even without coercion or direct instruction. Identifying this sooner may have allowed more proactive site engagement and timeline planning, while maintaining neutrality, which might have improved participation.

Recruiting HCPs for research is widely acknowledged as challenging (Browne et al. 2022). A major barrier is lack of time, as heavy workloads and tight schedules limit their availability to participate in research (Brodaty et al. 2013; Browne et al. 2022). Additionally, HCPs may not perceive the direct benefits of the research to their practice or find it personally interesting

(Browne et al. 2022). Browne et al. (2022) reported that flexibility in timing and location and minimising commitment time could facilitate recruitment. They also found that financial incentives are not always necessary to drive participation, suggesting that protected time and continuous professional development (CPD) credit recognition could be effective incentives for many HCPs (Browne et al. 2022). While no incentives were offered in this study, exploring the delivery of some form of CPD on topics of interest to participants, with organisational support and collaboration with leaders, could be as approach to encourage participation without coercion.

Future research may also consider larger studies or developing questionnaires to improve response rates. Qualitative research has been shown to play an important role in designing and refining questionnaires as a data collection tool. A systematic review found a growing trend of using qualitative data to inform questionnaire design, with semi-structured individual interviews being the most reported method for generating survey questions, followed by focus groups (Ricci et al. 2018). Using qualitative methods in this way increases the likelihood that questions become clear, meaningful, and pertinent to the target population.

According to Tombs and Strange (2024), questionnaires offer several advantages for researchers and participants, potentially addressing barriers for partaking in interview studies. They offer practical benefits such as reduced complexity, lower time and resource demands, and simplified data collection through online forms. Questionnaires also provide a standardised approach to questioning, facilitating analysis and comparability. They can also encourage participation by ensuring anonymity and capture diverse perspectives by reaching a broader audience, including those restricted by cultural or logistical constraints. However, questionnaires may not always guarantee the richness and depth of interviews (Tombs and Strange 2024).

A draft questionnaire, developed from the three interviews and related literature on decision-making, is included in Appendix 6.16. However, before use, it requires expert review and piloting to evaluate its timing, flow, and clarity, ensuring the questions are understood as intended (Oppenheim 2000). This could form a potential future study, collaborating with project supervisors or MPharm students to validate and implement the

questionnaire, enhancing understanding of decision-making processes. Future exploration could also consider how it might be adopted to the unique OOH settings of other countries.

6.5.3 Limitations

This study contributed to understanding oral antibacterial prescribing experiences and decision-making in NHS 111 CSHs during OOH periods in Wales from the perspective of PIPs. While doing so, it also, to a limited extent, helped address the gap identified by Lyness et al. (2021) regarding the experiences of NMIPs in primary care OOH settings and their specific professional needs. However, it faced several limitations. The response rate could not be estimated because the number of individuals reached through gatekeepers and social media advertisements was unknown. The small sample size also made it challenging to achieve and assess data saturation, potentially restricting the diversity of perspectives. Recruitment was facilitated mainly through gatekeepers, which may have introduced selection bias, as they had greater access to pharmacists than to GPs within the hubs. This imbalance, combined with supplementary recruitment strategies such as snowballing and social media adverts (posted on pharmacy-related platforms), may explain the absence of GP participants. Consequently, the study may not fully reflect experiences across NHS 111 CSHs. Additionally, although approvals were obtained to recruit from the three CSHs, interviews were conducted with participants from only two, which may have further constrained perspective diversity.

Nonetheless, the three interviews were rich in content and provided in-depth insights from individuals with varied IH experiences, allowing an understanding of the CSH work environment, with most views broadly aligning. While the identified themes provide valuable initial observations, they should be interpreted with caution within the study context given these limitations. Recruitment challenges may also encourage institutions to better support research activities by addressing individual needs to enhance participation and engagement.

6.6 Conclusion

By addressing nuances of practice not captured in earlier phases, this chapter supports to the expansion aim of MMR (Chapter 3, Section 3.3), broadening the scope of inquiry and deepening understanding of the practical aspects of prescribing in these settings.

This study is the first to explore how PIPs in NHS 111 CSHs in Wales make oral antibacterial prescribing decisions during OOH periods. It highlights the complexity of this process, presenting various factors that HCPs manage, including patient acuity and clinical uncertainty associated with remote OOH assessments, the lack of diagnostic tools, limited access to other healthcare services, and the need for effective communication. The study also emphasises the importance of contextualising prescribing decisions within the unique challenges of each clinical setting, ensuring that prescribing practices and AMS interventions are evaluated and applied in ways that align with the specific context.

Chapter 7 Integration and General Discussion

7.1 Overview of the Chapter

This chapter concludes the research by integrating and summarising the main findings from Chapters 4–6, where data were triangulated to assess their relationships and to address the aim of MMR (Chapter 3, Section 3.3). It discusses key findings in relation to existing literature and highlights the strengths and limitations of the work undertaken. The chapter then explores the broader implications and suggests directions for future research.

7.2 Triangulation of Findings

Triangulation was conducted to integrate and compare results from the quantitative and qualitative studies, moving from isolated findings to a more cohesive understanding. Literature has shown that findings from the same research can sometimes be inconsistent, highlighting the challenges of interpreting mixed-methods data and the value of triangulation in capturing diverse perspectives (Tonkin-Crine et al. 2016). In this thesis, data and methodological triangulation were employed using different data collection techniques, research methods, and data sources (Table 7.1).

Table 7.1: Summary of Datasets and Related Chapters

Chapter	Data Source	Description	Timeframe
4	CASPA	Retrospective, administrative census data on oral antibacterial prescribing	2015–16 to 2021–22
4	Choose Pharmacy (PIPS module)	Retrospective, administrative census data on PIPS consultations involving oral antibacterials	June 2020 to September 2022
5	Stakeholders from each HB in Wales	Qualitative interviews with lead and primary care antimicrobial pharmacists, where feasible	Not applicable
6	Prescribers in Wales NHS 111 CSHs	Qualitative interviews with prescribers working in NHS 111 CSHs during OOH periods	Not applicable

Key: CASPA: Comparative Analysis System for Prescribing Audit; CSHs: Clinical Support Hubs; NHS: National Health Service; OOH: out-of-hours; PIPS: Pharmacy Independent Prescribing Service.

Tonkin-Crine et al.'s (2016) triangulation protocol was used, as it enables systematic integration of previously collected data, providing a comprehensive understanding while revealing points of disagreement that may add new insights or warrant investigation. Data from Chapters 4–6 were first analysed separately. Results from each were then reviewed, and key findings summarised into statements for side-by-side comparison. In the qualitative studies, findings within each theme were noted, especially when themes were broad. Similar findings within each study were consolidated into higher-level statements. These

were compared pairwise across datasets (e.g., dataset A vs B, dataset A vs C), resulting in six comparisons per finding. A coding matrix was created to display the relationships, as shown in Table 7.2.

Table 7.2: Relationship Categories in the Triangulation Process (Tonkin-Crine et al. 2016)

Category	Description
Agreement (convergence)	Findings are consistent across datasets.
Partial agreement (complementary)	Findings relate to the same topic but offer different perspectives or details.
Dissonance (conflicting)	Findings contradict each other.
Silence (no overlap)	Findings appear only in one dataset.
Not applicable	Neither dataset contained relevant data.

The results matrix (Appendix 7.1) was reviewed to identify neutral overarching themes. For example, those related to prescribing challenges or influences, contextual differences, and suitability of prescribing indicators were grouped under reframing AMS in OOH settings, rather than being framed as barriers. These were then discussed in relation to literature.

7.3 Integration Results

Across the four datasets (Table 7.1), 43 findings were compared (Appendix 7.1), resulting in 258 paired comparisons. Of these, two findings were from three datasets, 20 from two datasets, and 21 from one dataset. There were ten instances of agreement, ten of partial agreement, and six of dissonance (Table 7.3). Silence (n=149) and not applicable (n=83) were most frequently reported, an expected outcome given the distinct timeframes and focus of each study. Consequently, each dataset produced unique findings with limited overlaps and comparability. Quantitative data came from retrospective, census-based secondary analyses of all-Wales oral antibacterial prescribing across (1) primary care (GP surgeries, OOH services, including NHS 111 CSHs) and (2) PIPS. These system-levels datasets contrasted with the qualitative interviews, which captured individual-level perspective which differed in focus: (3) stakeholders' (lead and/or primary care antimicrobial pharmacists) views on prescribing, and (4) PIPs' experiences and decision-making in a specific OOH setting (NHS 111 CSHs). These differences reflected the varied roles and knowledge bases of participants, with some findings more relevant to frontline OOH HCPs and others to those overseeing AMS at the HB level. Findings in Table 7.3 are colour-coded (Table 7.4) to illustrate how they supported theme development.

Table 7.3: Pairwise Comparison Results

Theme, Finding Number, and Topic		CASPA ↔ PIPS	CASPA ↔ Stakeholders	CASPA ↔ NHS 111 CSHs	PIPS ↔ Stakeholders	PIPS ↔ NHS 111 CSHs	Stakeholders ↔ NHS 111 CSHs
1	Prescribing patterns	D	A	S	D	S	S
2	Variation across health boards	A	PA	S	PA	S	S
3	Increasing pharmacist prescribing over time	A	S	S	S	S	NA
4	Lower prescribing proportion in OOH	A	S	S	S	S	NA
5	Coronavirus disease (COVID-19) impact	S	PA	S	S	NA	S
6	PIPS contribution to care	S	NA	NA	S	S	NA
7	PIPS users	S	NA	NA	S	S	NA
8	Conditions managed by pharmacists	S	NA	S	S	PA	S
9	Pharmacist prescribing & referral approach	S	NA	S	S	PA	S
10	Pharmacist quality of prescribing	S	NA	S	S	A	S
11	GAS, media, public behaviour impact	NA	S	NA	S	NA	S
12	Adapting to challenges affecting drug choice	NA	S	S	S	S	PA
13	Insufficient public awareness	NA	S	NA	S	NA	S
14	Patient behaviour in OOH	NA	S	S	S	S	D
15	System impact on data & auditing	NA	S	NA	S	NA	S
16	Data limitations: OOH denominators, documentation, and demographics	NA	S	NA	S	NA	S
17	Lack/limited auditing & feedback	NA	S	S	S	S	A
18	Data sharing and communication	NA	S	NA	S	NA	S
19	Data to support interventions	NA	S	NA	S	NA	S
20	Communication across services	NA	S	NA	S	NA	S
21	Working with context limitations	NA	S	S	S	S	A
22	Different OOH prescribing approaches	NA	S	S	S	S	D
23	Defensive prescribing & safety-netting	NA	S	S	S	S	D
24	Communication with OOH teams	NA	S	NA	S	NA	S
25	Benefits of education and peer reviews	NA	S	S	S	S	A
26	Value of expert-led training	NA	S	S	S	S	A

Key: A: agreement; CASPA: Comparative analysis System for Prescribing Audit; D: dissonance; GAS: Group A Streptococcus; NA: not applicable; NHS 111 CSHs: National Health Service 111 Clinical Support Hubs; OOH: out-of-hours; PA: partial agreement; PIPS: Pharmacy Independent Prescribing Service; S: silence.

Table 7.3: Pairwise Comparison Results (continued)

Theme, Finding Number, and Topic		CASPA ↔ PIPS	CASPA ↔ Stakeholders	CASPA ↔ NHS 111 CSHs	PIPS ↔ Stakeholders	PIPS ↔ NHS 111 CSHs	Stakeholders ↔ NHS 111 CSHs
27	Undergraduate education & junior support	NA	S	NA	S	NA	S
28	Leadership to promote AMS & interventions	NA	S	NA	S	NA	S
29	Communication/collaboration between healthcare professionals/leaders	NA	S	S	S	S	PA
30	Specific initiatives to OOH	NA	S	S	S	S	PA
31	Useful tools and interventions	NA	S	S	S	S	A
32	Delayed prescribing	NA	S	S	S	S	D
33	Challenges in remote OOH assessment	NA	S	S	S	S	PA
34	Evaluation of interventions	NA	S	NA	S	NA	S
35	What is a successful intervention?	NA	S	NA	S	NA	S
36	Adaptation to OOH goals	NA	NA	S	NA	S	S
37	Limited diagnostics does not impact immediate decisions	NA	NA	S	NA	S	S
38	Patient-centred approach is followed	NA	NA	S	NA	S	S
39	Suitability for remote management	NA	NA	S	NA	S	S
40	Referral practices for high-risk patients	NA	NA	S	NA	S	S
41	Communication with patients as AMS strategy	NA	NA	S	NA	S	S
42	Communication needs: eliciting patient data	NA	NA	S	NA	S	S
43	NPIs and incentive schemes	NA	S	S	S	S	PA

Key: A: agreement; CASPA: Comparative analysis System for Prescribing Audit; D: dissonance; NA: not applicable; NHS 111 CSHs: National Health Service 111 Clinical Support Hubs; NPIs: National Prescribing Indicators; OOH: out-of-hours; PA: partial agreement; PIPS: Pharmacy Independent Prescribing Service; S: silence.

Table 7.4: Themes and Corresponding Colour Codes Used to Guide Their Development in Table 7.3

Colour	Theme	Colour	Theme
	Reframing AMS in OOH Settings		Education, Training, and Raising Awareness
	Subtheme: Diagnostics and Uncertainty in OOH Services		Driving AMS Through Leadership and Quality Communication
	Data Improvement, Monitoring, and Evaluation		Expanding Role of PIPs

AMS: antimicrobial stewardship; OOH: out-of-hours; PIPs: Pharmacist independent prescribes.

7.4 Discussion of Findings

7.4.1 Reframing AMS in OOH Settings

Findings from Chapter 4 revealed an overall decline in oral antibacterial prescribing across primary care in Wales, including IH and OOH services, although prescribing patterns varied across HBs (discussed further in Chapter 4). While OOH prescriptions represent only a small proportion of total antibacterial primary care use, these services present unique complexities for HCPs due to their distinct working conditions and patient population.

Qualitative findings from both interview studies (Chapters 5 and 6) highlight challenges that can impact oral antibacterial prescribing in OOH contexts, including limited diagnostic tools, constrained availability of other services, and high patient acuity. The need to adapt to remote, telephone-based consultations in NHS 111 CSHs without the ability to examine patients physically also contributes to uncertainty. Similar challenges have been reported in OOH services across other countries (Colliers et al. 2018; Williams et al. 2018), as identified in the scoping review (Chapter 2). These OOH-specific challenges overlap with broader factors affecting general prescribing, such as healthcare crises (e.g., COVID-19, GAS outbreak), media-driven changes in public perception and behaviour, and fluctuating drug supply and shortages. All these system-wide pressures further complicate efforts to optimise antibacterial prescribing as discussed in Chapter 5.

Given the contextual differences, comparing OOH and IH practices is not always appropriate and should be approached cautiously. Implementing AMS interventions that are effective in IH care may therefore not be feasible in OOH settings. While certain AMS resources (e.g., the TARGET toolkit, MicroGuide) were valued across settings (Chapters 5 and 6), certain strategies such as delayed prescribing, commonly used in IH services, are often perceived impractical in urgent OOH scenarios (Chapter 6), where patients seek immediate care because they cannot wait for routine appointments. Similarly, although incentive schemes and prescribing targets were seen to encourage appropriate prescribing (Chapter 5), applying standard indicators (e.g., NPIs) without adapting them to the OOH context seems unreasonable, as this overlooks service constraints and the patient population served (Chapter 6). Careful planning is therefore needed when designing OOH-specific targets, taking into account indicator type, availability of pre-existing data, data collection costs, and monitoring frequency (Arur et al. 2011).

National initiatives, including the NPIs, improvement goals, and the UK NAP, guide efforts to combat AMR. However, focusing narrowly on reducing prescription volumes does not align with the purpose of OOH care, which prioritises timely management of acute cases, many involving infections requiring antibacterial drugs (Chapters 5 and 6). In this context, key performance indicators may be more appropriate targets, as OOH services are evaluated on delivering timely, safe, and effective care rather than prescribing patterns (NHS England 2025b). Adapting AMS interventions therefore requires balancing immediate clinical needs with the longer-term goal of mitigating AMR, recognising that compromises may sometimes be necessary between optimal AMS and urgent care provision.

A more context-relevant approach to AMS in OOH services may focus on evaluating the quality of (non)-prescribing decisions, including the appropriateness of the clinical approach on a case-by-case basis (Chapter 6). This involves assessing whether the choice of drug, dose, frequency, and duration is clinically justified based on the resources and information available at the time. It also acknowledges the limitations of working in these settings, particularly remotely, by evaluating HCPs' ability to provide patient-centred care, clear safety-netting advice, and appropriate referrals, which may sometimes be used to avoid unnecessary prescribing (Chapter 6).

While such detailed evaluation is not routinely performed across all OOH services, elements of it are sometimes incorporated into performance and peer reviews in NHS 111 CSHs. The renewed UK NAP aligns with this approach, emphasising that prescribing quality, not just volume, should be a central focus (UK Government 2024). This strategy offers a supportive framework for enhancing prescribing and patient care, enabling more nuanced clinical decisions and improves understanding of who is prescribing, how, and in what context (UK Government 2024). This is particularly important in evolving healthcare systems with diverse prescriber groups and increasing remote consultations. However, its implementation in OOH settings may be challenging due to the time required, particularly with high workloads and reliance on frequently changing locum staff.

Adapting AMS interventions to the specific context and determinants of prescribing has been discussed in the literature. Colliers et al. (2023), using a mixed-methods approach, showed that co-designing interventions with stakeholders and tailoring them to OOH services, alongside active GP engagement, notably improved prescribing practices, reducing

inappropriate prescribing and increasing guideline adherence. While these findings highlight the value of locally developed, context-specific, and collaborative strategies to AMS, their success could also depend on other factors, such as local culture, leadership, and resources, which may limit generalisability across OOH services.

7.4.1.1 Diagnostics and Uncertainty in OOH Services

Diagnostics are a fundamental component for effective AMS, guiding appropriate prescribing (Bach 2025; Pennisi et al. 2025) and supporting the WHO GAP on AMR (WHO 2015). By enabling more informed and tailored clinical decisions, diagnostic tools can help reduce unnecessary prescribing and slow the spread of AMR (O'Neill 2016). International interest in integrating diagnostics and POCT into prescribing pathways has grown lately. The WHO has launched the AMR Diagnostic Initiative, positioning diagnostics as a core strategy for tackling AMR, supporting patient care, stewardship, infection control, and surveillance. It also highlights the significance of accessing high-quality diagnostics at all healthcare levels (WHO 2023b).

In the UK, the 20-year vision for addressing AMR prioritises safe and effective patient care, ensuring antibacterial prescribing is guided by diagnostic tests, decision support tools, or relevant clinical data (DHSC 2019a). This commitment was reinforced in the UK NAP (DHSC 2019b) and the 2020 Wellcome Trust AMR report (Wellcome Trust 2020), which promote the development and uptake of rapid and reliable diagnostic technologies. The 2019–24 UK NAP included a target to report the percentage of antibacterial prescriptions supported by a diagnostic or decision support tool by 2024 (DHSC 2019b). However, this target was not met due to limitations in reliable measurement, including diagnostic results not being digitally captured and the lack of a centralised diagnostics database (Glover 2024; National Audit Office 2025b). The current 2024–29 NAP does not set a measurable diagnostics target but emphasises strengthening decision-making through adequate test availability, decision support tools, and risk-stratifications in community and hospital settings to reduce unnecessary antibacterial use (UK Government 2024).

Diagnostic access is particularly constrained in OOH services, where laboratory support, POCTs, and other diagnostic resources are limited or entirely absent (Chapters 5 and 6). HCPs working remotely during these periods frequently face clinical uncertainty, combined with a complex patient mix. Stakeholders perceived that the lack of diagnostic support in

OOH services may drive defensive prescribing, resulting in higher antibacterials issued without confirmatory testing (Chapter 5). Such uncertainty is not unique to OOH services in Wales but reflects a broader issue across other healthcare systems. International studies have identified similar challenges, noting that diagnostic uncertainty in OOH care often leads to higher antibacterial prescribing (de Bont et al. 2015b; Colliers et al. 2018).

Interestingly, HCPs in NHS 111 CSHs reported maintaining a consistent approach despite these limitations, issuing empirical treatment only when clinically warranted (Chapter 6). According to them, the consequences of these decisions are more likely to affect longer-term patient care and subsequent HCPs rather than the immediate prescribing decision.

Addressing diagnostic uncertainty is critical for AMS. Richards (2020) highlights the lack of timely access to diagnostic services across the NHS in different clinical areas, a limitation directly relevant to OOH and NHS 111 HCPs. The report advocates for community-based diagnostic centres to improve care delivery. Decentralisation of POCTs may also extend beyond these centres, as home-based diagnostics are increasingly feasible (Richards et al. 2022). Although dedicated diagnostic centres are not currently established in Wales, initiatives such as the STTT service in community pharmacies have introduced POCT and shown reductions in antibacterial prescribing (Mantzourani et al. 2020). However, this service may not be consistently available during OOH periods, leaving HCPs at a disadvantage compared with those in IH care. Given its success in these settings, extending POCT to OOH care warrants consideration to provide timely, equitable access to diagnostics, which may reduce unnecessary prescribing and align OOH care with national goals.

7.4.2 Data Improvement, Monitoring, and Evaluation

Oral antibacterial prescribing in Wales OOH services had not been researched before this PhD, apart from one HB where an interviewee verbally described some unpublished work, though the extent of that examination is unknown (Chapter 5). As Chapter 5 highlighted, awareness of OOH prescribing practices was limited, with difficulties accessing and evaluating available data. This reveals a clear gap in understanding and emphasises the need for improved data access, reporting, and routine monitoring. A major barrier lies in the limitations of current data systems. Adastra, now Clinical Patient Management (OneAdvanced 2025), the primary system for recording consultations and prescriptions in GP OOH and NHS 111 CSHs, relies heavily on free-text entries that vary in quality and

completeness. Similar issues were encountered when analysing PIPS data from Choose Pharmacy (Chapter 4), which lacks standardisation in reporting free-text fields and often omits clinical details, limiting accurate analysis. Moreover, CASPA does not capture contextual information (e.g., demographics, indications, or whether prescriptions were delayed, repeated, or immediate), hindering robust evaluation and understanding of prescribing patterns in OOH settings. However, the absence of such data reflects the intended purpose of CASPA, i.e., recording prescriptions dispensed in community pharmacies submitted to NHS Wales for pricing and reimbursement, rather than a fault in the system.

In addition to systemic issues, inconsistencies in recording and dispensing OOH prescriptions across HBs, especially the use of pre-packed items, hinder reliable data collection. As Chapter 5 revealed, CASPA data (analysed in Chapter 4) did not capture pre-packed items, as they are supplied directly by GP OOH services rather than dispensed through community pharmacies. Accessing such data proved difficult due to non-standardised record-keeping and variation in systems and procedures across HBs. This lack of uniformity was repeatedly raised when findings were presented to stakeholders and during attempts to obtain the data. In ABUHB, for example, pre-packed items issued during OOH visits are recorded in the Adastra system and dispensed via automated drug robots (Omniceil), which track supplies without printed prescriptions (Vaughan 2024). This means the quantity supplied as pre-packed items can be obtained. However, this system may not be utilised in other HBs, where automation is limited and recording systems differ, making such data less feasible to obtain (Phillips 2024; Vaughan 2024). Creavin and Creavin (2025) reported similar challenges in a commentary, attributing gaps in NHS OOH data within the UK and its representation in research to the service fragmentation and data unavailability. They also highlighted poor integration, disconnected systems, and weak handover processes between IH and OOH services, which complicate data collection and evidence-based improvements. Structural and organisational factors also complicated data analysis and interpretation. These included differences in HB OOH arrangements, such as the use of external providers (e.g., Shropdoc) (Shropdoc 2025; NHS Wales n.d.-a) or cross-coverage by other HBs, as with SBUHB providing services for another HB (Audit Wales Office 2017). The 2019 realignment of SBUHB and CTMUHB borders further reduced the comparability of data over the study

period. As a result, it is unclear how changes in the population covered by those HBs may have influenced prescribing patterns and analysis of data, complicating longitudinal comparisons. Another key gap was the lack of denominators in OOH services, unlike GP surgeries, where registered patient lists provide a clear basis for analysis and comparability (Chapter 5). Without this context, and the lack of reporting on pre-packed items, auditing and interpreting prescribing volumes becomes complex, and comparisons across HBs and settings (e.g., IH vs OOH) less robust. These data and auditing challenges align with Borek et al. (2019), who noted that auditing OOH services is difficult or impossible due to differing systems and the absence of a defined population or area.

Collectively, these limitations point to the urgent need for more robust data documentation and auditing in OOH services. Borek et al. (2019) highlighted the value of developing tools or systems that support automated antibacterial prescribing audits, benchmarking, and personalised feedback in OOH services, yet such infrastructure is absent, leaving prescribing practices unclear. HCPs in NHS 111 CSHs receive little or no feedback on their prescribing, with audits and evaluations frequently lacking, limiting their ability to identify areas for improvement, or benchmark against peers (Chapter 6). A reliable, integrated data system would facilitate meaningful evaluation and allow for regular audits and actionable feedback (Chapter 5). Such mechanisms seem to be more established in IH services, which benefit from continuous auditing and feedback, and interventions available to them, likely due to their substantially higher prescribing proportions (analysed in Chapter 4). The lack of comparable structures and support in OOH services creates a clear disparity, potentially limiting effective oversight. This imbalanced support may bias evaluations of OOH performance and compromise care in already challenging resource-limited conditions. Providing HCPs with clear, accessible, and actionable data and feedback could enhance understanding of prescribing patterns, support sustained improvement, and form the basis for targeted, data-driven AMS interventions, as discussed in Chapter 5.

The Wales Audit Office (2018) similarly identified problems in collecting performance and quality data on OOH services, leading to management difficulties. Variability in reporting across HBs created comparability issues, and some HBs lacked sufficient clinical audit of care quality provided by HCPs. Some interviewees in the Audit Office report also suggested that OOH services often received attention only when operational problems arose. Comparable

issues seem to exist in OOH antibacterial prescribing, where stakeholder interviews found limited awareness, oversight, and auditing, reinforcing the need for systemic reform.

An international interdisciplinary consensus work has identified key priorities for optimising AMS, including the use of technology to support prescribing. Charani et al. (2021) highlighted that infrastructure and system limitations, such as limited expertise and fragmented or disconnected data systems, can hinder the adoption of innovations. They also noted that sustainable progress in AMS requires economically and contextually appropriate interventions, improved data use and prescribing systems across healthcare settings, and scalable technological solutions. These considerations are relevant to OOH services, where the present study identified substantial limitations. Addressing these gaps is therefore critical for OOH prescribing and stewardship.

7.4.3 Education, Training, and Raising Awareness

Education is a key pillar in the global response to AMR, supporting stewardship efforts. The WHO's GAP on AMR highlights raising awareness and promoting behavioural change through effective communication, education, and training as a core objective (WHO 2015). This includes embedding AMR content into professional education, training, and CPD, as well as integrating it into school curricula, including primary and secondary schools (WHO 2023e) to build understanding and awareness from a young age (WHO 2015).

Aligned with these efforts, the UK NAP 2024–29 sets national targets to increase AMR-related knowledge by 10% among the public and HCPs by 2029, using 2018 and 2019 levels as baselines, respectively (UK Government 2024). Improvement will be measured using international surveys tailored to the public and HCPs, with the most recent UK data showing that 29% of public respondents and 59% of HCP respondents answered all questions correctly (UK Government 2024). To achieve this, the UK Government is implementing campaigns informed by public attitudes to promote sustained behavioural change. It is also committed to working with schools and educators to use guidance on AMR and infection prevention, and to releasing an engagement guide to enhance understanding of AMR risks and individual actions to reduce infection (UK Government 2024).

Ongoing professional AMS education and training, including peer-review discussions and shared learning, especially those led by subject-matter experts, were considered important

(Chapters 5 and 6). However, access to these opportunities may vary across settings. As noted in Chapter 5, potential differences may exist in the provision and uptake of education and training between IH and OOH. The Royal College of General Practitioners recommends sufficient training hours in urgent primary care or OOH to ensure competence and confidence (Royal College of General Practitioners 2019). It also emphasises the need for defined OOH competencies that reflect the service reality, including skills in using technology and leading MDTs, alongside consistent supervision to reinforce safe prescribing. In NHS 111 CSHs, as Chapter 6 highlighted, HCPs receive an induction programme, complete an e-learning transition portfolio (RPS 2021), and undertake periodic training sessions. Comparable opportunities, however, may be less available in GP OOH settings, warranting further exploration. Such differences highlight a gap that could influence HCPs' prescribing and AMS efforts.

To address this, all HCPs, whether in IH services, GP OOH, or NHS 111 CSHs, should have equal access to high-quality CPD that supports safer and more consistent prescribing. This includes refresher courses, regular feedback, and training tailored to the specific challenges of each service model, with OOH-focused programmes preparing HCPs to manage the demands and complexities of the services. Monitoring uptake and collecting feedback can ensure content and delivery remain engaging, effective, and relevant.

A perceived gap in healthcare education was highlighted, particularly around clinical readiness and AMS understanding, with some interviewees viewing the teaching undertaken as not always reflecting practice (Chapter 5). In pharmacy education, however, UK programmes, including those in Wales, meet GPhC accreditation standards (General Pharmaceutical Council n.d.-b). This contrast may suggest a misalignment between academic education and workplace expectations, where theory is emphasised but opportunities for experiential learning, application, and reflection may be limited. Current CSPPS placements do not require AMS to be covered, though students may be exposed to this area through ad hoc activities, patient case reviews or interactions with antimicrobial pharmacists (James 2025).

Embedding structured placements in AMS, OOH, and remote settings, where AMS decision-making is critical, could expose students to real challenges, reinforce theoretical learning, and foster critical reflection. Incorporating feedback from these experiences into

undergraduate training would strengthen preparedness and better align education with service needs. This is particularly relevant given the NHS workforce trends, as OOH services face shortages of experienced HCPs to provide mentorship and model safe prescribing, promoting recent recommendations for dedicated OOH modules for trainee GPs (Creavin and Creavin 2025). Similar modules could also be implemented for trainee and newly qualified pharmacists, ensuring they gain comparable experience in OOH settings and receive stronger, ongoing post-qualification support.

Much of the commentary on educational gaps, although not specific to pharmacists, relates to professionals trained under earlier educational standards. Pharmacy education is now undergoing major transformation, driven by revised GPhC standards in 2021, which place greater emphasis on clinical practice and independent prescribing. Implementation began in the 2021–22 academic year, with all UK pharmacy graduates from 2026 onward qualifying as independent prescribers (NHS England 2024a; UK Clinical Pharmacy Association 2024).

To align teaching with these standards, a national AMS competency framework has been established to ensure students acquire the necessary knowledge and skills and apply them effectively. The framework was developed by a working group across the four UK nations and coordinated by NHS England, mapping competencies to the 2021 GPhC standards and the RPS prescribing competencies that linked to AMR, covering six domains (Table 7.5). Practice-based activities have been suggested to support learning on placements (NHS England 2024c; Fleming et al. 2025). NHS England and the Pharmacy School Council have also introduced indicative curricula embedding the AMR and AMS domain alongside other priority areas (Table 7.5) (NHS England 2024a).

It remains to be seen whether newly registered pharmacists educated under the updated standards demonstrate stronger service delivery skills and AMS knowledge (Fawkes et al. 2025). Evaluation is needed to assess the impact of these reforms and whether differences exist between graduates from different schools.

Table 7.5: Indicative Curricula for the MPharm and Foundation Training Year (NHS England 2024a)

Priority Area	Brief Description
Prescribing	Covers person-centred care and collaboration, professional practice, leadership and management, education and research.
Public health and health inequalities	Covers health promotion, prescribing in relation to public health, health behaviours, health inequalities, social diversity, health protection and public health themes.
Genomics	Covers an overview of genomic medicine, the applications of genomic medicine and drug safety.
Antimicrobial resistance and antimicrobial stewardship	Covers infection prevention and control, antimicrobial and antimicrobial resistance, antimicrobial stewardship, vaccine uptake, person-centred care and interprofessional collaborative practice.
Clinical reasoning	Covers an overview of clinical reasoning, the use and interpretation of diagnostic tests, understanding of cognitive biases and human factors, critical thinking and evidence-based practice.

7.4.4 Driving AMS Through Leadership and Quality Communication

Effective communication is essential for safe, evidence-based practices across all healthcare levels, including between IH and OOH services. Leadership, whether from governance leads, supervisory roles, or senior clinicians, is central to enabling this. Leaders help inform service direction by setting goals and expectations, offering guidance and reassurance, and fostering high-quality dialogue within teams, creating an environment where staff feel supported (Chapter 5). Approachable leaders who provide constructive feedback foster open communication, encouraging HCPs to raise concerns, question practices, and reflect on their work. They also have an influential role in promoting AMS activities (e.g., training, interventions, and regular updates). By endorsing these activities, leaders reinforce their importance and increase HCP engagement (Chapter 5). Conversely, where leadership is weak or absent, communication likely becomes limited, leaving staff unsupported and limiting the uptake of stewardship activities. A stakeholder consultation study in England identified appointing AMS leadership as one of the most feasible and high-priority interventions to improve prescribing and implement interventions in GP surgeries and OOH services (Borek et al. 2019). The absence of designated leaders, however, was seen as a barrier, stressing the importance of visible, committed leadership in driving AMS forward. In Wales, AMS leadership has been demonstrated by appointing antimicrobial pharmacists in senior positions (Liaskou et al. 2018), providing clear oversight across primary and

secondary care, with some HBs extending roles to cover both sectors. However, OOH services remain under-prioritised, with limited clarity around leadership responsibilities perceived from antimicrobial pharmacists in Chapter 5. Although not in relation to AMS, the Wales Audit Office (2018) also called for reviewing national OOH leadership arrangements and assessing whether they are adequately aligned with other NHS groups. Without designated AMS leaders for OOH services, or a clear remit for existing leaders, these services risk being excluded from stewardship priorities. Strengthening AMS leadership to explicitly include OOH services could help address the gaps discussed in Chapter 5, including limited integration, data sharing, communication between IH and OOH services, while also facilitating cross-sector collaboration necessary for coordinated AMS efforts. These leaders should develop a deeper understanding of OOH practices, workflows, and challenges to effectively influence AMS across settings.

While IH and OOH teams operate under different constraints, joint leadership and collaboration may help reduce division between the two, align their values, and close communication and practice gaps. They could also help develop shared solutions through feedback loops, updates on changing guidelines or practices, and by highlighting successes and improvement areas. Such collaboration promotes collective responsibility and wider engagement, reinforcing consistent AMS messaging and creating a more integrated system that enhances user experience. Although some collaboration already occurs through regular AWAPG meetings, these efforts appear to mainly focus on IH services. Therefore, ensuring greater inclusion of OOH services may require adjustments or negotiated leadership arrangements that allow overlapping working hours.

Interprofessional communication is also key to optimising prescribing. Whether formal (e.g., meetings, educational sessions) or informal (e.g., brief discussions between colleagues), these interactions provide support, build confidence in decision-making, and facilitate the sharing of perspectives and expertise (Chapter 6). In OOH services, however, opportunities for such interactions may be limited. Staff are not always co-located (e.g., in GP OOH) and teams consist of a rotating workforce who may not have previously worked together. These workforce challenges, identified by Williams et al. (2018) and many stakeholders in Chapter 5, were seen as barriers to AMS and effective communication. By contrast, HCPs in NHS 111 CSHs described a more positive experience (Chapter 6). The service structure supported

efficient communication and collaboration, particularly during patient calls, and enabled staff to seek immediate advice, which was viewed as a strength. In these settings, GPs could draw on pharmacists' expertise in antibacterial drugs to optimise prescribing choices, while pharmacists could benefit from GPs' diagnostic expertise, creating an environment that supported decision-making despite the challenges of remote work. Such exchanges, though not consistently available across all OOH settings, promote shared learning, reflection, and the best possible care. These contrasting views show how well-designed service structures can foster communication, even in contexts frequently perceived as isolated.

Communicating with patients is critical for optimal prescribing, especially in OOH and remote services. Patient-centred communication requires understanding concerns and clarifying expectations (King and Hoppe 2013), which are sometimes assumed or misunderstood, especially in relation to antibacterial prescribing (Colliers et al. 2021a). Evidence suggests that active listening and addressing patients' ICEs improves satisfaction and reduces follow-up appointments (King and Hoppe 2013; Silverman et al. 2016). By exploring patients' perspectives and gathering relevant clinical details, HCPs can make informed decisions and justify management choices, particularly when opting not to prescribe. This also prevents assumptions that patients expect antibacterial drugs, as many consult OOH services for reassurance, information, or symptom relief rather than antibacterial prescriptions (Chapter 6) (O'Connor et al. 2019; Lecky et al. 2020).

Although some stakeholders perceive higher demand for antibacterial drugs in OOH services, with patients sometimes expecting easier access to prescriptions (Chapter 5), communication strategies should prioritise patient-centred approaches. Even with OOH barriers, patients should be actively involved in their own care. Open dialogue and shared decision-making empower patients and enhance the overall experience for both HCPs and patients. It helps reduce unnecessary prescribing without compromising satisfaction or increasing follow-up visits for the same issue (Coxeter et al. 2015; Tonkin-Crine et al. 2017). Failing to implement these strategies risks reinforcing the perception of OOH as a setting for easy prescriptions, potentially driving inappropriate antibacterial use.

A key aspect of patient communication, especially in OOH care, is providing well-structured safety-netting advice at the end of consultations (Royal College of General Practitioners 2011; Williams et al. 2018). Safety netting serves as a safeguard and a communication

strategy. It reassures patients, helps them manage symptoms confidently, clarifies what to expect and which warning signs to watch for, and advises when and how to seek further care, potentially reducing unnecessary prescribing and follow-up appointments (Burvenich et al. 2025). Professionals in Chapter 6 emphasised giving detailed advice; however, as this was outside the study's scope with limited interview data on this aspect, it could not be further evaluated.

Broader evidence highlights the need to refine safety-netting advice to ensure it is clear, patient-specific, and easy to follow. While more commonly documented in OOH than IH services in the UK, research has identified areas for improvement (Edwards et al. 2025). Advice frequently lacked timeframes for follow-up when symptoms persisted, leaving patients uncertain when to seek further care, and over half of recorded advice was generic, limiting its effectiveness (Edwards et al. 2025). Safety netting was also more common in consultations for suspected infections and in-person visits than telephone consultations (Edwards et al. 2025). Similar practices have been observed in Belgium OOH services, where advice was often vague or absent, fragmented across the consultation's end, rarely documented, and more likely offered when antibacterials were prescribed (Colliers et al. 2022). These findings suggest that, despite widespread recognition of its importance, safety netting is inconsistently applied and rarely documented, with implications for patient safety and AMS efforts.

HCPs should therefore focus on delivering clear, high-quality safety-netting advice tailored to the patient's condition and level of understanding. It is equally important to verify that patients have understood the advice, for example through teach-back methods (Wannheden et al. 2024), and to consider how the advice is communicated and documented, not just delivered. Written materials, such as information leaflets, can reinforce verbal advice and support patients after the consultation. A systematic review suggests that leaflets in GP consultations can reduce antibacterial prescribing, patients' use of antibacterial drugs, and the likelihood of future consultations for similar illnesses (de Bont et al. 2015a). Similarly, an interactive booklet supporting discussions with parents of febrile children and delivering tailored advice in primary care and OOH services has been shown to reduce antibacterial prescriptions and parents' intentions to reconsult for similar conditions (Francis et al. 2009; De Bont et al. 2018). To promote consistent, evidence-based advice,

reliable resources, such as NHS-endorsed Healthier Together (Royal College of General Practitioners 2021a) and the TARGET toolkit leaflets (Royal College of General Practitioners 2021b), are recommended and were frequently cited by stakeholders (Chapter 5). These tools help ensure advice is clinically appropriate and easy to understand and follow.

Training in effective communication is important for all HCPs, particularly those in OOH services and remote care. Targeted training may enhance HCPs' ability to elicit information, explain complex issues clearly, assess patient understanding, and provide effective safety-netting advice, resulting in better outcomes, especially when face-to-face interaction is limited. Research supports that communication skills training helps GPs reduce unnecessary antibacterial prescriptions in primary care (Cals et al. 2009; van der Velden et al. 2012; Strumann et al. 2020), suggesting its potential value in OOH and remote settings.

Strengthening communication training in healthcare education at the undergraduate level is also crucial. While effective communication with patients and colleagues is embedded in the UK AMS competencies for healthcare undergraduates (Courtenay et al. 2018), further enhancement may be needed. Learner-centred methods, such as peer role-play and simulated patient encounters, offer opportunities for practice, feedback, reflection, and repetition, enhancing understanding and application of these skills, especially when facilitated by trained educators (Bachmann et al. 2022). Practical training should emphasise active listening, clear and empathetic language, and, where possible, visual aids or written materials to ensure patients understand information and feel supported. As healthcare increasingly shifts to remote and digital delivery, traditional training models should be adapted to reflect current practice. In UK pharmacy education, the new General Pharmaceutical Council (2021) standards emphasise the provision of patient-centred care in person and via remote consultations, with specific outcomes on remote consultations and digital use included.

7.4.5 Expanding the Role of PIPs

The thesis highlights the progressive and increasingly embedded role of PIPs across IH and OOH healthcare services in Wales. Although the CASPA dataset did not differentiate between pharmacist and nurse independent prescribers, a notable rise in NMIP prescribing activity in IH services was observed (Chapter 4). This trend reflects greater use of their prescribing rights and clinical expertise in response to growing demand and workforce

optimisation, in line with the WG plans (Welsh Pharmaceutical Committee 2019). The growth is also reflected in GP practices, where overall pharmacist prescriptions rose from 857,222 in 2019–20 to 1,198,384 in 2023–24 (Welsh Government 2024c). These trends also suggest an ongoing redistribution of clinical responsibilities.

Prescribing activity has also grown noticeably in community pharmacies, with prescriptions increasing from 7,471 in 2020–21 to 80,383 in 2023–24 (Welsh Government 2024c). This upward trend was also evident in Chapter 4, which reported rising consultations and prescriptions through the PIPS during standard and OOH periods since its introduction. This growth reflects the increasing number of CPIPs and pharmacy sites providing the service, expanding access to care beyond GP practices and other settings. Patient reports in Chapter 4 indicated that without the PIPS, most would have otherwise sought GP care, highlighting the role of CPIP and PIPS in improving accessibility and relieving some pressure on other parts of the healthcare system. As of January 2025, about one-third of community pharmacies in Wales (around 220) offer the PIPS (Welsh Government 2025a). However, the number operating during OOH periods is unclear, limiting understanding of its full contribution to OOH care.

While CPIPs' prescribing rights are currently defined by their scope of practice and the PIPS specification, Chapter 4 data suggest that many are gaining confidence in managing conditions beyond their formal remit. This may reflect a growing ambition to advance their clinical role and contribution to patient care. Another pharmacy scheme, the CAS is available in 99% of pharmacies in Wales and has seen increasing public uptake, with over 420,000 visits in the past year alone (Welsh Government 2025a). The scheme has expanded beyond its 28 conditions, with the STTT and UTI services made mandatory in June and October 2025, respectively (Community Pharmacy Wales 2025b). Further PIPS expansions are also being considered to extend access to a broader range of conditions ahead of winter 2025–26 (Community Pharmacy Wales 2025b). Based on Chapter 4 analysis, incorporating additional conditions into the PIPS would be a logical next step.

The ambition for service expansion, however, contrasts with persistent barriers that may constrain safe delivery, especially if a model similar to Scotland's Pharmacy First Plus is adopted (see Chapter 4). Complex cases likely require in-person assessment and diagnostic support, yet CPIPs, especially during OOH periods, lack access to diagnostics and POCTs,

including CRP testing or imaging (Section 7.4.1.1), unlike GP surgeries, though availability in surgeries may still be less than desired. This can increase the risk of misdiagnosis or inappropriate prescribing. Another challenge is the absence of structured protocols and referral pathways in community pharmacies, limiting CPIPs' ability to escalate complex cases and potentially compromising patient safety (Mantzourani 2025). Addressing these gaps would require investment in POCTs, development of pharmacy referral pathways, and closer integration between CPIPs and MDTs. Plans to expand access to CRP testing across pharmacies have been delayed (Hodson 2025), with testing currently available in only a few sites and constrained by funding (Mackridge 2025).

Workforce pressures further add to these challenges, making adequate and sustained support for CPIPs crucial. As Chapter 5 and Section 7.4.3 highlighted, continuous training and education are essential for HCPs, and in this context, for CPIPs to build the confidence and clinical skills required to manage a wider range of conditions. However, such training and education opportunities can become limited or inconsistent when protected time and resources are not allocated (Davies et al. 2024), particularly in busy community pharmacies. Without this time and sufficient staffing, CPIPs must manage expanded PIPS responsibilities alongside traditional dispensing and other duties, placing considerable burden on their capacity and potentially affecting decision-making, proper documentation, and overall wellbeing.

A recent Royal Pharmaceutical Society (2025) analysis highlighted the scale of this issue, with 87% of pharmacy professionals in the UK at high burnout risk. This figure was highest in community pharmacy (91%, compared with 86% in non-community pharmacy) and was consistent with previous years (93% in 2023 and 96% in 2022). Of concern, 61% had considered leaving their current positions or the pharmacy profession, with proportions lower in GP practice (69%) and hospital pharmacy (72%) than in community pharmacy (79%) (RPS 2025). Reported contributing factors included inadequate staffing (70%), work-life imbalance (49%), lack of protected learning time (47%), lack of support from colleagues or senior staff (47%), increased financial burdens (47%), and long working hours (34%) (RPS 2025). Access to protected learning time was reported as insufficient by over half of respondents, with only 35% of community pharmacy staff receiving it, compared to 44% in hospital pharmacy and 68% in GP practice (RPS 2025). Regionally, 73% of respondents in

Wales reported insufficient protected time, higher than in England and Scotland (64%), and internationally (45%) (RPS 2025). Ensuring the long-term sustainability of the pharmacy services, including the PIPS, therefore requires investment in structural support, including adequate staffing and protected time. These are also essential for AMS, where up-to-date knowledge of guidelines, resistance patterns, and appropriate prescribing enables safe practices and alignment with national priorities.

PIPs also contribute to NHS 111 in Wales, providing remote consultations and clinical support during OOH periods (Chapter 6). The NHS 111 service was first piloted in Wales in 2016 and 2017, with pharmacists formally integrated through a dedicated transition programme in 2018 (Anon. 2018). Since then, pharmacists have become an essential part of NHS 111 CSHs, managing a wide range of queries, including medications and common ailments. These queries are directed to PIPs, allowing them to apply their clinical expertise to recommend appropriate treatment or advise on suitable actions (RPS n.d.-b). Their involvement has been successful, with 80% of calls closed without onward referral (Wickware 2019). While this figure is old and includes all query types, it highlights their contribution to remote OOH care. A focused evaluation of consultations for suspected infections would better clarify their impact on AMS in these settings.

Clinical experience and decision-making conducted by PIPs in NHS 111 CSHs may differ from that of those in GP OOH settings and community pharmacies. These differences may reflect variations in consultation mode, professional background and experience, scope of practice, and access to diagnostics, as noted earlier. Despite these differences, PIPs in the hubs were perceived to deliver high-quality care and make safe prescribing decisions within the service boundaries (Chapter 6), with limited data from Chapter 4 indicating that prescribing for 4Cs was, in most cases, guidance-based. While CPIPs sometimes extended prescribing beyond the PIPS remit, those in the hubs reported initiating consultations and managing cases within their competence, seeking advice from colleagues, and referring cases when uncertain or when they exceeded their expertise. However, the reasons for CPIPs exceeding the service remit remain unclear, as the focus of Chapter 4 did not allow them to justify their decisions, whereas those in the hubs were able to explain their thought processes. It would be interesting to conduct a similar study with CPIPs to understand their rationale for such practices.

7.5 Strengths and Limitations

The study addressed an identified gap on oral antibacterial prescribing in primary care OOH services in Wales. This gap was identified through a published comprehensive scoping review guided by a robust methodological framework (Chapter 2). To the researcher's knowledge, no previous studies have specifically explored this aspect in Wales. Early engagement with stakeholders reinforced the need to investigate oral antibacterial prescribing in these unexplored settings. The thesis offers a description of prescribing patterns and insights into the perspectives of key stakeholders involved in AMS oversight, as well as prescribers working within NHS 111 CSHs, which form an integral part of OOH services.

Using a mixed-methods approach facilitated a holistic exploration of the topic, offering greater depth than either quantitative or qualitative methods alone while mitigating individual limitations, as discussed in Chapter 3. Findings from one phase informed the development and refinement of the research objectives, methods, and tools, for the subsequent phase. This approach provided methodological flexibility, enabling the researcher to remain reflexive, respond to and build upon issues as they arose, thereby enhancing the overall depth and relevance of the research.

A key strength of this work was the involvement of diverse stakeholders throughout (Table 7.6). Their input and guidance helped shape the research direction, methodological choices, ethical approvals, and data access. Involving individuals with clinical, policy, AMS, and OOH experience provided the researcher with contextual insight early in and throughout the research, enhancing the study's relevance, methodological credibility, and findings.

Presenting the findings to these stakeholders opened valuable conversations with representatives from different HBs and PHW, during which some of the identified challenges were discussed and acknowledged. The project also coincided with one HB's early plans to evaluate its OOH antibacterial prescribing, with the researcher exchanging feedback from their PhD experience, suggesting the project's relevance to current priorities.

Table 7.6: Stakeholder Involvement

Stakeholder	Nature of Engagement
Pharmacist from WG	Supported and guided the project's conceptualisation.
Head of Patient Services & Chief Pharmacist in one HB	Assisted in refining the project's initial conceptualisation and its scope.
Assistant Director for Six Goals G2/3 who was the Professional Lead for NHS 111 Pharmacists at the time of the PhD	- Supported and guided the project's conceptualisation and its direction throughout. - Identified primary care out-of-hours location codes to obtain prescribing data and helped contextualise findings from Chapter 4. - Informed methodology, reviewed study documents, provided feedback and guidance on participant access, and shared study information as a primary gatekeeper in Chapter 6. - Were kept informed of findings from the studies.
ABUHB Divisional Director of Primary Care, Community Services, and Complex Care	- Supported and guided the project's conceptualisation and its direction throughout. - Helped contextualise findings from Chapter 4. - Informed methodology, reviewed study documents, provided feedback and guidance on participant access, and assisted with advertising the study as a gatekeeper in Chapter 6. - Were kept informed of findings from the studies.
A member from Digital Health and Care Wales	Facilitated study registration and access to Choose Pharmacy data, clarified concepts the system, and contributed to reviewing and co-authoring a study for publication from Chapter 4.
All-Wales Therapeutics and Toxicology Centre members	Facilitated access to Comparative Analysis system for Prescribing Audit (CASPA) data and clarified related queries in Chapter 4.
A member from Public Health Wales	Discussed complexities of out-of-hours prescription recording and challenges in obtaining pre-packed item volumes.
NHS Wales Shared Services Partnership – Procurement	Attempted to obtain oral antibacterial pre-packed items prescribed during out-of-hours services.
All-Wales Antimicrobial Pharmacist Group members	- Supported and engaged early in the project conceptualisation. - Helped contextualise findings from Chapter 4. - Offered to present findings and exchange feedback with a team from ABUHB planning a review of their out-of-hours antimicrobial prescribing, and with All-Wales Antimicrobial Pharmacist Group. - Supported the project for ethics needed in ABUHB for Chapter 6.
A faculty member from Cardiff School of Healthcare Sciences (Director of the JBI Wales Centre for Evidence-Based Care)	- Reviewed and provided feedback on the methodological approach and reporting of the scoping review in Chapter 2. - Co-authored the published scoping review.

ABUHB: Aneurin Bevan University Health Board; NHS: National Health Service; WG: Welsh Government.

Further analysis of routinely collected PIPS data (Chapter 4) could have provided additional insights into prescribing practices, including prescribing appropriateness. However, data limitations, such as inconsistent or insufficient documentation, posed significant challenges. Although assessing the appropriateness of all oral antibacterial prescriptions was not a primary objective, attempts were made to categorise patient diagnoses from available entries. Yet, the variability and free-text format made this process time-consuming and unsuitable for rigorous analysis to judge prescribing. This highlights the need for a standardised approach to documentation and is an area for future work.

Introducing a predefined list of conditions and drugs for prescribers to select from during consultations could support standardisation. While this may improve data capture, it could reduce the specificity of clinical entries. A combined approach, providing a coded list alongside the option for supplementary free text, could offer greater flexibility but would still carry risks of inconsistency. Using standardised clinical vocabulary, such as SNOMED CT, would allow CIPs to record consultation data accurately and consistently, supporting reliable assessment of prescribing practices and service improvement (SNOMED International 2025). Choose Pharmacy is currently being redesigned, and consideration is being given to incorporating such functionality to enhance standardisation and data quality.

Significant effort was dedicated to optimising recruitment for the qualitative phase to ensure sufficient participation (Chapter 6). Although the number of interviews was small, they produced rich perspectives and practical understanding of the topic. The study focused on the experiences and decision-making processes of prescribers in NHS 111 CSHs and did not include those in GP OOH locations. While interviewing this group would have enriched the findings, it was not feasible within the project's time constraints with unforeseen delays in obtaining ethical approvals (Chapter 6). Nonetheless, Chapter 6 opens avenues for research into prescribing practices and decision-making in GP OOH settings and community pharmacies, which could identify setting-specific challenges and support needs.

7.6 Implications

7.6.1 Policy

The CDC identifies leadership, accountability, tracking, and transparent reporting as core elements for effective AMS programmes (Chapter 1, Section 1.8.1). These elements may

need stronger emphasis within OOH services in Wales, where stewardship activities seem to be restricted, with minimal formal AMS oversight, feedback, and data reporting mechanisms. The lack of efficient and integrated data systems further constrains opportunities for monitoring and benchmarking prescribing practices. To enhance AMS in this context, investment in robust, interoperable data systems is essential. These should enable comprehensive and consistent prescribing data collection and evaluation across healthcare settings, including OOH services, to strengthen national surveillance and identify patterns of inappropriate practices. Developing an OOH prescribing platform is a key step forward. Achieving this will require collaboration between IH and OOH service leaders, stakeholders, and AMS surveillance teams in Wales to inform system design and establish an effective mechanism for auditing and evaluation.

The adoption of SNOMED CT as the standard clinical terminology across healthcare systems, including community pharmacy in Wales, should be prioritised. Although already in use in Wales primary care (Welsh Government 2015b), consistent application across community settings would improve data quality, monitoring of prescribing, interoperability, and integrated patient care. This would align Wales with England, where SNOMED CT is currently mandated as a national information standard across all NHS providers, including mental health, community systems, primary, and secondary care (NHS England 2025a).

This thesis also identifies that policymakers should consider expanding the clinical scope of CIPs to cover more conditions, enabling them to meet patient needs, improve access to care, and alleviate some pressure on other parts of the healthcare system. This expansion is already under consideration (Community Pharmacy Wales 2025b), aligning the PhD findings with current policy developments and ongoing transformations in pharmacy education. Addressing workforce capacity, including staffing and resources, is essential to support HCPs in making appropriate prescribing decisions and engaging with AMS activities.

7.6.2 Practice

Improving OOH prescribing practices requires investment in accessible diagnostics that support timely and accurate decision-making. Decentralised tools, such as POCTs, could help HCPs to quickly distinguish viral from bacterial infections, supporting their clinical decisions and reducing unnecessary antibacterial use, as demonstrated by the STTT service, where pharmacists use POCTs to guide sore throat management (Mantzourani et al. 2020).

AMS should be reinforced as a shared responsibility beyond clinical settings and individual HCPs. Engaging and collaborating with the public is essential to build a culture of responsible antibacterial use and promote collective stewardship, with communities actively involved in preserving the effectiveness of these drugs. Sustainable and measurable AMS efforts should include public-facing initiatives that educate and drive long-term behavioural change.

Awareness campaigns should deliver effective messaging and emphasise that AMR poses a risk to everyone, not just vulnerable populations or those who misuse antibacterial drugs.

Although evidence suggests some improvement in public awareness and antibacterial use in UK primary care (Pouwels et al. 2020), stakeholder perceptions from this project indicate that public understanding remains insufficient in practice.

Global and national public health campaigns, such as the annual World AMR Awareness Week (UKHSA 2024b; WHO 2024b; CDC 2025), have been designed to raise awareness among the public, HCPs, and policymakers, and encourage actions. However, concerns remain about the adequacy of these activities, with some misconceptions persisting (McNulty et al. 2022). Evidence suggests that campaigns are most impactful when they use mass media to communicate information, tailored messages targeting particular infections, and emphasise communication between HCPs and patients (Gilham et al. 2024). Traditional tools, such as posters and leaflets, retain value but their impact on attitudes and practices may be limited. AMS strategies should build on these insights, integrating creativity and accessibility to enhance public understanding and drive behaviour change.

The ongoing Antibiotic Guardian campaign, launched in 2014, illustrates this approach by encouraging HCPs and the public to pledge responsible use (Public Health England 2014). It promotes stewardship as personal responsibility, aiming to improve AMR knowledge and behaviours, with evaluation showing its effectiveness (Newitt et al. 2019). Campaigns could also adopt more engaging and emotionally resonant methods, such as personal storytelling from individuals affected by AMR (Elshenawy 2024), making the issue more impactful, relatable, and memorable than relying solely on figures and statistics. Innovative methods that promote active participation, including gamification, hold promise in raising awareness and understanding of complex concepts (WHO 2017; Ashiru-Oredope et al. 2022). In Wales, creative initiatives, such as campaigns featuring public figures (Public Health Wales 2024c), exhibitions and artwork competitions (Cardiff University 2022a), interactive immersive

events (Tyrrell et al. 2022), and the Superbugs educational website (Tyrrell et al. 2024), demonstrate the potential of such approaches. These should be expanded, delivered across more locations, and sustained to ensure lasting engagement.

Delivering consistent, evidence-based messaging on AMR through trusted and accessible platforms is crucial. As misinformation can spread rapidly, particularly via digital channels, proactive approaches are needed to counter incorrect and misleading content. Utilising widely used platforms, including social media, public health websites, and community networks, can help ensure accurate information reaches diverse audiences. International efforts have recognised the role of media in raising AMR awareness, and a toolkit has been developed to support effective media engagement in AMR communication at different levels and multiple audiences (WHO 2024a).

Additionally, AMS education should be strongly incorporated into school programmes for children and caregivers to foster positive health behaviours that persist into adulthood, with caregiver involvement reinforcing these messages. Educators and schools were encouraged to promote AMR awareness among children using accessible materials from the Junior and Family Antibiotic Guardian initiative (Ashiru-Oredope and Nicholson 2016). The UK-wide Antibiotic Guardian Schools Ambassadors initiative (piloted in 2019) further supports this by enabling HCPs and scientists to engage with schools and deliver AMR education using supporting resources (Miah et al. 2025). However, published data on the programme's reach are limited, and further exploration of engagement in Wales is needed.

7.6.3 Education

With the growing reliance on virtual consultations, particularly in remote OOH services and NHS 111 CSHs, clinical education must consider this shift. While programmes such as the Centre for Pharmacy Postgraduate Education e-learning and HEIW provide relevant education on remote consultations (Centre for Pharmacy Postgraduate Education 2020; Health Education and Improvement Wales n.d.-b), these could be strengthened by incorporating specific AMS content, including prescribing under uncertainty and strategies to reduce unnecessary prescriptions. Additionally, as pharmacy education is integrating digital and remote delivery (General Medical Council 2025), emphasis should be placed on AMS education in these contexts. Training may include placement of pharmacist trainees in these settings to prepare them for modern practice while maintaining patient safety and

care quality. Practical training should focus on eliciting key information, assessing symptoms without physical examination, delivering clear advice, and addressing patients concerns.

7.6.4 Research

This thesis has identified different directions for future research. Further investigation is needed into the views, experiences, and decision-making of HCPs, particularly those in GP OOH services and community pharmacists providing care during these times regarding oral antibacterial prescribing. A qualitative interview approach could be used, supported by strong leadership engagement to encourage participation (without coercion) through study promotion, recruitment facilitation, or incentives such as monetary rewards, prize draws, or CPD credits (Browne et al. 2022), as indirect incentives may be as important as financial ones (Johnston et al. 2010). Alternatively, self-administered surveys may be more practical for reaching a wider sample of OOH HCPs, allowing participation around their demanding schedules. To maximise response rates, the survey design should prioritise closed-ended questions, supplemented by open-ended questions only when necessary to capture insights that cannot be obtained otherwise. Targeted follow-up interviews could then explore key themes in depth based on survey responses.

It would also be valuable to explore patient motivations for accessing OOH services and their satisfaction with care, particularly regarding potential infection management. A mixed-methods approach, combining surveys to capture broader patterns with interviews to understand reasoning and experiences, would be an appropriate approach. While Courtenay et al. (2017b) has explored these aspects for NMIPs managing RTIs in primary care, further research is warranted to investigate possible variations across services, such as GP OOH, NHS 111 CSHs, and community pharmacies. Understanding these aspects in service-specific context could provide insights into patient behaviours, preferences, and experiences, informing interventions better aligned with service users' needs.

Future strategies to improve OOH prescribing quality should also consider developing, piloting, and evaluating interventions. These may include digital prompts or clinical decision support alerts, similar to those assessed by O'Connor et al. (2020) alongside an educational intervention, and tools used in the USA for various infections in hospital settings (Gohil et al. 2024a,b; Gohil et al. 2025b,a). These have shown promise in promoting appropriate prescribing and supporting compliance with AMS. Another important area is examining both

the quantity and quality of OOH antibacterial prescribing once data systems are improved, as enhanced data capture would enable detailed analysis of prescribing patterns, appropriateness, and adherence to guidelines.

7.7 Reflections on the Overall PhD Experience

Through this PhD, the researcher has contributed to the body of knowledge on oral antibacterial prescribing in Wales primary care OOH services, a setting often overlooked. While the findings addressed some key gaps, they also raised new questions regarding the optimisation of practices and stewardship in OOH services, suggesting directions for future research and recommendations for improvement. The work also highlighted the complexity of the service structure and the challenges faced by HCPs during OOH periods.

Over the course of the programme, the researcher deepened their understanding of different research methodologies and developed a range of skills they will carry forward into their academic/researcher career. They gained new experience conducting a comprehensive scoping review (Chapter 2), managing the complexities of using administrative data from different sources, including data preparation and analysis (Chapter 4). The researcher also undertook qualitative research for the first time, developing new skills in conducting, transcribing, and analysing interviews, using NVivo to facilitate the process (Chapters 5 and 6). These experiences have been invaluable in building capability as a mixed-methods researcher and have laid a strong foundation for ongoing learning and contribution.

Beyond these skills, the programme has also contributed to personal and professional growth. The researcher has become more reflective, resilient, and confident in managing the challenges of independent research. They have grown more assured in sharing their work at conferences, participating in school-led activities, and hosting workshops, enhancing their communication skills and expanding their academic network. Engaging in critical thinking, collaboration, and interdisciplinary work has fostered growth as a researcher and team member. Co-supervising MPharm student projects have further prepared them for their academic career. Overall, the PhD has shaped their research identity and strengthened their commitment to contribute to clinical practice.

7.8 Conclusion

Oral antibacterial prescribing in primary care IH and OOH services in Wales has declined over the study period, contributing to the UK NAP's goals to combat AMR. However, variations persist across HBs, likely influenced by the population demographics, local needs, and available resources in each area. Community pharmacies, particularly through the PIPS, have become an increasingly important part of care, including during OOH periods, and their contribution continues to grow.

Understanding prescribing in OOH services proved difficult due to limitations in current data and the varied landscape of service provision, which includes GP OOH, NHS 111, and community pharmacies, each with distinct challenges and operational complexities. Key stakeholders at the HB level also demonstrated limited awareness of prescribing practices in these services, with most effort and attention focused on IH services. Successful development, adaptation, and sustainability of interventions require several key factors: access to high-quality, informative data to understand the service context, strong leadership, effective communication, champions within the settings, clear goals, easy-to-use interventions, and stakeholder buy-in. These elements are crucial for facilitating continuous improvement and implementing best practices in OOH services.

OOH consultations, especially those delivered remotely, present significant challenges. HCPs must adapt to constraints such as limited diagnostic tools and the absence of face-to-face assessment, while managing acute and often complex cases based on patient-reported information. Despite these limitations, they are expected to make safe and appropriate prescribing decisions. Ensuring they are supported with necessary tools, training, and systems is essential to safeguard patient care and promote prudent use in OOH services.

7.9 Dissemination of Findings

Findings from this PhD have been and will be disseminated through a range of academic and professional channels, including peer-reviewed journals, national conferences, and direct engagement with NHS Wales stakeholders. A summary of dissemination activities, linked to relevant chapters, is presented in Table 7.7.

Table 7.7: Dissemination of Findings

Output	Details	Chapter
Publication (review article)	Al Hussain, S. K. et al. (2025). Oral Antibacterial Drug Prescribing in Primary Care Out-of-Hours Services: A Scoping Review. <i>Antibiotics (Basel)</i> ,14(1):100. https://doi.org/10.3390/antibiotics14010100	2
Conference abstract/poster	Al Hussain, S. K. et al. (2023). 448 Prescribing of oral antibacterial drugs in primary care out-of-hours services: a scoping review. <i>Pharmacy Education</i> , 23(5), p. 11–12. https://doi.org/10.46542/pe.2023.235.138 [International Pharmaceutical Federation (FIP) Pharmacy Practice Research summer meeting 2023]	2
Conference abstract/poster	Al Hussain, S. K. et al. (2023). 448 Prescribing of oral antibacterial drugs in primary care out-of-hours services: a scoping review. <i>International Journal of Pharmacy Practice</i> , 31(Suppl 1), i8. https://doi.org/10.1093/ijpp/riad021.009 [Health Services Research and Pharmacy Practice (HSRPP) 2023]	2
Conference abstract/poster	Al Hussain, S. K. et al. (2023). Evaluation of oral antibacterial drug prescribing by community pharmacist independent prescribers during out-of-hours in Wales: A secondary data analysis study. <i>Pharmacy Education</i> , 23(5), p. 27–28. https://doi.org/10.46542/pe.2023.235.138 [FIP Pharmacy Practice Research summer meeting 2023]	4
Conference abstracts/poster	Al Hussain, S. K. et al. (2024). Oral antibacterial drug prescribing in primary care out-of-hours services in Wales: a secondary analysis study. <i>International Journal of Pharmacy Practice</i> , 32(Suppl 1), i26. https://doi.org/10.1093/ijpp/riae013.032 [HSRPP 2024]	4
Conference abstract/poster	Al Hussain, S. K. et al. (2025). Out-of-hours oral antibiotic prescribing through the community pharmacy independent prescribing service in Wales: a secondary data analysis study. <i>The British Journal of General Practice</i> , 75 (suppl 1), bjgp25X742053. https://doi.org/10.3399/bjgp25X742053 [British Journal of General Practice BJGP conference 2025]	4
Conference abstract/poster	Al Hussain, S. K. et al. (2024). Oral antibacterial prescribing in primary care and out-of-hours services: Stakeholders' perceptions. <i>2024 Research & Development Conference. Cwm Taf Morgannwg University Health Board</i> . Available at: https://ctmuhb.nhs.wales/services/research-and-development/research-development-conference/2024-research-development-conference/poster-presentations1/ [Cwm Taf Morgannwg University Health Board R&D conference]	5
Others	Presenting findings to <i>Aneurin Bevan University Health Board</i> HCPs including antimicrobial pharmacists. July 2024.	4 & 5
Others	Presenting findings to <i>All-Wales Antimicrobial Pharmacist Group</i> . July 2024.	4 & 5
Conference abstract/poster	Al Hussain, S. K. et al. (2025). Eliciting Stakeholders' Perspectives on Oral Antibacterial Prescribing in Primary Care Out-of-Hours Services in Wales: A Qualitative Interview Study. Submitted to <i>HSRPP</i> 2026, September 2025. Awaiting acceptance.	5
Conference abstract/poster	Al Hussain, S. K. et al. (2025). Oral Antibacterial Prescribing in NHS 111 Clinical Support Hubs During Out-of-Hours Periods: Experiences and Decision-Making Investigation. Submitted to <i>HSRPP</i> 2026, September 2025. Awaiting acceptance.	6

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Appendices

Chapter 2 Appendices

Appendix 2.1. Search Strategy

Source: Ovid MEDLINE(R) ALL <1946 to May 09, 2022>

Date: May 09, 2022

#	Search terms	Results
1	Pre-hospital*.mp	5630
2	Prehospital*.mp	14944
3	Exp After-hours care/	2089
4	Out of hours.mp	2279
5	After hours.mp	3287
6	Outside of normal working hours.mp	116
7	1 or 2 or 3 or 4 or 5 or 6	24680
8	Prescrib*.mp	173493
9	Prescrip*.mp	139205
10	8 or 9	268279
11	Antimicrobial*.mp	207569
12	Antibiotic*.mp	428234
13	exp Anti-Bacterial Agents/	785111
14	11 or 12 or 13	1079160
15	7 and 10 and 14	120

Source: Embase Classic+Embase <1947 to 2022 Week 18>

Date: May 09, 2022

#	Search terms	Results
1	Pre-hospital*.mp	9976
2	Prehospital*.mp	20506
3	Exp After-hours care/	569
4	Out of hours.mp	4362
5	After hours.mp	2341
6	Outside of normal working hours.mp	214
7	1 or 2 or 3 or 4 or 5 or 6	35419
8	Prescrib*.mp	293787
9	Prescrip*.mp	317518
10	8 or 9	502722
11	Antimicrobial*.mp	295899
12	Antibiotic*.mp	918530
13	exp Anti-Bacterial Agents/	4257013
14	11 or 12 or 13	4448377
15	7 and 10 and 14	221

Source: Ovid Emcare <1995 to 2022 Week 18>

Date: May 09, 2022

#	Search terms	Results
1	Pre-hospital*.mp	3354
2	Prehospital*.mp	10423
3	Exp After-hours care/	213
4	Out of hours.mp	1474
5	After hours.mp	1015
6	Outside of normal working hours.mp	51
7	1 or 2 or 3 or 4 or 5 or 6	15564
8	Prescrib*.mp	77443
9	Prescrip*.mp	103546
10	8 or 9	147314
11	Antimicrobial*.mp	47985
12	Antibiotic*.mp	158799
13	exp Anti-Bacterial Agents/	618012
14	11 or 12 or 13	647691
15	7 and 10 and 14	91

Source: Cochrane library

Date: May 09, 2022

#	Search terms	Results
1	Pre-hospital*	819
2	Prehospital*	2197
3	After-hours care	112
4	"out of hours"	203
5	"after hours"	141
6	"outside of normal working hours"	2
7	MeSH descriptor: [After-Hours Care] explode all trees	34
8	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7	2531
9	Prescrib*	30283
10	Prescrip*	18371
11	#9 OR #10	42263
12	Antimicrobial*	12580
13	Antibiotic*	35664
14	MeSH descriptor: [Anti-Bacterial Agents] explode all trees	12944
15	#12 OR #13 OR #14	48525
16	#8 AND #11 AND #15	37
17	in Cochrane Reviews, Cochrane Protocols, Trials and Editorials	35

Source: WoS Core Collection

Date: May 09, 2022

#	Search terms	Results
1	((TS=(pre-hospital* OR prehospital* OR "after hours" OR "out of hours" OR "outside of normal working hours")) AND TS=(prescrib* OR prescrip*)) AND TS=(antimicrobial* OR antibiotic* OR "anti-bacterial agents")	104

Source: Scopus

Date: May 09, 2022

#	Search terms	Results
1	TITLE-ABS-KEY (<i>pre-hospital*</i> OR <i>prehospital*</i> OR <i>"after hours"</i> OR <i>"out of hours"</i> OR <i>"outside of normal working hours"</i>) AND TITLE-ABS-KEY (<i>prescrib*</i> OR <i>prescrip*</i>) AND TITLE-ABS-KEY (<i>antimicrobial*</i> OR <i>antibiotic*</i> OR <i>"anti-bacterial agents"</i>)	144

Source: CINAHL Plus with Full Text (EBSCOhost)

Date: May 09, 2022

#	Search terms	Results
1	"Pre-hospital*"	2942
2	(MH "Prehospital Care") OR "Prehospital*"	19415
3	"After-hours care"	88
4	""out of hours""	2585
5	""after hours""	28278
6	""outside of normal working hours""	44
7	S1 OR S2 OR S3 OR S4 OR S5 OR S6	51562
8	(MH "Prescribing Patterns") OR "Prescrib*"	73681
9	"Prescrip*"	83819
10	S8 OR S9	134070
11	"Antimicrobial*"	27383
12	"Antibiotic*" OR (MH "Antibiotics")	92323
13	"Anti-Bacterial Agents/" OR (MH "Antiinfective Agents")	37,786
14	S11 OR S12 OR S13	112403
15	S7 AND S10 AND S14	119

Appendix 2.2. Data Charting Form

Study ID	1	2	3	4	5	6	7	8	9	10
First Author										
Publication Year										
Title										
Study Aim / Objectives										
Country										
Methods / Design										
Study Duration / Year										
Settings										
Study Population										
Sample Size / Number of Encounters / Prescriptions										
Main Findings										
Limitations by Study Authors										
Limitations by the Researcher										

Chapter 4 Appendices

Appendix 4.1. Data Request Form



AWTTC

All Wales Therapeutics & Toxicology Centre
Canolfan Therapiwteg a Thocsicoleg Cymru Gyfan



WAPSU

Welsh Analytical Prescribing Support Unit
Uned Cymorth Presgripsiynu Dadansoddol Cymru

WAPSU PRESCRIBING DATA

REQUEST FORM

Name:	Sarah Al Hussain Karen Hodson Rhian Deslandes
Organisation:	School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Telephone:	
Email:	

For the attention of:	WAPSU
Request: CASPA Data	
<i>Please provide details of the nature and context of your request (e.g. AM question/patient enquiry/public enquiry) including any specific details that may help inform the response.</i>	
As part of an antimicrobial stewardship project, we are requesting all Wales antimicrobial prescribing data within primary care for the last five years to quantify the prescribing volume of all antibacterial drugs included within the British National Formulary (BNF subsection 5.1 – Infections, Antibacterial Drugs) with a special look at the volume of prescribing of the 4Cs (co-amoxiclav, cephalosporins, clindamycin, quinolones) as described in the national prescribing indicators 2022-2023, and to compare, when applicable, the quantity of prescribing within in-hours and out-of-hours services, between-profession (GPs vs non-medical independent prescribers), and different health boards.	
Time period (e.g. year to month 20XX, quarter to month 20XX, trend data from month 20XX)	
Trend data of antimicrobial prescribing for the financial years from the beginning of April 2017 until the end of March 2022	
Type of data (e.g. annually/quarterly/monthly data for total cost/items per denominator)	
- Number of items of antibacterial drugs per month per all prescribers (CASPA "National-GP" category) working during the standard working hours (in-hours) per health board. - Number of items of antibacterial drugs per month per non-medical independent prescribers (CASPA "Miscellaneous Prescribers – Independent Prescribers" category) working during the standard working hours (in-hours) per health board.	

- Number of items of **antibacterial drugs** per month per each W or V code/unique identifier for out-of-hours services per health board.*
- Number of items per month for **each antibacterial class** per health board in in-hour services per all prescribers (CASPA "National-GP" category) as noted in the BNF i.e., broad-spectrum penicillins, cephalosporins, macrolides.
- Number of items per month for **each antibacterial class** per health board in in-hour services per non-medical independent prescribers (CASPA "Miscellaneous Prescribers – Independent Prescribers" category) as noted in the BNF i.e., broad-spectrum penicillins, cephalosporins, macrolides.
- Number of items per month for **each antibacterial class** per health board per each W or V code/unique identifier for out-of-hours services as noted in the BNF i.e., broad-spectrum penicillins, cephalosporins, macrolides.*
- Number of items per month per **each individual** antibacterial drug **of the 4Cs** per health board in in-hours services per all prescribers (CASPA "National-GP" category) i.e., co-amoxiclav, cephalosporins, clindamycin, quinolones.
- Number of items per month per **each individual** antibacterial drug **of the 4Cs** per health board in in-hours services per non-medical independent prescribers (CASPA "Miscellaneous Prescribers – Independent Prescribers" category), i.e., co-amoxiclav, cephalosporins, clindamycin, quinolones.
- Number of items per month per **each individual** antibacterial drug **of the 4Cs** per health board by each W or V code/unique identifier for out-of-hours services, i.e., co-amoxiclav, cephalosporins, clindamycin, quinolones.*

Antibacterial drugs are those available in the BNF subsection 5.1 only.

*The out-of-hours W codes or unique identifiers we are requesting are appended.

Type of prescriber (e.g. GP, dental, supplementary/independent/nurse prescriber, secondary care prescriber)

All prescribers as a whole and classified by profession (GPs and non-medical independent prescribers), and local health board, working in primary care settings during standard working hours (in-hours) and all W codes/unique identifies for out-of-hours services for each health board

Intended purpose of information

To help us focus our analysis on the appropriate key areas it would be helpful to know what this information will be used for.

Data will be used for research purposes only to analyse the current trend of antimicrobial prescribing across Wales within in-hours and out-of-hours services.

Data needed by:

As we recognise that the most recent data will not be available probably until June 2022, would it be possible for some data to be made available as soon as possible with a follow-up data later?

Please send completed form to [REDACTED]

Query

Because we understand that the "National GP" category in CASPA includes all prescribing GP practices within Wales and because W codes for the out-of-hours (OOH) services have in many cases been set up as dummy practices, can the researchers please ask if the OOH data

is included in the "National GP" category or it is only for standard working hours data? And is that the case for all health boards' OOH services?

Appendix 4.2. Bank Holidays in the UK (Wales) (GOV.UK 2022)

Year	Date	Day	Occasion
2020	1 January	Wednesday	New Year's Day
	10 April	Friday	Good Friday
	13 April	Monday	Easter Monday
	8 May	Friday	Early May bank holiday (VE day)
	25 May	Monday	Spring bank holiday
	31 August	Monday	Summer bank holiday
	25 December	Friday	Christmas Day
	28 December	Monday	Boxing Day (substitute)
2021	1 January	Friday	New Year's Day
	2 April	Friday	Good Friday
	5 April	Monday	Easter Monday
	3 May	Monday	Early May bank holiday (VE day)
	31 May	Monday	Spring bank holiday
	30 August	Monday	Summer bank holiday
	27 December	Monday	Christmas Day (substitute)
	28 December	Tuesday	Boxing Day (substitute)
2022	3 January	Monday	New Year's Day (substitute)
	15 April	Friday	Good Friday
	18 April	Monday	Easter Monday
	2 May	Monday	Early May bank holiday (VE day)
	2 June	Thursday	Spring bank holiday
	3 June	Friday	Platinum Jubilee bank holiday
	29 August	Monday	Summer bank holiday
	19 September	Monday	Bank holiday for the State Funeral of Queen Elizabeth II
	26 December	Monday	Boxing Day
	27 December	Tuesday	Christmas Day (substitute)

Appendix 4.3. Prescribing Proportions of Health Boards in Relation to All Wales

Table A4.1: Number of Prescribed Items and Prescribing Proportions in Relation to All Wales*

All Oral Antibacterial Prescriptions				
HBs	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
HB A	2,818,301 (18.8)	2,754,065 (18.9)	64,236 (14.4)	180,387 (17.4)
HB B	2,103,068 (14.0)	2,038,160 (14.0)	64,908 (14.6)	105,068 (10.2)
HB C	2,360,337 (15.7)	2,346,556 (16.1)	13,781 (3.1)	65,522 (6.3)
HB D	1,954,499 (13.0)	1,805,503 (12.4)	148,996 (33.5)	81,296 (7.9)
HB E	1,902,588 (12.7)	1,851,855 (12.7)	50,733 (11.4)	138,802 (13.4)
HB F	578,362 (3.9)	568,380 (3.9)	9,982 (2.2)	45,844 (4.4)
HB G	3,280,136 (21.9)	3,187,433 (21.9)	92,703 (20.8)	417,793 (40.4)
All Wales	14,997,291	14,551,952	445,339	1,034,712
Oral 4C Prescriptions				
HBs	Primary care n	IH n (%)	OOH n (%)	IH by NMIPs n (%)
HB A	194,218 (15.3)	187,684 (15.4)	6,534 (12.9)	7,761 (15.0)
HB B	153,855 (12.2)	147,717 (12.2)	6,138 (12.1)	4,186 (8.1)
HB C	220,109 (17.4)	218,391 (18.0)	1,718 (3.4)	3,538 (6.8)
HB D	173,638 (13.7)	154,318 (12.7)	19,320 (38.2)	3,926 (7.6)
HB E	178,662 (14.1)	171,637 (14.1)	7,025 (13.9)	8,640 (16.7)
HB F	48,963 (3.9)	47,839 (3.9)	1,124 (2.2)	2,443 (4.7)
HB G	296,054 (23.4)	287,386 (23.7)	8,668 (17.2)	21,176 (41.0)
All Wales	1,265,499	1,214,972	50,527	51,670

*Unadjusted to population.

Chapter 5 Appendices

Appendix 5.1. CSPPS-REC Approval

SPPS Ethics Approval Notification (EAN)

8/9/14 v12

Cardiff School of Pharmacy and Pharmaceutical Sciences, Research Ethics Approval

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for the following study:

Project title:	<u>2223-17: Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out of-hours services: a qualitative interview study</u>

This is a/an:	Undergraduate project	
	ERASMUS project	
	Postgraduate project	X
	Staff project	

Name of researchers: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

STATEMENT OF ETHICS APPROVAL

This project has been considered and has been approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 04/05/2023
(Deputy Chair, School Research Ethics Committee)

Appendix 5.2. Interview Schedule with an Example of the Graphs Provided

Version 1.2 - Dated 11 May 2023

Introduction

Thanks for taking part in this study.

I am just checking to make sure you have read and signed the information sheet and are still happy to participate.

I would like to remind you that this interview will be recorded.

Before we start, let me give an overview of what we will discuss today. I am interested in exploring your views on oral antibacterial drug prescribing within primary care in Wales, focusing on out-of-hours (OOH) prescribing for your Health Board (HB) if that is fine. I would also like to identify implemented antimicrobial stewardship (AMS) interventions if any, and your views on potential barriers and facilitators to implementing such interventions. So, your answers do not have to be right or wrong.

So, before we begin, is there anything you want to know?

Could you please confirm your name before the recording starts?

I will start recording now. (audio for face-to-face interviews; audio and video for online interviews)

Section I

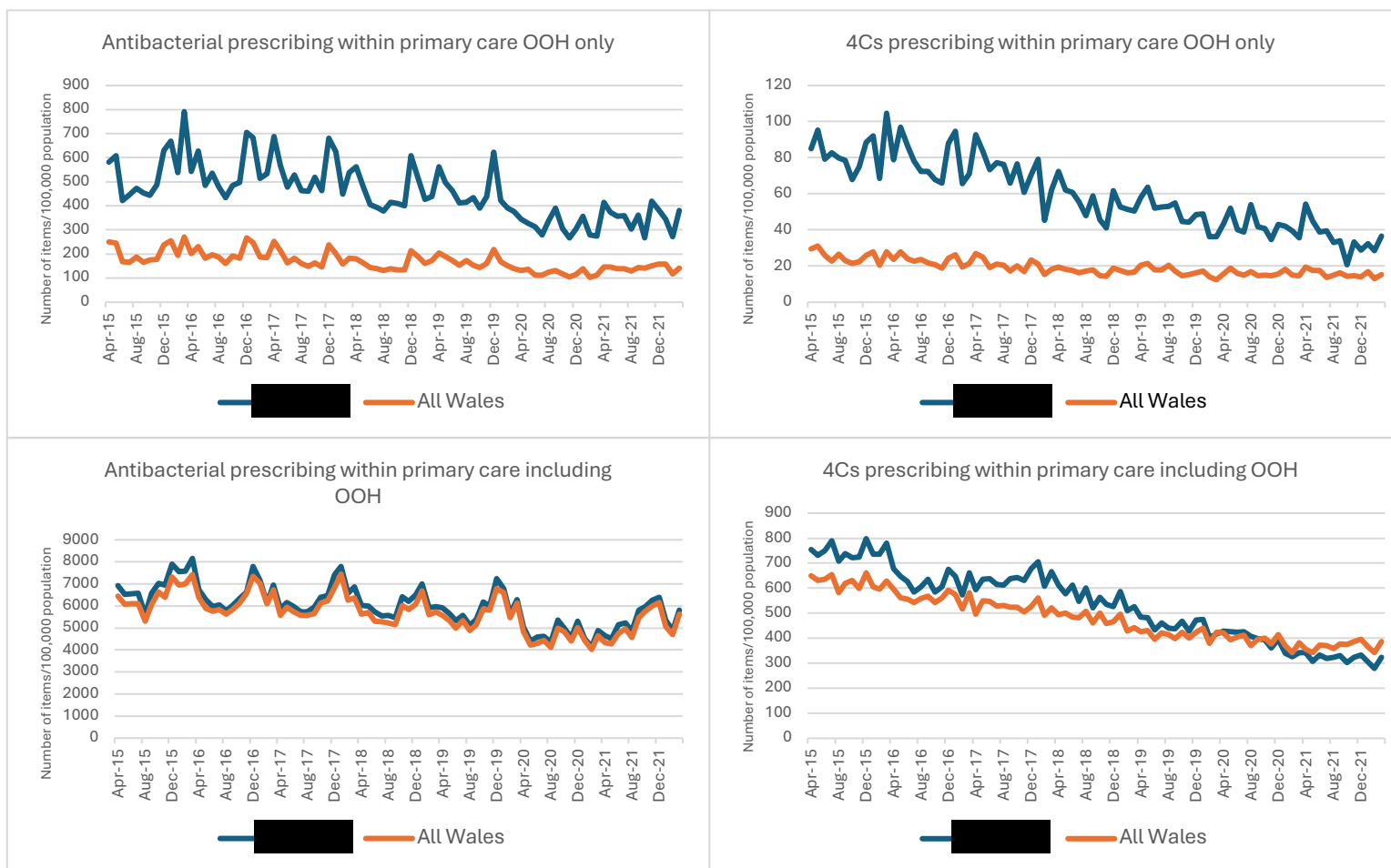
Role and overall experience of Lead Antimicrobial Pharmacists, antimicrobial pharmacists in primary care, or an equivalent staff member.
1. For how long have you been working as a Lead Antimicrobial Pharmacist, an antimicrobial pharmacist in primary care, or your current post on this Health Board (HB)? 2. Can you tell me briefly about your role within your HB? • The sector of practice (primary care vs. secondary care) • Experience within the HB • If a Lead Antimicrobial Pharmacist, is there a specific antimicrobial pharmacist post for primary care? ○ If yes, when did that start?
Views and perceptions of Lead Antimicrobial Pharmacists, antimicrobial pharmacists in primary care, an equivalent staff member on prescribing oral antibacterial drugs within primary care and specifically out-of-hours (OOH) services.
1. How do you perceive the prescribing of oral antibacterial drugs in primary care? • At All-Wales level, at your HB level 2. What do you think of the prescribing practices of antibacterial drugs within primary care during OOH services specifically? Is it different from primary care during office hours? • At All-Wales level, at your HB level ○ If yes, in what way and why do you think such a difference exists? ○ If not, why do you think that? 3. How do you think your HB is doing in terms of the volume and the appropriateness of prescribing within primary care generally and during OOH periods? • Do you expect any differences with other HBs? ○ If yes, why and what are the differences? ○ If not, why is that?
Existing issues and potential solutions to prescribing in primary care and OOH services

1. Could you please highlight any existing issue that is or has impacted oral antibacterial drug prescribing in primary care? • At All-Wales level, at your HB level • Positive or negative way 2. What changes or improvements would you like to see made to primary care more broadly and OOH services specifically to optimise prescribing of antibacterial drugs? 3. Do you think reducing the use of antibacterial drugs in primary care OOH would make an important difference in addressing the overall AMR problem? • If yes, why do you think that? • If not, why do you think that? 4. In your opinion, how could you help to optimise prescribing and improve the practice of antibacterial drug prescribing at the HB during OOH services? • E.g., guideline-recommended antibacterial, fewer prescribing approach, others • How do you perceive the relevance of the National Prescribing Indicators to in-hours services compared to OOH?
Implementing AMS interventions to improve practice in primary care and OOH services.
1. (Are there any/ Are you familiar with) interventions or strategies to improve antibacterial prescribing within primary care and OOH services? • If any, what are these? • At what level (All-Wales, HB)? • What are your experiences with such interventions? Do they work? To what extent? • How do you assess how successful are these? 2. Are there any facilitators for implementing antimicrobial stewardship strategies in primary care specific to OOH services? 3. From your experience, what would you say are barriers to implementing primary care OOH-specific antimicrobial stewardship interventions?
How successful are AMS interventions within primary care and OOH services
1. When would you consider an AMS intervention successful? 2. Is there anything you think could be done to ensure the successful implementation of AMS interventions/initiatives? 3. Do you evaluate how successful an AMS intervention is in your HB? • If yes: ○ What mechanisms/ criteria/ tools do you use or base your evaluation upon? ○ What challenges do you face? • If not, what are the reasons? Is there any future plan to do so?

We will be discussing those questions during the interview; however, if you do have any particular policies or reports that you would like to share with us, we will be grateful.

Section II From the graphs below of monthly prescribing data:

1. Could you please explain the reason why HB D has generally higher prescribing volume in relation to all Wales, especially within OOH services?
2. What do you think is/are the reason(s) for the substantial reduction seen in the prescribing volume in your HB, especially within OOH for all antibacterial and the 4Cs, particularly following 2017/18? (e.g., local interventions, strategies, incentives, guidelines, others?)



Beyond the questions I asked above, are there any other things you'd like to add about how antibacterial prescribing has been managed within your HB during this timeframe? I would like to hear about them during the interview.

We have reached the end of the interview.
Thank you for your time and your participation.

Appendix 5.3. CSPPS-REC 1st Amendment Approval

SPPS Amendment Approval Notification (AAN)

11/10/14 v1

**Cardiff School of Pharmacy and Pharmaceutical Sciences,
Research Ethics Approval**

AMENDMENT APPROVAL

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for amendment(s) to the following study:

Project ref and title:	<u>2223-17: Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out-of-hours services: a qualitative interview study.</u>

Name of researcher: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

The amendment(s) dated 10th August 2023 have been reviewed and approved.

Any further amendments will require approval.

STATEMENT OF ETHICS APPROVAL

The proposed amendment(s) have been considered and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 15/08/2023
(Deputy Chair, School Research Ethics Committee)

Appendix 5.4. Gatekeeper Invitation Letter, Information Sheet, Consent Form

Gatekeeper Invitation Letter

Version 1.4 - Dated 10 Aug 2023

Dear X,

Title of Project: Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out-of-hours services: a qualitative interview study.

Name of Researcher and location of researcher: Sarah Al Hussain, Rhian Deslandes, Karen Hodson, Cardiff University School of Pharmacy and Pharmaceutical Sciences (Part of a PhD project)

I hope you are doing well.

We met previously at one of the antimicrobial pharmacists' meetings and had a chat about my project regarding out-of-hours (OOH) prescribing. As we previously discussed, my current project aims to explore the perceptions of Lead Antimicrobial Pharmacists, antimicrobial pharmacists for primary care, or equivalent staff members, if suitable, in Wales around oral antibacterial prescribing in primary care, with OOH services focus. The project also seeks their views on possible strategic interventions to improve prescribing practices.

In order to achieve this we are aiming to recruit Lead Antimicrobial Pharmacists, antimicrobial pharmacists for primary care, or equivalent staff members, if you believe this would be suitable, in Wales from each Local Health Board. We would like to therefore ask for your support in getting in touch with these individuals, including yourself, by forwarding information to them on my behalf. The project has been reviewed and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee and approved/received permission from a number of R&D at the Local Health Boards to date.

If you would be willing to consider this, please read the attached information sheet which outlines exactly what you are being asked to do and when. All involvement as a gatekeeper throughout the study should take less than an hour of your time. If you agree to assist, we kindly ask you to sign and return the gatekeeper consent form attached.

So far, permission has been given by four out of the seven Local Health Boards. However, we are still awaiting responses from the remaining three Health Boards. If you prefer, we can wait until we have received permission from all seven Local Health Boards before sending the project-related information. However, if you find it manageable, we can proceed with the four Health Boards that have already given their permission, namely ABUHB, SBUHB, CVUHB, and HDUHB.

Please contact me on my email ([REDACTED]) if you have any questions about this request.

Your sincerely,
Sarah

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Gatekeeper Information Sheet



Version 1.4 - Dated 10 Aug 2023

Thank you for taking the time to read this information sheet.

You are being invited to assist in a study project. Before you decide whether or not to assist, it is important for you to understand why the study is being undertaken and what it will involve. Please take some time to read the following information carefully and discuss it with others, if you wish.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the perceptions of Lead Antimicrobial Pharmacists, antimicrobial pharmacists for primary care, or equivalent staff members in Wales around oral antibacterial prescribing in primary care, with OOH services focus within their own health board. The study also seeks their views on possible strategic interventions to improve prescribing practices.

This study will be part of the doctoral thesis.

2. Why have I been invited to assist in the project?

You have been invited because through your role as one of the Lead Antimicrobial Pharmacists in Wales, you have access to potential participants that we wish to approach to ask if they would like to take part in the project. We would therefore like to ask if you would be willing to act as a “gatekeeper”. Without you passing on information on our behalf we would not be able to recruit relevant individuals.

3. Do I have to take part?

No, your role is entirely voluntary and it is up to you to decide whether or not to assist. If you decide to assist, we will discuss the study with you and ask you to sign a gatekeeper consent form. If you decide not to assist, you do not have to explain your reasons and it will not affect your legal rights. You are free to withdraw the consent for your role in the project at any time, without giving a reason, even after signing the consent form.

4. What will taking part involve?

We would like to ask you to act in the capacity of a gatekeeper by forwarding information to potential participants on our behalf. The individuals who are suitable to take part are Lead Antimicrobial Pharmacists (or, if you believe it would be more suitable, antimicrobial pharmacists for primary care or equivalent staff members) from the seven Local Health Boards in Wales, including yourself and six other pharmacists. The project will involve the participant being interviewed individually to gain insights into prescribing of antibacterial drugs within primary care, particularly in out-of-hours, in Wales, and explore their views and perceptions of current Local Health Boards' practices.

We ask that you only forward the details of the project to them, which includes the invitation email, information sheet, and consent form. Please do not amend any of these documents or provide further information. If you agree to assist we will provide these as soon as possible. Please can you forward them to the potential participants once we successfully obtain the required permission to conduct the study from the Local Health Board Research and Development departments? We will keep you updated on the permission status. You must not coerce or instruct the individuals to participate, it is entirely their own decision. If they would like to participate they will be asked to contact the researcher directly on the contact details provided (i.e. you will not need to pass information back to us). You must not provide us with any information related to the individual or attempt to answer any questions they might ask you about the project – they should contact the research team

directly. We would also like you to forward a reminder (all documentation will be provided to you) 2 weeks after the initial contact. All involvement should take no more than an hour of your time.

5. Will I be paid for taking part?

No, your assistance will be entirely voluntary with no payment.

6. What will happen to my Personal Data?

The only personal data held will be your name, work contact details and email address in order to forward the documentation onto you. Cardiff University is the Data Controller and is committed to respecting and protecting your personal data in accordance with your expectations and Data Protection legislation. Further information about Data Protection, including:

- your rights
- the legal basis under which Cardiff University processes your personal data for research
- Cardiff University's Data Protection Policy
- how to contact the Cardiff University Data Protection Officer
- how to contact the Information Commissioner's Office

may be found at <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

All of your details, including your consent form, your name and email address, will be retained for a minimum period of five years after the end of the project or after publication, whichever is later, in accordance with the University Records Retention Schedules and may be accessed by members of the research team and, where necessary, by members of the University's governance and audit teams or by regulatory authorities. We would like you to sign the consent form electronically and send it back to the researcher's email address. The consent form will be held on Cardiff University online server on a password-protected computer in order to maintain confidentiality.

7. What if there is a problem?

If you have any concerns or complaints about the project, please contact Prof. Karen Hodson, the academic supervisor on [REDACTED], who will address the issue. If you remain unhappy and wish to complain formally, you can do this by contacting the Director of Research, at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED].

8. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, Dr. Rhian Deslandes Prof. Karen Hodson, School of Pharmacy and Pharmaceutical Sciences in Cardiff University. The project is funded by *Saudi Arabia Cultural Bureau* in the UK.

9. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee, Cardiff University and approved by the Research and Development Office at each Local Health Board.

10. Further information and contact details

Should you have any questions relating to this study, you may contact myself/us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff

CF10 3NB
[REDACTED]

Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Thank you for considering assisting us in this project. If you decide to help out, you will be given a copy of the Gatekeeper Information Sheet and a signed consent form to keep for your records.

Gatekeeper Consent Form



Version 1.4 - Dated 10 Aug 2023

Title of project: Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out-of-hours services: a qualitative interview study.

SREC reference and committee: 2223-17 Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Name of Principal Investigator: Sarah Al Hussain
Supervisors: Rhian Deslandes, Karen Hodson

This project aims to explore Lead Antimicrobial Pharmacists', antimicrobial pharmacists for primary care, or equivalent staff members' perceptions around oral antibacterial prescribing in primary care, with a focus on out-of-hours (OOH). The project also seeks their views on possible strategic interventions to improve prescribing practices in Wales. If you are willing to assist in this study, we will ask for your support in distributing information to potential participants. Characteristics of the potential participants have been provided in the information sheet. Any interested participants should be directed to contact the research team to discuss participation further.

All information collected from you during the study will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation.

Please initial to confirm your understanding of the study and that you are happy to be involved in the role of a gatekeeper.

Please initial box

I confirm that I have read and understand the gatekeeper information sheet dated 11/05/2023 version 1.3 provided for the above study.	
I confirm that I have understood the gatekeeper information sheet dated 11/05/2023 version 1.3 for the above project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
I understand that my participation as a gatekeeper is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect legal rights.	
I agree to not coerce or in any way convince potential participants to take part in the study.	
I agree to distribute the information provided to potential participants at the timeframe stated in the gatekeeper information sheet and that none of the documents will be modified in anyway.	
I understand that any personal information collected during the study will be anonymised and remain confidential.	

Name of Gatekeeper:

Date:

Signature:

Name of Researcher:

Date:

Signature:

Name of Person taking consent:
(if different from researcher)

Date:

Signature:

Appendix 5.5. Participant Invitation Letter, Information Sheet, Consent Form

Participant Invitation Letter

Version 1.2 - Dated 11 May 2023

Subject:

Exploration of stakeholders' views and perceptions of antibacterial drug prescribing in primary care out-of-hours services – an invitation to participate in a study

Content:

Dear Pharmacist,

You are invited to participate in an interview-based study carried out by Sarah Al Hussain, a PhD student and supervised by Dr Rhian Deslandes and Prof. Karen Hodson at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University, as part of a PhD project. The study is about your views and perceptions as a Lead Antimicrobial Pharmacist, an antimicrobial pharmacist for primary care, or an equivalent staff member about oral antibacterial drug prescribing in Wales primary care, with a focus on out-of-hours services for each Local Health Board. It will also identify potential opportunities and challenges to implementing antimicrobial stewardship programmes within these settings. It is anticipated that your participation would enrich the PhD thesis overall and inform the direction of future research.

Please find attached a consent form and a participant information sheet for further details. It would be interesting to hear your thoughts on the prescribing within the individual local health board. This will entail a brief interview anticipated to last for a maximum of 60 minutes and can be conducted at a time and place convenient for you.

If you require any additional information before making a decision to participate, feel free to contact us at this email address ([REDACTED]), and we will be happy to discuss any question/concern you may have.

If you would like to take part in the study, please fill/sign the consent form and send it back to this email [REDACTED] to arrange a mutually convenient date, time, and venue for an interview.

Your participation would be highly valued.

Yours sincerely,

Participant Information Sheet



Version 1.3 - Dated 11 May 2023

Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out-of-hours services: a qualitative interview study.

You are being invited to take part in a study project. Before you decide whether or not to take part, it is important for you to understand why the study is being undertaken and what it will involve. Please take time to read the following information carefully and discuss it with others, if you wish.

Thank you for reading this.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the perceptions of Lead Antimicrobial Pharmacists, antimicrobial pharmacists for primary care, or equivalent experienced staff members in Wales around oral antibacterial prescribing in primary care, with OOH services focus. The study also seeks their views on possible strategic interventions to improve prescribing practices.

This part of the project follows on from an earlier investigation of prescribing patterns of oral antibacterial drugs within each Local Health Board and all Wales.

This study will be part of the doctoral thesis.

2. Why have I been invited to take part?

You have been invited because you are one of the Lead Antimicrobial Pharmacists, the antimicrobial pharmacist for primary care, or an equivalent staff member in Wales who have experience, knowledge, and understanding of what has been done and possibly planned across Wales at the Local Health Board level in terms of antibacterial prescribing in primary care and out-of-hours (OOH) services in particular. We believe that your views and perceptions are of value, as they will enable us to understand the prescribing patterns in Wales OOH services. In addition, they will enable us to gain insight into possible initiatives to promote rational prescribing of oral antibacterial drugs in these settings.

3. Do I have to take part?

No, your participation in this study project is entirely voluntary and it is up to you to decide whether or not to take part. If you decide to take part, we will discuss the project with you and ask you to sign a consent form. If you decide not to take part, you do not have to explain your reasons and it will not affect your legal rights.

You are free to withdraw your consent to participate in the project at any time, without giving a reason, even after signing the consent form. However, withdrawal of consent will not be possible once the transcripts have been anonymised.

4. What will taking part involve?

Taking part in the study will involve a one-to-one interview with the researcher (Sarah). The interview will be conducted either face-to-face or online via Microsoft Teams. The time and place of the interview will be scheduled at the convenience of each participant. You will be interviewed once, and the interview is expected to last approximately 30 to 60 minutes. The interview will be audio recorded by the researcher using a digital recording device for in-person interviews and will be held in a quiet meeting room at the participant's workplace.

Both audio and video will be recorded for virtual interviews; however, you will have the flexibility to have your camera on or off. If you prefer to switch your camera off, only the audio will be recorded. The interview questions and graphs that represent the trends of oral antibacterial prescribing data in primary care and OOH services for all Wales and those specific to your Local Health Board will be shared with you one week before your scheduled interview to go over and consider your responses. We do not expect you to email or provide a response before the interview. If you do not feel comfortable answering any of the questions, you may skip them in the interview. However, there will be no sensitive questions asked during the interview. The interviews will be transcribed and analysed by the researcher. Any discussion/obtained data during the interview is confidential and will be protected and anonymised. The interview procedure will be clearly explained to you prior to the commencement of the interviewing process.

Before deciding to take part, we would like to provide you with an opportunity to ask any questions about the project and your participation. If you agree to be involved in the study, you will need to sign a consent form electronically and send it back to the researcher via email using the contact information provided below.

5. Will I be paid for taking part?

No. You should understand that any data you give will be as a gift and you will not benefit financially in the future should this project lead to the development of a new treatment/method/test/assessment.

6. What are the possible benefits of taking part?

There will be no direct advantages or benefits to you from taking part, but your contribution will help us understand prescribing patterns of oral antibacterial drugs across Wales, especially within OOH services, and what could possibly have influenced the prescribing practices at the Health Board level. Your input would also inform future research planning and development.

7. What are the possible risks of taking part?

Your participation in the study does not involve any risk. You may choose not to answer certain questions if you feel uncomfortable.

8. Will my taking part in this research project be kept confidential?

All information collected from (or about) you during the project will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation. Please see 'What will happen to my Personal Data?' (below) for further information.

9. What will happen to my Personal Data?

Your personal data, according to the General Data Protection Regulation (GDPR), including the individual name, address, email address, contact details, and the Local Health Board, will be collected for this study.

Cardiff University is the Data Controller and is committed to respecting and protecting your personal data in accordance with your expectations and Data Protection legislation. Further information about Data Protection, including:

- your rights
- the legal basis under which Cardiff University processes your personal data for research
- Cardiff University's Data Protection Policy
- how to contact the Cardiff University Data Protection Officer
- how to contact the Information Commissioner's Office

may be found at <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

After the transcription process immediately, which will be completed by the primary researcher using Microsoft transcription features, the research team will anonymise all the personal data it has collected from, or about, you in connection with this project, with the exception of your consent form, your name, and email address. Any identifiable information on the transcripts will be removed so no one can be identified. Your consent form, your name, and email address will be retained for five years upon the completion of the project in accordance with the University Records Retention Schedules and may be accessed by members of the research team and, where necessary, by members of the University's governance and audit teams or by regulatory authorities. Anonymised information will be kept for a minimum of five years in accordance with the University

Records Retention Schedules but may be published in support of the research project and/or retained indefinitely, where it is likely to have continuing value for research purposes.

Note that it will not be possible to withdraw any anonymised data that has already been published or in some cases, where identifiers are irreversibly removed during the course of the project, from the point at which it has been anonymised.

10. What happens to the data at the end of the research project?

According to the University Records Retention Schedule, the collected data will be kept for a minimum of five years following the completion of the project. Data will be stored on Cardiff University OneDrive, a supported and secured online server, with password-protected files on a password-protected computer.

11. What will happen to the results of the research project?

The study will be part of a thesis that will be submitted for a Doctor of Philosophy in Pharmacy and Pharmaceutical Sciences degree. It is also our intention to publish the results of this study in academic journals and present findings at conferences. Participants will not be identified in any report, publication, or presentation. We may use verbatim quotes from participants. The findings of the study will be discussed with other key stakeholders once all names and any identifying information have been anonymised. A summary of the study will be provided to the participants upon request.

12. What if there is a problem?

If you wish to complain, or have grounds for concerns about any aspect of the manner in which you have been approached or treated during the course of this study, please contact Prof. Karen Hodson, the academic supervisor. If your complaint is not managed to your satisfaction, please contact the Director of Research at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED]

If you are harmed by taking part in this project, there are no special compensation arrangements. If you are harmed due to someone's negligence, you may have grounds for legal action, but you may have to pay for it.

13. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, PhD student; Dr. Rhian Deslandes; and Prof. Karen Hodson, the academic supervisors at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University in Cardiff University. The study is currently funded by *Saudi Arabia Cultural Bureau* in the UK.

14. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee (SREC), Cardiff University and approved by the Research and Development (R&D) office at your respective Local Health Board.

15. Further information and contact details

Should you have any questions relating to this project, you may contact us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Tel: [REDACTED]

Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Tel: [REDACTED]

Thank you for considering to take part in this project. If you decide to participate, you will be given a copy of the Participant Information Sheet and a signed consent form to keep for your records.

Participant Consent Form



Version 1.3 - Dated 11 May 2023

Title of project: Exploration of stakeholders' views and perceptions of oral antibacterial drug prescribing in all Wales primary care out-of-hours services: a qualitative interview study.

SREC reference and committee: 2223-17, The Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Name of Chief/Principal Investigator: Sarah Al Hussain

Supervisors: Rhian Deslandes, Karen Hodson

	Please initial box
I confirm that I have read the information sheet dated 11/05/2023 version 1.3 for the above study.	
I confirm that I have understood the information sheet dated 11/05/2023 version 1.3 for the above study and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
I confirm that I am happy for the researcher to send me the interview questions and the Local Health Board prescribing data for the above study a week before the scheduled interview for me to consider and have the opportunity to ask questions.	
I understand that my participation is voluntary and I am free to withdraw at any time without giving a reason and without any adverse consequences (e.g. to medical care or legal rights, if relevant), but up until the point of anonymisation. I understand that if I withdraw, information about me that has already been obtained may be kept by Cardiff University.	
I consent to the processing of my personal information including my name and work email address for the purposes explained to me. I understand that such information will be held in accordance with all applicable data protection legislation and in strict confidence, unless disclosure is required by law or professional obligation.	
I understand who will have access to personal information provided, how the data will be stored and what will happen to the data at the end of the project.	
I consent to being audio recorded for the purposes of the project and I understand how it will be used in the study.	
For virtual interviews via Microsoft Teams, I consent for my interview to be video recorded for the purposes of the project and I understand how it will be used in the study.	
I understand that anonymised excerpts and/or verbatim quotes from my interview may be used as part of the study publication.	
I understand how the findings and results of the study will be written up and published.	
I agree to take part in this study.	

Name of participant (print)

Date

Signature

Name of person taking consent
(print)

Date

Signature

Role of person taking consent
(print)

THANK YOU FOR PARTICIPATING IN OUR STUDY

YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP

Appendix 5.6. Participant Reminder Letter

Version 1.2 - Dated 11 May 2023

Subject:

Reminder Exploration of stakeholders' views and perceptions of antibacterial drug prescribing in primary care out-of-hours services – an invitation to participate in a study

Content:

* Reminder

Note: Please ignore this email if you have already responded to the previous email

Dear Pharmacist,

We are sorry for bothering you. We understand that you are busy. We sent you an invitation letter 2 weeks ago to consider participating in an interview-based study related to prescribing antibacterial drugs in Wales primary care and OOH services. As we have not heard back from you, we wonder whether you had the opportunity to look into the details attached.

A copy of the original email is below. I have attached another copy of the information sheet and a consent form.

I would really appreciate the time you have taken to consider our request.

Thank you for your help.

Kind regards,

Sarah

Content:

Dear Pharmacist,

You are invited to participate in an interview-based study carried out by Sarah Al Hussain, a PhD student and supervised by Dr Rhian Deslandes and Prof. Karen Hodson at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University, as part of a PhD project. The study is about your views and perceptions as a Lead Antimicrobial Pharmacist, an antimicrobial pharmacist for primary care, or an equivalent staff member about oral antibacterial drug prescribing in Wales primary care, with a focus on out-of-hours services for each Local Health Board. It will also identify potential opportunities and challenges to implementing antimicrobial stewardship programmes within these settings. It is anticipated that your participation would enrich the PhD thesis overall and inform the direction of future research.

Please find attached a consent form and a participant information sheet for further details. It would be interesting to hear your thoughts on the prescribing within the individual local health board. This will entail a brief interview anticipated to last for a maximum of 60 minutes and can be conducted at a time and place convenient for you.

If you require any additional information before making a decision to participate, feel free to contact us at this email address ([REDACTED]), and we will be happy to discuss any question/concern you may have. If you would like to take part in the study, please fill/sign the consent form and send it back to this email ([REDACTED]) to arrange a mutually convenient date, time, and venue for an interview.

Your participation would be highly valued.

Yours sincerely,

Appendix 5.7. Participant Documentation Letter and Interview Reminder

Version 1.3 - Dated 11 May 2023

Dear X,

Thank you for consenting to participate in the interview-based study carried out by a research team from the School of Pharmacy and Pharmaceutical Sciences, Cardiff University. The study aims to explore your views and perceptions as a Lead Antimicrobial Pharmacist (or an antimicrobial pharmacist for primary care/equivalent staff member) about oral antibacterial drug prescribing in primary care in Wales, with a focus on out-of-hours (OOH) services in each Health Board. It also seeks your perspectives on potential opportunities and challenges to implementing antimicrobial stewardship programmes within these settings.

As discussed, your interview will be on [day, date, time, and location (online or in-person)]. Please find attached the interview questions for you to consider your responses before the interview. Underneath the questions, you will find graphs to provide an overview of oral antibacterial drug prescribing volume over the period 2015/16-2021/22 for primary care and OOH services related to your respective health board and Wales as a whole. The graphs include prescribing data for all oral antibacterial drugs (including the 4Cs) and the 4Cs alone. Where appropriate, there are also a few questions linked to each graph that I would like you to consider, which might help understand why certain changes in prescribing happened.

We do not expect you to make any notes or to contact the researcher beforehand; however, please feel free to do so if you would like to. We are interested in hearing your thoughts during the interview.

If you require further clarification or have any questions, please contact us at this email

([REDACTED]).

Thank you for your time.

Yours sincerely,

Appendix 5.8. Efforts Made to Obtain Volumes of Pre-packed Items Dispensed OOH Services

Following the interviews with lead and primary care antimicrobial pharmacists in the seven HBs, a key point was raised about the researcher's exploration of the antibacterial prescription volume in Wales. Although the volume was obtained from the CASPA which captured prescriptions issued in primary care settings and dispensed in community pharmacies including those prescribed and dispensed by community pharmacist independent prescribers (PIPs), it did not capture the volume of prescriptions given to patients as pre-pack items that were dispensed outside of community pharmacy settings, e.g., given directly to patients from a medicines stock in a cupboard when visiting GP OOH. This may have an impact on the volume described earlier in Chapter 4 and should therefore be carefully interpreted. Numerous steps were undertaken by the researcher to account for the volume of these pre-pack items. After the interviews, members of the AWAPG were approached and asked if they were aware of any source that could be accessed to obtain such data. They frequently recommended speaking to the lead for antimicrobial surveillance for Public Health Wales, as she has been lately working in trying to get hold of antimicrobial prescribing data in OOH settings. The researcher contacted and virtually met the antimicrobial surveillance lead where she discussed the processes she undertook in order to get the data as there was no straightforward way. She explained that previously, there were 3-4 different systems in Wales where it was difficult to identify anything within. However, in late 2021, Wales moved to a new pharmacy stock management and control system, i.e., CareFlow Medicines Management (CMM) formerly known as WellSky, which also took several months to finally roll up in 2022. As such, the system enabled them to have data from 2022 onwards.

Although the current system allowed to track how many items were supplied to different locations (issue point) and how many items have been returned. Several limitations were identified which restricted the use of the data provided by the system. It can only look at the stock that has been sent to a cupboard where GPs work, for example, rather than looking at prescriptions. Moreover, when medicines are returned, the system does not restock them against the original amount issued for that particular month. Instead, it depends on when that medicine stock is returned which could be months or even years later, i.e., they are restocked against the month they were returned and not the month they were issued which does not necessarily mirror the actual prescribing activity or the monthly supplied and returned items. Additionally, the data extends beyond the timeframe covered in this thesis and only covers the data spanning from 2022, the year when it was in place (approximately 18-24 months from the time of contact). It lacked any data for the timeframe that the researcher is examining from March 2015 to April 2022.

At the same time, the research team also approached the Primary Care and Community Pharmacy Director in ABUHB to inquire about who could be consulted to get such data. To his knowledge, the supply of pre-packed items varied across the HBs, with some handling their own supply while others getting it from other HBs. He could not provide further details and suggested approaching a known contact within the Medicines Procurement and Optimisation Wales within NWSSP, who may have a better idea. Ultimately, several meetings were held with the Medicines Value Unit Negotiating Principal in the NWSSP over three months to work on data from the Procurement services database CareFlow, where both the project and the issue faced were explained. As such, a thorough discussion and an agreement on what data to obtain was reached. However, the procurement data needed to be manipulated to obtain such data, i.e., the volume of dispensed items during OOH periods. For example, returned items and those not linked to specific patients were excluded, as they were either returned to manage the stock or were still in the location cupboard they were supplied to and were

not dispensed yet. They were also reported either as a pack with the number of pills, unit dose form, or bottles in the case of liquid dosage forms rather than the number of items used earlier with CASPA and Choose Pharmacy - PIPS data. Additionally, it was challenging to differentiate between items dispensed from primary care OOH locations and those prescribed in hospital wards as part of secondary care, as these were referred to by location names rather than explicitly identified as OOH settings.

Since these are two different types of data that cannot be looked at in the same way (CASPA data consists of dispensed prescriptions regardless of patient's consumption that do not come back to pharmacy stock compared to pre-pack items which depend on the movement of stock in and out of specific locations), a decision was made to include pre-packs data separately from the CASPA data despite the caveats with this approach. This was done to give a sense and approximation of how the pre-pack volume potentially contributes as a proportion to the overall volume of prescribing in Wales using the pre-pack volume from January 2023 to December 2023 as a proxy.

Chapter 6 Appendices

Appendix 6.1. CSPPS-REC Approval

SPPS Ethics Approval Notification (EAN)

8/9/14 v12

Cardiff School of Pharmacy and Pharmaceutical Sciences, Research Ethics Approval

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for the following study:

Project title:	<u>2324-16: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation</u>

This is a/an:	Undergraduate project	
	ERASMUS project	
	Postgraduate project	X
	Staff project	

Name of researchers: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

STATEMENT OF ETHICS APPROVAL

This project has been considered and has been approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 08/01/2024
(Deputy Chair, School Research Ethics Committee)

Appendix 6.2. CSPPS-REC 1st Amendment Approval

SPPS Amendment Approval Notification (AAN)

11/10/14 v1

**Cardiff School of Pharmacy and Pharmaceutical Sciences,
Research Ethics Approval**

AMENDMENT APPROVAL

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for amendment(s) to the following study:

Project ref and title:	<u>2324-16: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.</u>

Name of researcher: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

The amendment(s) dated 12th January 2024 have been reviewed and approved.

Any further amendments will require approval.

STATEMENT OF ETHICS APPROVAL

The proposed amendment(s) have been considered and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 19/01/2024
(Deputy Chair, School Research Ethics Committee)

Appendix 6.3. Primary Gatekeeper Documentation

Primary Gatekeeper Invitation Letter

Title of Project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

Name of Researcher and location of researcher: Sarah Al Hussain.

Supervisors: Rhian Deslandes, Karen Hodson.

Cardiff University School of Pharmacy and Pharmaceutical Sciences (Part of a PhD project)

Dear XXXX,

I hope you are doing well.

We have met previously at multiple meetings and had a chat about my project around out-of-hours (OOH) prescribing. As we recently discussed, my current project aims to explore the decision-making process of prescribers of the different professions working in primary care OOH settings, particularly in 111 clinical support hubs across Wales, when prescribing antibacterial drugs. The project also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

In order to achieve this we are aiming to recruit general practitioners (GPs) and pharmacist independent prescribers who completed their training portfolio/probation periods, or at least 30 hours of their training working in NHS 111 clinical support hubs outside the regular working hours across Wales. We would like to therefore ask for your support in getting in touch with these individuals, by forwarding information to the 111 clinical support hub coordinators to request their permission to act in the capacity of direct gatekeepers to the potential participants. It is the coordinators who will then contact the participants on my behalf. The project has been reviewed and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee and registered/granted permission by the R&D at Betsi Cadwaladr University Health Board (BCUHB) so far, one of the HB overseeing NHS 111 service across all Wales.

If you would be willing to consider this, please read the attached information sheet which outlines exactly what you are being asked to do and when. All involvement as a gatekeeper throughout the study should take less than an hour of your time.

Please contact me on my email ([REDACTED]) if you have any questions about this request.

Your sincerely
Sarah

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff,
CF10 3NB
[REDACTED]

Primary Gatekeeper Information sheet

Thank you for taking the time to read this information sheet.

You are being invited to assist in a study project. Before you decide whether or not to assist, it is important for you to understand why the study is being undertaken and what it will involve. Please take some time to read the following information carefully and discuss it with others, if you wish.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, specifically in NHS 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

This part of the project follows on from an earlier quantitative investigation of prescribing patterns of oral antibacterial drugs in Wales and qualitative exploration of lead and primary care antimicrobial pharmacists' views on prescribing in primary care and OOH services.

This study will be part of the doctoral thesis.

2. Why have I been invited to assist in the project?

You have been invited because, through your role as the national professional lead for NHS 111 programme in Wales, you have access to potential participants that we wish to approach to ask if they would like to take part in the project through the NHS 111 clinical support hub coordinators. We would therefore like to ask if you would be willing to act as a "gatekeeper". Without you passing on information on our behalf we would not be able to recruit relevant individuals.

3. Do I have to take part?

No, your role is entirely voluntary and it is up to you to decide whether or not to assist. If you decide to assist, we will discuss the study with you and ask you to sign a gatekeeper consent form. If you decide not to assist, you do not have to explain your reasons and it will not affect your legal rights. You are free to withdraw the consent for your role in the project at any time, without giving a reason, even after signing the consent form.

4. What will taking part involve?

We would like to ask you to act in the capacity of a gatekeeper by forwarding information to potential participants on our behalf through the use of the hub coordinators. The individuals who are suitable to take part are prescribers, either GPs and pharmacist independent prescribers, working shifts in OOH services, particularly in 111 clinical support hubs across Wales who completed their training portfolio/probation periods, or at least 30 hours of their training in NHS 111 clinical support hubs. The project will involve the participants being interviewed individually to gain insights into the decision-making process when prescribing antibacterial drugs within primary care OOH (in 111 clinical support hubs) in Wales, and identify available resources within these settings and strategies used to support appropriate prescribing practices. We ask that you only forward the details of the project to 111 clinical support hub coordinators, which includes, an advert, the invitation email, a direct gatekeeper's information sheet, and a consent form. We would also like you to forward a reminder (all documentation will be provided to you) 2 weeks after the initial contact. After obtaining their consent, you will be asked to forward another invitation email containing the study advert, participant information sheet and consent form to the hub coordinators and ask them to share these with the potential participants. Please do not amend any of these documents or provide further information. If you agree to assist, we will provide these as soon as possible once we successfully obtain the required permission to conduct the study from the relevant Research and Development departments to please forward them to the potential hub coordinators and then for them to directly contact potential participants. You must not coerce or instruct the individuals to participate, it

is entirely their own decision. If they would like to participate they will be asked to sign and send the consent form back to the researcher directly on the contact details provided (i.e. you will not need to pass information back to us). You may explain the recruitment process and their involvement to the hub coordinators should they have any questions. All involvement should take no more than an hour of your time.

5. Will I be paid for taking part?

No, your assistance will be entirely voluntary with no payment.

6. How will we use information about you?

We will need to use information from you for this research project.

This information will include your name, initials, and contact details (including your work email address). People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

All of your details, including your consent form, your name and email address, will be retained for a minimum period of 15 years in accordance with the University Records Retention Schedules

7. What are your choices about how your information is used?

- You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.
- We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

8. Where can you find out more about how your information is used?

You can find out more about how we use your information:

- by speaking with the PhD student (Sarah Al-Hussain) or Sarah's supervisors
- by reviewing the Cardiff University Data Protection Policy: <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

by contacting the University Data Protection by email: [REDACTED] or in writing to: Data Protection Officer, Compliance and Risk, University Secretary's Office, Cardiff University McKenzie House, 30-36 Newport Road Cardiff CF24 0DE

9. What if there is a problem?

If you have any concerns or complaints about the project, please contact Prof. Karen Hodson, the academic supervisor on [REDACTED], who will address the issue. If you remain unhappy and wish to complain formally, you can do this by contacting the Director of Research, at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED].

10. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, Dr. Rhian Deslandes Prof. Karen Hodson, School of Pharmacy and Pharmaceutical Sciences in Cardiff University. The project is funded by *Saudi Arabia Cultural Bureau* in the UK.

11. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee, Cardiff University and registered/granted permission has been obtained by the Research and Development (R&D) at Aneurin Bevan University Health Board (ABUHB), Swansea Bay University Health Board (SBUHB), and Betsi Cadwaladr University Health Board (BCUHB), overseeing NHS 111 service hubs across all Wales..

12. Further information and contact details

Should you have any questions relating to this study, you may contact myself/us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Thank you for considering assisting us in this project. If you decide to help out, you will be given a copy of the Gatekeeper Information Sheet and a signed consent form to keep for your records.



Primary Gatekeeper Consent Form

Title of project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

SREC reference and committee: 2324-16, Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Name of Principal Investigator: Sarah Al Hussain
Supervisors: Rhian Deslandes, Karen Hodson

This project aims to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, particularly in 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices. If you are willing to assist in this study, we will ask for your support in distributing information to potential participants. Characteristics of the potential participants have been provided in the information sheet. Any interested participants should be directed to contact the research team to discuss participation further.

All information collected from you during the study will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation.

Please initial to confirm your understanding of the study and that you are happy to be involved in the role of a gatekeeper.

Please initial box

1. I confirm that I have read and understand the gatekeeper information sheet dated 23/05/2024 version 1.4 provided for the above study.	
2. I confirm that I have understood the gatekeeper information sheet dated 23/05/2024 version 1.4 for the above project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
3. I understand that my participation as a gatekeeper is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect legal rights	
4. I agree to not coerce or in any way convince potential participants to take part in the study.	
5. I agree to distribute the information provided to potential hub coordinators at the timeframe stated in the gatekeeper information sheet and that none of the documents will be modified in anyway.	
6. I understand that any personal information collected during the study will be de-identified and remain confidential.	

Name of Gatekeeper:

Date:

Signature:

Name of Researcher:

Date:

Signature:

Name of Person taking consent:
(if different from researcher)

Date:

Signature:

Primary Gatekeeper Reminder Letter

* Reminder

Dear XXXX,

I'm sorry for bothering you. You probably remember that I contacted you 2 weeks ago about being a gatekeeper of a study undertaken as a part of my PhD project. I wonder if you had the opportunity to look into the details attached. A copy of the original email is below. I have attached another copy of the information sheet and a consent form.

I would really appreciate the time you have taken to consider this.

Thanks for your support.

Kind regards,
Sarah

Dear XXXX,

I hope you are doing well.

We have met previously at multiple meetings and had a chat about my project around out-of-hours (OOH) prescribing. As we recently discussed, my current project aims to explore the decision-making process of prescribers of the different professions working in primary care OOH settings, particularly in 111 clinical support hubs across Wales, when prescribing antibacterial drugs. The project also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

In order to achieve this we are aiming to recruit general practitioners (GPs) and pharmacist independent prescribers who completed their training portfolio/probation periods, or at least 30 hours of their training working in NHS 111 clinical support hubs outside the regular working hours across Wales. We would like to therefore ask for your support in getting in touch with these individuals, by forwarding information to the 111 clinical support hub coordinators to request their permission to act in the capacity of direct gatekeepers to the potential participants. It is the coordinators who will then contact the participants on my behalf. The project has been reviewed and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee and registered/granted permission by the R&D at Betsi Cadwaladr University Health Board (BCUHB) so far, one of the HB overseeing NHS 111 service across all Wales.

If you would be willing to consider this, please read the attached information sheet which outlines exactly what you are being asked to do and when. All involvement as a gatekeeper throughout the study should take less than an hour of your time.

Please contact me on my email ([REDACTED]) if you have any questions about this request.

Your sincerely
Sarah

Appendix 6.4. Direct Gatekeeper Documentation

Direct Gatekeeper Invitation Letter

Title of Project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

Name of Researcher and location of researcher: Sarah Al Hussain.

Supervisors: Rhian Deslandes, Karen Hodson.

Cardiff University School of Pharmacy and Pharmaceutical Sciences (Part of a PhD project)

Dear hub coordinator,

I hope you are doing well.

You are invited to assist with a PhD project around out-of-hours (OOH) prescribing carried out by a research team in the School of Pharmacy and Pharmaceutical Sciences at Cardiff University. The project aims to explore the decision-making process of prescribers of the different professions working in primary care OOH settings, particularly in 111 clinical support hubs across Wales, when prescribing antibacterial drugs. The project also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

In order to achieve this we are aiming to recruit general practitioners (GPs) and pharmacist independent prescribers who completed their training portfolio/probation periods, or at least 30 hours of their training in NHS 111 clinical support hubs, and currently working shifts in 111 clinical support hubs outside the regular working hours across Wales. We would like to therefore ask for your support in getting in touch with these individuals, by forwarding information to them on my behalf. The project has been reviewed and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee and registered/granted permission by the R&D at Betsi Cadwaladr University Health Board (BCUHB) so far, one of the HB overseeing NHS 111 service across all Wales.

If you would be willing to consider this, please read the attached information sheet which outlines exactly what you are being asked to do and when. All involvement as a gatekeeper throughout the study should take less than an hour of your time.

Please contact me on my email ([REDACTED]) if you have any questions about this request.

Your sincerely
Sarah

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Direct Gatekeeper Information sheet

Thank you for taking the time to read this information sheet.

You are being invited to assist in a study project. Before you decide whether or not to assist, it is important for you to understand why the study is being undertaken and what it will involve. Please take some time to read the following information carefully and discuss it with others, if you wish.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, specifically in NHS 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

This part of the project follows on from an earlier quantitative investigation of prescribing patterns of oral antibacterial drugs in Wales and qualitative exploration of lead and primary care antimicrobial pharmacists' views on prescribing in primary care and OOH services.

This study will be part of the doctoral thesis.

2. Why have I been invited to assist in the project?

You have been invited because, through your role as one of the NHS 111 clinical support hub coordinators in Wales, you have access to potential participants that we wish to approach to ask if they would like to take part in the project. We would therefore like to ask if you would be willing to act as a "gatekeeper". Without you passing on information on our behalf we would not be able to recruit relevant individuals.

3. Do I have to take part?

No, your role is entirely voluntary and it is up to you to decide whether or not to assist. If you decide to assist, we will discuss the study with you and ask you to sign a gatekeeper consent form. If you decide not to assist, you do not have to explain your reasons and it will not affect your legal rights. You are free to withdraw the consent for your role in the project at any time, without giving a reason, even after signing the consent form.

4. What will taking part involve?

We would like to ask you to act in the capacity of a gatekeeper by forwarding information to potential participants on our behalf. The individuals who are suitable to take part are prescribers, either GPs and pharmacist independent prescribers, working shifts in OOH services, particularly in 111 clinical support hubs across Wales who completed their training portfolio/probation periods, or at least 30 hours of their training in NHS 111 clinical support hubs. The project will involve the participants being interviewed individually to gain insights into the decision-making process when prescribing antibacterial drugs within primary care OOH (in 111 clinical support hubs) in Wales, and identify available resources within these settings and strategies used to support appropriate prescribing practices. We ask that you only forward the details of the project to them, which includes, an advert, the invitation email, information sheet, and consent form. Please do not amend any of these documents or provide further information. If you agree to assist, we will provide these as soon as possible once we successfully obtain the required permission to conduct the study from the relevant Research and Development departments to please forward them to the potential participants. You must not coerce or instruct the individuals to participate, it is entirely their own decision. If they would like to participate they will be asked to contact the researcher directly on the contact details provided (i.e. you will not need to pass information back to us). You must not provide us with any information related to the individual or attempt to answer any questions they might ask you about the project – they should contact the research team directly. We would also like you to forward a reminder (all documentation will be provided to you) 2 weeks after the initial contact. All involvement should take no more than an hour of your time.

5. Will I be paid for taking part?

No, your assistance will be entirely voluntary with no payment.

6. How will we use information about you?

We will need to use information from you for this research project.

This information will include your name, initials, and contact details (including your work email address). People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

All of your details, including your consent form, your name and email address, will be retained for a minimum period of 15 years in accordance with the University Records Retention Schedules

7. What are your choices about how your information is used?

- You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.
- We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

8. Where can you find out more about how your information is used?

You can find out more about how we use your information:

- by speaking with the PhD student (Sarah Al-Hussain) or Sarah's supervisors
- by reviewing the Cardiff University Data Protection Policy: <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

by contacting the University Data Protection by email: [REDACTED] or in writing to: Data Protection Officer, Compliance and Risk, University Secretary's Office, Cardiff University McKenzie House, 30-36 Newport Road Cardiff CF24 0DE

9. What if there is a problem?

If you have any concerns or complaints about the project, please contact Prof. Karen Hodson, the academic supervisor on [REDACTED], who will address the issue. If you remain unhappy and wish to complain formally, you can do this by contacting the Director of Research, at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED].

10. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, Dr. Rhian Deslandes Prof. Karen Hodson, School of Pharmacy and Pharmaceutical Sciences in Cardiff University. The project is funded by *Saudi Arabia Cultural Bureau* in the UK.

11. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee, Cardiff University and registered/granted permission has been obtained by the Research and Development (R&D) at Aneurin Bevan University Health Board (ABUHB), Swansea Bay University Health Board (SBUHB), and Betsi Cadwaladr University Health Board (BCUHB), overseeing NHS 111 service hubs across all Wales..

12. Further information and contact details

Should you have any questions relating to this study, you may contact myself/us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue

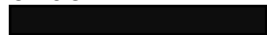
Cardiff
CF10 3NB



Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB



Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB



Thank you for considering assisting us in this project. If you decide to help out, you will be given a copy of the Gatekeeper Information Sheet and a signed consent form to keep for your records.



Direct Gatekeeper Consent Form

Title of project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

SREC reference and committee: 2324-16, Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Name of Principal Investigator: Sarah Al Hussain
Supervisors: Rhian Deslandes, Karen Hodson

This project aims to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, particularly in 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices. If you are willing to assist in this study, we will ask for your support in distributing information to potential participants. Characteristics of the potential participants have been provided in the information sheet. Any interested participants should be directed to contact the research team to discuss participation further.

All information collected from you during the study will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation.

Please initial to confirm your understanding of the study and that you are happy to be involved in the role of a gatekeeper.

Please initial box

1. I confirm that I have read and understand the gatekeeper information sheet dated 23/05/2024 version 1.2 provided for the above study.	
2. I confirm that I have understood the gatekeeper information sheet dated 23/05/2024 version 1.2 for the above project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
3. I understand that my participation as a gatekeeper is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect legal rights.	
4. I agree to not coerce or in any way convince potential participants to take part in the study.	
5. I agree to distribute the information provided to potential participants at the timeframe stated in the gatekeeper information sheet and that none of the documents will be modified in anyway.	
6. I understand that any personal information collected during the study will be de-identified and remain confidential.	

Name of Gatekeeper:
Name of Researcher:
Name of Person taking consent:
(if different from researcher)

Date:
Date:
Date:

Signature:
Signature:
Signature:

Direct Gatekeeper Reminder Letter

* Reminder

Dear hub coordinator,

I'm sorry for bothering you. We have contacted you 2 weeks ago about being a gatekeeper of a service evaluation undertaken as a part of a PhD project by a research team at Cardiff University. We wonder if you had the opportunity to look into the details attached. A copy of the original email is below. I have attached another copy of the information sheet and a consent form.

We would really appreciate the time you have taken to consider this.

Thanks for your support.

Kind regards,

Dear hub coordinator,

I hope you are doing well.

You are invited to assist with a PhD project around out-of-hours (OOH) prescribing carried out by a research team in the School of Pharmacy and Pharmaceutical Sciences at Cardiff University. The project aims to explore the decision-making process of prescribers of the different professions working in primary care OOH settings, particularly in 111 clinical support hubs across Wales, when prescribing antibacterial drugs. The project also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

In order to achieve this we are aiming to recruit general practitioners (GPs) and pharmacist independent prescribers who completed their training portfolio/probation periods, or at least 30 hours of their training in NHS 111 clinical support hubs, and currently working shifts in 111 clinical support hubs outside the regular working hours across Wales. We would like to therefore ask for your support in getting in touch with these individuals, by forwarding information to them on my behalf. The project has been reviewed and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee and registered/granted permission by the R&D at Betsi Cadwaladr University Health Board (BCUHB) so far, one of the HB overseeing NHS 111 service across all Wales.

If you would be willing to consider this, please read the attached information sheet which outlines exactly what you are being asked to do and when. All involvement as a gatekeeper throughout the study should take less than an hour of your time.

Please contact me on my email ([REDACTED]) if you have any questions about this request.

Your sincerely
Sarah

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Appendix 6.5. Email Reply After Targeted Number Reached

Dear [Healthcare Professional],

Thanks for reading the letter and offering your time for our interview project.

As outlined in the participant information sheet provided earlier, we were seeking a specific number of individuals to be interviewed, and I regret to inform you that we have now successfully recruited a sufficient number of participants.

Thank you once again for your interest. We appreciate your support.

Kind regards,
Sarah

Appendix 6.6. Email in Response to Those Approaching While Still in Training

Dear [Healthcare Professional],

Thanks for reading the letter and offering your time for our interview project.

As outlined in the participant information sheet provided earlier, we are specifically looking for individuals who have longer experience in OOH settings i.e., no longer in the training period, to be interviewed. Unfortunately, as you are within this category, we regret to inform you that you do not currently meet our inclusion criteria.

Thank you once again for your interest. We appreciate your support.

Kind regards,
Sarah

Appendix 6.7. Participant Documentation

Participant Invitation Letter

Subject:

Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation – an invitation to participate in a study

Content:

Dear Healthcare Professional,

You are invited to participate in an interview-based study carried out by Sarah Al Hussain, a PhD student and supervised by Dr Rhian Deslandes and Prof. Karen Hodson at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University, as part of a PhD project. The study is about exploring your decision-making process when prescribing antibacterial drugs in primary care out-of-hours (OOH) settings. It will also identify potential factors influencing your antibacterial prescribing decision, available resources within these settings, and strategies used to support appropriate prescribing practices. It is anticipated that your participation would enrich the PhD thesis overall and inform the direction of future research in this area.

Please find attached the study advert, along with a consent form and a participant information sheet for further details. It would be interesting to hear from you about your experience working in OOH services, specifically NHS 111 clinical support hubs. This will entail a brief interview, conducted either face-to-face or online, anticipated to last for 60 minutes and can be conducted at a time and place convenient for you.

If you require any additional information before making a decision to participate, feel free to contact us at this email address ([REDACTED]), and we will be happy to discuss any questions/concerns you may have. If you would like to take part in the study, please fill/sign the consent form and send it back to this email ([REDACTED]) to arrange a mutually convenient date, time, and venue for an interview.

Your participation would be highly valued.

Yours sincerely,

Participant Information Sheet

Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

You are being invited to take part in a study project. Before you decide whether or not to take part, it is important for you to understand why the study is being undertaken and what it will involve. Please take time to read the following information carefully and discuss it with others, if you wish.

Thank you for reading this.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the experience and decision-making process among prescribers, including general practitioners (GPs) and pharmacist independent prescribers of different professional groups if applicable, when prescribing oral antibacterial drugs in primary care during OOH periods, specifically in NHS 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

This project will be part of a doctoral thesis which follows on from an earlier quantitative investigation of prescribing patterns of oral antibacterial drugs in Wales and qualitative exploration of lead and primary care antimicrobial pharmacists' views on prescribing in primary care and OOH services.

2. Why have I been invited to take part?

You have been invited because you are one of the healthcare professionals (GPs or pharmacist independent prescribers) in Wales who have past or current experience in OOH services in particular, through NHS 111 clinical support hubs, and completed your training portfolio/probation periods, or at least 30 hours of your training working in NHS 111 clinical support hubs outside the regular working hours. We believe that sharing your experience and decision-making process when prescribing antibacterial drugs outside the normal working hours will be of value, as they will enable us to understand any factors or challenges that may influence your prescribing decisions and identify available resources of use in OOH. In addition, they will enable us to gain insight into their potential needs in order to promote rational prescribing of oral antibacterial drugs in these settings. Please do not identify individual patients. We kindly request you to focus on general principles and your approach in prescribing decision-making.

We are recruiting a specific number (n=12) of healthcare professionals. If, by the time you respond to this invitation, we have already reached 12 participants, we will inform you and extend our appreciation for offering your time. If you have not completed at least 30 hours of your training, you do not meet our inclusion criteria.

3. Do I have to take part?

No, your participation in this study project is entirely voluntary and it is up to you to decide whether or not to take part. If you decide to take part, we will discuss the project with you and ask you to sign a consent form. If you decide not to take part, you do not have to explain your reasons and it will not affect your legal rights.

You are free to withdraw your consent to participate in the project at any time, without giving a reason, even after signing the consent form. However, withdrawal of consent will not be possible once the transcripts have been de-identified.

4. What will taking part involve?

Taking part in the study will involve a one-to-one interview with the researcher (Sarah). The interview will be conducted either face-to-face or online via Microsoft Teams, based on preference and geographical location. The time and place of the interview will be scheduled at the convenience of each participant. You will be interviewed once, and the interview is expected to last for approximately 60 minutes. The interview will be audio

recorded by the researcher using a digital recording device for in-person interviews and will be held in a quiet meeting room at your workplace or Cardiff University, School of Pharmacy and Pharmaceutical Sciences, Redwood building. Recorded interviews will be transferred to the researcher's OneDrive as soon as possible and deleted from the recording device. For virtual interviews, a new Team page will be created, and you will receive an invitation to a meeting within this Team for the interview, which will be recorded with your consent. Once the interviews end, the recordings will be saved in OneDrive managed by the researcher and made accessible to the project supervisors only. Both audio and video will be recorded; however, you will have the flexibility to have your camera on or off. If you prefer to switch your camera off, only the audio will be recorded. It is also advisable to stay in a quiet room in order to minimise distractions, preferably one where only the participant is present. Each interview recording, in-person or virtual, will be given pseudonyms and numbers to maintain confidentiality, privacy, and anonymity.

The interview questions will be shared with you one week before your scheduled interview to go over and consider your responses. We do not expect you to email or provide a response before the interview. If you do not feel comfortable answering any of the questions, you may skip them in the interview. However, there will be no sensitive questions asked during the interview. The interviews will be transcribed and analysed by the researcher. All data obtained during the interview is confidential and will be protected and de-identified. The interview procedure will be clearly explained to you prior to the commencement of the interviewing process.

Before deciding to take part, we would like to provide you with an opportunity to ask any questions about the project and your participation. If you agree to be involved in the study, you will need to complete the consent process either by electronically signing the consent form or printing, signing, scanning, and returning the signed document to the researcher via email using the contact information provided below.

You are also encouraged to suggest and share the project information with other potential participants in the same situation as yours. Those individuals are either GP or pharmacist independent prescribers working in NHS 111 clinical support hubs OOH in Wales and completed their training or at least 30 hours of training in these settings. Please do not pass other potential participants' information to the researcher without their consent. You must not provide us with any information related to the individual or attempt to answer any questions they might ask you about the project – they should contact the research team directly. You must not coerce or instruct the individuals to participate, it is entirely their own decision. If they would like to participate they will be asked to contact the researcher directly on the contact details provided (i.e. you will not need to pass information back to us).

5. Will I be paid for taking part?

No. You should understand that any data you give will be as a gift and you will not benefit financially in the future should this project lead to the development of a new treatment/method/test/assessment.

6. What are the possible benefits of taking part?

There will be no direct advantages or benefits to you from taking part, but your contribution will help us understand antibacterial drug prescribing decision-making process and what could possibly influence the prescribing of these drugs within OOH services. Your input may also inform future research planning and development.

7. What are the possible risks of taking part?

Your participation in the study does not involve any risk. You may choose not to answer certain questions if you feel uncomfortable.

8. Will my taking part in this research project be kept confidential?

All information collected from (or about) you during the project will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation. Please see 'What will happen to my Personal Data?' (below) for further information.

9. How will we use information about you?

We will need to use information from you for this research project.

This information will include your name, initials, contact details (including your work email address) and your place of work. People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

10. What are your choices about how your information is used?

- You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.
- We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

11. Where can you find out more about how your information is used?

You can find out more about how we use your information:

- by speaking with the PhD student (Sarah Al-Hussain) or Sarah's supervisors
- by reviewing the Cardiff University Data Protection Policy: <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>
- by contacting the University Data Protection by email: [REDACTED] or in writing to: Data Protection Officer, Compliance and Risk, University Secretary's Office, Cardiff University McKenzie House, 30-36 Newport Road Cardiff CF24 0DE

12. What happens to the data at the end of the research project?

According to the University Records Retention Schedule, the collected data will be kept for a minimum of 15 years following the completion of the project. Data will be stored on Cardiff University OneDrive, a supported and secured online server, with password-protected files on a password-protected computer. Control and access to all data will be restricted to the researcher and the supervisory team.

13. What will happen to the results of the research project?

The study will be part of a thesis that will be submitted for a Doctor of Philosophy in Pharmacy and Pharmaceutical Sciences degree. It is also our intention to publish the results of this study in academic journals and present findings at conferences. Participants will not be identified in any report, publication, or presentation. We may use verbatim quotes from participants. The findings of the study will be discussed with other key stakeholders once all names and any identifying information have been de-identified. A summary of the study will be provided to the participants upon request.

14. What if there is a problem?

If you wish to complain, or have grounds for concerns about any aspect of the manner in which you have been approached or treated during the course of this study, please contact Prof. Karen Hodson, the academic supervisor, on the contact details below. If your complaint is not managed to your satisfaction, please contact the Director of Research at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED].

If you are harmed by taking part in this project, there are no special compensation arrangements. If you are harmed due to someone's negligence, you may have grounds for legal action, but you may have to pay for it.

15. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, PhD student; Dr. Rhian Deslandes; and Prof. Karen Hodson, the academic supervisors at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University in Cardiff University. The study is currently funded by *Saudi Arabia Cultural Bureau* in the UK.

16. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee (SREC), Cardiff University and permission has been obtained from the Research and Development (R&D) offices at Aneurin Bevan University Health Board (ABUHB), Swansea Bay University Health Board (SBUHB), and Betsi Cadwaladr University Health Board (BCUHB), overseeing NHS 111 clinical support hubs across all Wales.

17. Further information and contact details

Should you have any questions relating to this project, you may contact us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]
Tel: [REDACTED]

Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]
Tel: [REDACTED]

Thank you for considering to take part in this project. If you decide to participate, you will be given a copy of the Participant Information Sheet and a signed consent form to keep for your records.



Participant Consent Form

Title of project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

SREC reference and committee: 2324-16, Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee.

Name of Chief/Principal Investigator: Sarah Al Hussain

Supervisors: Rhian Deslandes, Karen Hodson

	Please initial box
1. I confirm that I have read the information sheet dated 23/05/2024 version 2.0 for the above study.	
2. I confirm that I have understood the information sheet dated 23/05/2024 version 2.0 for the above study and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
3. I confirm that I am happy for the researcher to send me the interview questions for the above study prior to the scheduled interview for me to consider and have the opportunity to ask questions.	
4. I understand that my participation is voluntary and I am free to withdraw at any time without giving a reason and without any adverse consequences (e.g. to medical care or legal rights, if relevant), but up until the point of de-identification. I understand that if I withdraw, information about me that has already been obtained may be kept by Cardiff University.	
5. I consent to the processing of my personal information including my name and work email address for the purposes explained to me. I understand that such information will be held in accordance with all applicable data protection legislation and in strict confidence, unless disclosure is required by law or professional obligation.	
6. I understand who will have access to personal information provided, how the data will be stored and what will happen to the data at the end of the project.	
7. I consent to being audio recorded for the purposes of the project and I understand how it will be used in the study.	
8. For virtual interviews via Microsoft Teams, I consent for my interview to be video recorded for the purposes of the project and I understand how it will be used in the study.	
9. I understand that de-identified excerpts and/or verbatim quotes from my interview may be used as part of the study publication.	
10. I understand how the findings and results of the study will be written up and published.	
11. I agree to take part in this study.	

Name of participant (print)

Date

Signature

Name of person taking consent (print)

Date

Signature

Role of person taking consent (print)

**THANK YOU FOR PARTICIPATING IN OUR STUDY
YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP**



Decision-making process when prescribing antibacterial drugs in out-of-hours settings:

An exploration of the decision-making process, challenges and strategies associated with antibacterial drug prescribing in out-of-hours settings.

We are inviting you as **a GP or pharmacist independent prescriber who has experience in primary care out-of-hours settings, particularly in 111 clinical support hubs** to take part in an interview

* We are interested in exploring your perspectives on:

- Factors influencing your decision-making process
- Available resources and strategies used to support your decisions

* Taking part will involve:

- A one-on-one interview, either online or face-to-face
- Last for 60 minutes, audio and/or video-recorded

For more information or if you are interested in participating, please contact Sarah Al Hussain at Cardiff University, School of Pharmacy and Pharmaceutical Sciences: [REDACTED]

Participant Reminder Letter

Subject:

Reminder Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation – an invitation to participate in a study

Content:

* Reminder

Note: Please ignore this email if you have already responded to the previous email

Dear Healthcare Professional,

We are sorry for bothering you. We understand that you are busy. We sent you an invitation letter 2 weeks ago to consider participating in an interview-based study related to decision-making when prescribing antibacterial drugs in Wales primary care OOH services, specifically NHS 111 clinical support hubs. As we have not heard back from you, we wonder whether you had the opportunity to look into the details attached. A copy of the original email is below. I have attached another copy of the information sheet and a consent form.

I would really appreciate the time you have taken to consider our request.

Thank you for your help.

Kind regards,

Sarah

Content:

Dear Healthcare Professional,

You are invited to participate in an interview-based study carried out by Sarah Al Hussain, a PhD student and supervised by Dr Rhian Deslandes and Prof. Karen Hodson at the School of Pharmacy and Pharmaceutical Sciences, Cardiff University, as part of a PhD project. The study is about exploring your decision-making process when prescribing antibacterial drugs in primary care out-of-hours (OOH) settings. It will also identify potential factors influencing your antibacterial prescribing decision, available resources within these settings, and strategies used to support appropriate prescribing practices. It is anticipated that your participation would enrich the PhD thesis overall and inform the direction of future research in this area.

Please find attached the study advert, along with a consent form and a participant information sheet for further details. It would be interesting to hear from you about your experience working in OOH services, specifically NHS 111 clinical support hubs. This will entail a brief interview, conducted either face-to-face or online, anticipated to last for 60 minutes and can be conducted at a time and place convenient for you.

If you require any additional information before making a decision to participate, feel free to contact us at this email address ([REDACTED]), and we will be happy to discuss any questions/concerns you may have. If you would like to take part in the study, please fill/sign the consent form and send it back to this email ([REDACTED]) to arrange a mutually convenient date, time, and venue for an interview.

Your participation would be highly valued.

Yours sincerely,

Appendix 6.8. CSPPS-REC 2nd Amendment Approval

SPPS Amendment Approval Notification (AAN)

11/10/14 v1

Cardiff School of Pharmacy and Pharmaceutical Sciences, Research Ethics Approval

AMENDMENT APPROVAL

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for amendment(s) to the following study:

Project ref and title:	<u>2324-16: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.</u>

Name of researcher: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

The amendment(s) dated 2nd May 2024 have been reviewed and approved.

Any further amendments will require approval.

STATEMENT OF ETHICS APPROVAL

The proposed amendment(s) have been considered and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 21/05/2024
(Deputy Chair, School Research Ethics Committee)

Appendix 6.9. Study Advert

Study Advert – English

“Is there any doctor or pharmacist here working out-of-hours, specifically in NHS 111 hubs for at least 30 hours? Could you help with our study? Please read the attached.”

**Call for Participants**



Decision-making when prescribing antibacterial drugs in NHS 111 out-of-hours

Are you a doctor or a pharmacist independent prescriber working for NHS 111 clinical support hubs out-of-hours in Wales? Have you worked for at least 30 hours in NHS 111 hubs? You are invited to take part in the study!

Working in NHS 111 clinical support hubs outside regular hours may pose challenges for prescribers not encountered during standard working hours, especially when prescribing antibacterial drugs. Little is known about the decision-making processes used by prescribers in out-of-hours services in Wales.

*** We are interested in exploring your perspectives on:**

- Factors influencing your decision-making process in these settings
- Available resources, challenges and strategies used to support your decisions

*** Taking part will involve:**

- A one-on-one interview, either online or face-to-face
- Last up to 60 minutes, audio and/or video-recorded
- Date, time and location of convenience to participant

For more information or if you are interested in participating, please contact Sarah Al Hussain at Cardiff University, School of Pharmacy and Pharmaceutical Sciences: [REDACTED]

Study Advert – Welsh

A oes fferylllydd yn gweithio y tu allan i oriau gwaith am o leiaf 30 awr - yn benodol yng nghanolfannau GIG 111? Fedrwch chi helpu gyda'n hastudiaethau? Darllenwch y linc wedi'i atodi



Galwad i bobl gymryd rhan



Gwneud penderfyniadau wrth ragnodi cyffuriau gwrthfacterol yn GIG 111 y tu allan i oriau gwaith

Ydych chi'n feddyg neu'n fferylllydd-bresgripsiynydd annibynnol sy'n gweithio i ganolfannau cymorth clinigol GIG 111 y tu allan i oriau gwaith yng Nghymru? Ydych chi wedi gweithio am o leiaf 30 awr mewn canolfannau GIG 111? Fe'ch gwahoddir i gymryd rhan yn yr astudiaeth!

Gall gweithio mewn canolfannau cymorth clinigol GIG 111 y tu allan i oriau gwaith rheolaidd achosi heriau i bresgripsiynwyr nad ydyn nhw'n cael eu gweld yn ystod oriau gwaith safonol, yn enwedig wrth ragnodi cyffuriau gwrthfacterol. Ychydig iawn sydd i wybod am y broses gwneud penderfyniadau a ddefnyddir gan bresgripsiynwyr mewn gwasanaethau y tu allan i oriau gwaith yng Nghymru.

*** Mae diddordeb gyda ni mewn ymchwilio i'ch safbwyntiau ar y canlynol:**

- Ffactorau sy'n dylanwadu ar eich proses gwneud penderfyniadau yn y lleoliadau hyn
- Yr adnoddau sydd ar gael, heriau a strategaethau a ddefnyddir i gefnogi eich penderfyniadau

*** Bydd cymryd rhan yn golygu:**

- Cyfweliad un i un, naill ai ar-lein neu wyneb yn wyneb
- Mi fydd yn para hyd at 60 munud, sain a / neu dros fideo wedi'i recordio
- Dyddiad, amser a lleoliad sydd yn gyfleus i'r unigolyn

Am ragor o wybodaeth neu os oes diddordeb gyda chi mewn cymryd rhan, cysylltwch â Sarah Al Hussain ym Mhrifysgol Caerdydd, Ysgol Fferylliaeth a Gwyddorau Fferyllol: [REDACTED]

Appendix 6.10. Contact Reply Regarding Reposting Advert

Hi Sarah,

I've reposted it on Twitter but we wouldn't add it again on Facebook (we very rarely post this sort of content). I don't think it's the right audience for you anyway.

Thinking about it, Dai Joh runs a facebook group for past students so you could try asking him if he would mind posting it on there as that's probably a far more suitable audience for you.

Thanks,

Appendix 6.11. CSPPS-REC 3rd Amendment Approval

SPPS Amendment Approval Notification (AAN)

11/10/14 v1

**Cardiff School of Pharmacy and Pharmaceutical Sciences,
Research Ethics Approval**

AMENDMENT APPROVAL

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for amendment(s) to the following study:

Project ref and title:	<u>2324-16: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.</u>

Name of researcher: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

The amendment(s) dated 23rd May 2024 have been reviewed and approved.

Any further amendments will require approval.

STATEMENT OF ETHICS APPROVAL

The proposed amendment(s) have been considered and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 05/06/2024
(Deputy Chair, School Research Ethics Committee)

Appendix 6.12. Additional Gatekeeper Email on Recruitment Strategy

Hi Sarah,

Apologies for the delay in response, hope all is well.

I was unaware of the challenges you had for approvals within ABUHB, if you had flagged I could have picked-up directly within my current role.

I think you have approached the recruitment in the right way but there are challenges of getting commitment from the workforce in this area as essentially a “Locum” type workforce that is more transient and without financial incentive it can be challenging to persuade them to give up their time. I was thinking that you could be added (or a post could be put in) the two 111 pharmacist WhatsApp groups (North and South) to try and recruit more pharmacists but also could try and get a slot on the Health Boards OOHs Clinical Reference Group agendas to raise awareness and seek recruitment.

Happy to facilitate those options if something that might be helpful (on the second point I would only be able to influence ABUHBOOHS CRG).

Thanks,

Appendix 6.13. Additional Gatekeeper Documentation



Additional Gatekeeper Information Sheet

Thank you for taking the time to read this information sheet.

You are being invited to assist in a study project. Before you decide whether or not to assist, it is important for you to understand why the study is being undertaken and what it will involve. Please take some time to read the following information carefully and discuss it with others, if you wish.

1. What is the purpose of this research project?

Inappropriate use and prescribing of antibacterial drugs have been linked to the growing issue of antimicrobial resistance worldwide. Understanding the current situation in Wales in terms of prescribing oral antibacterial drugs may contribute in some way to developing antimicrobial stewardship initiatives. This is particularly important in primary care, where a considerable proportion of prescribing occurs, and specifically during out-of-hours (OOH) periods where little is known about prescribing practices.

The aim is to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, specifically in NHS 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices.

This part of the project follows on from an earlier quantitative investigation of prescribing patterns of oral antibacterial drugs in Wales and qualitative exploration of lead and primary care antimicrobial pharmacists' views on prescribing in primary care and OOH services.

This study will be part of the doctoral thesis.

2. Why have I been invited to assist in the project?

You have been invited because, through your role as a director of primary care and community services in Wales, you have access to potential participants that we wish to approach to ask if they would like to take part in the project. We would therefore like to ask if you would be willing to act as a "gatekeeper". Without you passing on information on our behalf we would not be able to recruit relevant individuals.

3. Do I have to take part?

No, your role is entirely voluntary and it is up to you to decide whether or not to assist. If you decide to assist, we will discuss the study with you and ask you to sign a gatekeeper consent form. If you decide not to assist, you do not have to explain your reasons and it will not affect your legal rights. You are free to withdraw the consent for your role in the project at any time, without giving a reason, even after signing the consent form.

4. What will taking part involve?

We would like to ask you to act in the capacity of a gatekeeper by posting information to potential participants on our behalf. The individuals who are suitable to take part are prescribers, either GPs and pharmacist independent prescribers, working shifts in OOH services, particularly in 111 clinical support hubs across Wales who completed their training portfolio/probation periods, or at least 30 hours of their training in NHS 111 clinical support hubs. The project will involve the participants being interviewed individually to gain insights into the decision-making process when prescribing antibacterial drugs within primary care OOH (in 111 clinical support hubs) in Wales, and identify available resources within these settings and strategies used to support appropriate prescribing practices. We ask that you only post the details of the project to them in two NHS 111 pharmacists WhatsApp groups, which include, an invitation and an advert. Please do not amend any of these or provide further information. If you agree to assist, we will provide these as soon as possible once we successfully obtain the required permission to conduct the study from the relevant Research and Development departments to please forward them to the potential participants. You must not coerce or instruct the individuals to participate, it is entirely their own decision. If they would like to participate they will be asked to contact the researcher directly on the contact details provided (i.e. you will not need to pass information back to us). You must not provide us with any information related to the individual or attempt to answer any questions they might ask you

about the project – they should contact the research team directly. We would also like you to forward a reminder (invitation and an advert) 2 weeks after the initial contact. All involvement should take no more than an hour of your time.

5. Will I be paid for taking part?

No, your assistance will be entirely voluntary with no payment.

6. How will we use information about you?

We will need to use information from you for this research project.

This information will include your name, initials, and contact details (including your work email address). People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

All of your details, including your consent form, your name and email address, will be retained for a minimum period of 15 years in accordance with the University Records Retention Schedules

7. What are your choices about how your information is used?

- You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.
- We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

8. Where can you find out more about how your information is used?

You can find out more about how we use your information:

- by speaking with the PhD student (Sarah Al-Hussain) or Sarah's supervisors
- by reviewing the Cardiff University Data Protection Policy: <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

by contacting the University Data Protection by email: [REDACTED] or in writing to: Data Protection Officer, Compliance and Risk, University Secretary's Office, Cardiff University McKenzie House, 30-36 Newport Road Cardiff CF24 0DE

9. What if there is a problem?

If you have any concerns or complaints about the project, please contact Prof. Karen Hodson, the academic supervisor on [REDACTED], who will address the issue. If you remain unhappy and wish to complain formally, you can do this by contacting the Director of Research, at Cardiff School of Pharmacy and Pharmaceutical Sciences on [REDACTED].

10. Who is organising and funding this research project?

The study is organised by Sarah Al Hussain, Dr. Rhian Deslandes Prof. Karen Hodson, School of Pharmacy and Pharmaceutical Sciences in Cardiff University. The project is funded by *Saudi Arabia Cultural Bureau* in the UK.

11. Who has reviewed this research project?

This project has been reviewed and given a favourable opinion by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee, Cardiff University and registered/granted permission has been obtained by the Research and Development (R&D) at Aneurin Bevan University Health Board (ABUHB) through , Swansea Bay University Health Board (SBUHB), and Betsi Cadwaladr University Health Board (BCUHB), overseeing NHS 111 service hubs across all Wales.

12. Further information and contact details

Should you have any questions relating to this study, you may contact myself/us during normal working hours:

Sarah Al Hussain, PhD student
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Dr. Rhian Deslandes
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Prof. Karen Hodson
School of Pharmacy and Pharmaceutical Sciences, Cardiff University
Redwood Building
King Edward VII Avenue
Cardiff
CF10 3NB
[REDACTED]

Thank you for considering assisting us in this project. If you decide to help out, you will be given a copy of the Gatekeeper Information Sheet and a signed consent form to keep for your records.



Additional Gatekeeper Consent Form

Title of project: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.

SREC reference and committee: 2324-16, Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee.

Name of Principal Investigator: Sarah Al Hussain

Supervisors: Rhian Deslandes, Karen Hodson

This project aims to explore the experience and decision-making process among prescribers, including GPs and pharmacist independent prescribers, when prescribing oral antibacterial drugs in primary care during OOH periods, particularly in 111 clinical support hubs. The study also seeks to identify available resources within these settings and strategies used to support appropriate prescribing practices. If you are willing to assist in this study, we will ask for your support in posting information to potential participants. Characteristics of the potential participants have been provided in the information sheet. Any interested participants should be directed to contact the research team to discuss participation further.

All information collected from you during the study will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation.

Please initial to confirm your understanding of the study and that you are happy to be involved in the role of a gatekeeper.

Please initial box

1. I confirm that I have read and understand the gatekeeper information sheet dated 17/10/2024 version 1.0 provided for the above study.
2. I confirm that I have understood the gatekeeper information sheet dated 17/10/2024 version 1.0 for the above project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.
3. I understand that my participation as a gatekeeper is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect legal rights.
4. I agree to not coerce or in any way convince potential participants to take part in the study.
5. I agree to distribute the information provided to potential participants at the timeframe stated in the gatekeeper information sheet and that none of the documents will be modified in anyway.
6. I understand that any personal information collected during the study will be de-identified and remain confidential.

Name of Gatekeeper:

Date:

Signature:

Name of Researcher:

Date:

Signature:

Name of Person taking consent:
(if different from researcher)

Date:

Signature:

Appendix 6.14. CSPPS-REC 4th Amendment Approval

SPPS Amendment Approval Notification (AAN)

11/10/14 v1

**Cardiff School of Pharmacy and Pharmaceutical Sciences,
Research Ethics Approval**

AMENDMENT APPROVAL

This form has been signed by the School Research Ethics Officer as evidence that approval has been granted by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee for amendment(s) to the following study:

Project ref and title:	<u>2324-16: Exploring antibacterial prescribing decision-making in primary care out-of-hours settings: a qualitative interview investigation.</u>

Name of researcher: (PG/Staff projects only)	<u>Sarah Al Hussain</u>
Name of supervisor(s):	<u>Rhian Deslandes, Karen Hodson</u>

The amendment(s) dated 17th October 2024 have been reviewed and approved.

Any further amendments will require approval.

STATEMENT OF ETHICS APPROVAL

The proposed amendment(s) have been considered and approved by the Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee

Signed  Name M Ivory Date 14/11/2024
(Deputy Chair, School Research Ethics Committee)

Appendix 6.15. Interview Schedule

Introduction

Thanks for taking part in this study.

I am just checking to make sure you have read and signed the information sheet and the consent form and are still happy to participate. I would like to remind you that this interview will be recorded.

Before we start, let me give an overview of what we will discuss today. I am interested in exploring your experience working in primary care out-of-hours (OOH) services in Wales, especially when it comes to prescribing antibacterial drugs in 111. I would like to identify any factors that may influence your decision to prescribe an antibiotic, available resources, and strategies used to manage patients to support appropriate prescribing. So, there are no right or wrong answers.

Please DO NOT identify individual patients. We kindly request you to focus on general principles and your approach in prescribing decision-making.

Before we begin, is there anything you want to know?

I will start recording now. (if consent given: audio for face-to-face interviews; audio and video for online interviews)

Interview Schedule

Experience in OOH settings
• Could you please confirm your name, professional group, and the hub you work for? • Can you tell me about your experience working in OOH settings? - What settings? (e.g., 111 remotely, 111 hubs, others) - Opening time. - How many shifts do you usually work? (range) - Type of patients who consult you. - Conditions you frequently come across. - Who do you work with (professional team) • Do you have a current or past IH experience? <u>If yes:</u> - What settings? (e.g., GP surgeries or community pharmacy) - Opening time. - How many shifts do you usually work? (range) - Type of patients who consult you. - Conditions you frequently come across. - Who do you work with (professional team) • What is your decision-making process when deciding the best course of action for a patient generally? • What is your approach and what process do you go through to come to a decision to prescribe an oral antibacterial drug for a patient? - When working OOH (all participants) - When working IH (those with current or past IH experience) [if applicable, based on their answer to the question above] - What do you think are the differences in your approach when prescribing in OOH services compared to IH services? (those with current or past IH experience) - From your discussion with others such as colleagues, what might you perceive the differences to be? (those with OOH experience only)

Factors influencing antibacterial drug prescribing behaviour and decisions in OOH settings
• What factors influence your antibacterial drug prescribing decisions in OOH settings and why? - Patient factors - Previous history of condition factors - Environmental/organisational factors - Others • When you are uncertain or had difficulties in deciding whether to (or not) prescribe an antibacterial drug, how do you manage such situations working OOH? - How do you approach the concept of back-up (delayed or just in case) prescribing of antibacterial drugs? - If used, when do you consider it? • When do you consult colleagues (e.g., doctors or pharmacists) for advice during a consultation? - Patient factors - Resource factors - Reassurance - Others • Could you explain the difference, if there is one, between patient expectations of antibacterial prescriptions in OOH and IH services? - How do patients respond to not prescribing antibacterial in OOH services? - How do you manage that response?
Available resources to support prescribers' decisions in OOH services
• What sources of information or guidance do you use to support your antibacterial drug prescribing decisions? - OOH services (all participants) - IH services (those with current or past IH experience) - What is the difference, if any? (those with current or past IH experience) • Are you aware of any existing information sources or guidance that are used during IH services? (those with OOH experience only) • Are there any OOH-specific guidelines or protocols that you follow when prescribing these drugs? • Are there occasions where you do not follow the guidance when working OOHs? - If so, why? - Could you give an example of a situation? - What is your management approach if the guidance recommends a sample/ diagnostic test that is not feasible in OOH [e.g., midstream urine (MSU) if needed for urinary tract infection (UTI)]
Prescribers needs and strategies used to manage patients and support appropriate prescribing
• What do you think could be put in place to support prescribers to optimise antibacterial drug prescribing decision? • If any, what feedback do you receive on your antibacterial drug prescribing in OOH services? • What training or education sessions do you receive for OOH experience? - How do you think training/education should be delivered? - Who should deliver them? • What advice, if any, do you give patients when they ask for antibacterial drugs? • Can you tell me about strategies used in OOH to optimise antibacterial prescribing?

- E.g., Counselling and education, delayed prescribing, reflect on your practice, discuss your approaches with colleagues.
- How do you feel about it?
- What are your thoughts about the potential use of OOH-specific initiatives? (assuming there aren't any to start with)
 - Incentives
 - Specific guidance
 - Specific national prescribing indicators (NPIs)
 - Are there certain initiatives you have experience with within the HB for OOH?

Appendix 6.16. Proposed Self-Administered Questionnaire

Introduction:

This questionnaire aims to collect information on the factors that may influence prescribers' decision-making processes, specifically regarding antibacterial prescribing in NHS 111 clinical support hubs during out-of-hours (OOH) periods in Wales. Additionally, it aims to explore the strategies and resources used to support these decisions. Your responses will help understand challenges faced working in these settings and identify areas for improvement in prescribing practices.

• Demographic information

- Gender: ☐ Male ☐ Female ☐ Other ☐ Prefer not to say
- Professional role: ☐ GP ☐ Pharmacist
- Length of experience:
- In-hours experience: ☐ Secondary care ☐ Primary care ☐ Urgent care
☐ Community pharmacy ☐ None ☐ Other:
- Number of shifts/weekdays or weekends:
- NHS 111 transition portfolio: ☐ Completed ☐ In progress

• What process do you undertake when you pick up a call in the NHS 111 clinical support hubs?

.....

.....

.....

.....

.....

• What do you consider when deciding to prescribe antibacterial drugs? [Please check all that apply]

- ☐ Patient symptoms
- ☐ Patient history
- ☐ Laboratory tests
- ☐ Patient demand/request for antibacterial drug
- ☐ AMS principles
- ☐ Legal implications
- ☐ Guidelines
- ☐ Time and day
- ☐ Nature of the service
- ☐ Others (please specify):
-

• A patient with a presentation suggestive of UTI calls NHS 111, with local guidelines recommending obtaining a midstream urine (MSU) sample. Given that the NHS 111 hubs cannot perform urine dipsticks or culture and sensitivity testing, how would you manage this patient?

- ☐ Prescribe antibacterial drugs empirically
- ☐ Prescribe and over-the-counter (OTC) symptomatic relief medications only
- ☐ Refer to an out-of-hours (OOH) GP service
- ☐ Refer to other services
- ☐ It depends (please explain):
-
-
- ☐ Others (please specify):
-

• **What strategies and approaches do you use to enhance your decision-making in these settings?**
[Please check all that apply]

- ☐ Patient counselling and education
 - ☐ Prescribe to err on the side of caution when uncertain
 - ☐ Refer the patient to other services
 - ☐ Communication techniques
 - ☐ Prefer not to prescribe
 - ☐ Watchful waiting with proper safety netting
 - ☐ Offer delayed prescriptions
 - ☐ Discussing approaches with colleagues
 - ☐ Others (please specify):
-

• **In my clinical practice, I involve patients in the decision-making process when prescribing antibacterial drugs.**

- ☐ Always ☐ Often ☐ Sometimes ☐ Rarely ☐ Never

Please explain

.....

• **In my clinical practice, I involve other healthcare professionals when prescribing antibacterial drugs.**

- ☐ Always ☐ Often ☐ Sometimes ☐ Rarely ☐ Never

Please explain

.....

• **If applicable, when conducting a consultation with a patient about a possible infection, what education or guidance do you provide regarding the use or non-use of antibacterial drugs, and what factors guide your advice?**

.....

.....

.....

• **What are the main barriers that you face while working in NHS 111 clinical support hubs? [Please check all that apply]**

- ☐ Lack of sufficient time
- ☐ Time pressure
- ☐ Diagnostic uncertainty
- ☐ Fear of missing a serious diagnosis
- ☐ Lack of follow-up
- ☐ Self-reported symptoms
- ☐ Inability to see/examine patients
- ☐ Patient attitude
- ☐ Limitations to guidelines
- ☐ Lack of access to medical records
- ☐ Limited resources
- ☐ Patient pressure of expectations
- ☐ Others (please specify):

Please explain

.....

.....

• **What sources of information or guidance do you use to support your antibacterial drug prescribing decision in NHS 111 hubs during OOH periods? [Please check all that apply and indicate if any is specific to OOH settings]**

- ☐ Clinical guidelines (please specify):
- ☐ Peer discussions
- ☐ Online resources (please specify):.....
- ☐ Others (please specify):.....

• **What would help you improve your antibacterial prescribing practices in these settings? [Please check all that apply]**

- ☐ OOH specific guidelines
- ☐ Defined National Prescribing Indicators for OOH settings
- ☐ More education
- ☐ Diagnostic tools
- ☐ Decision support tools
- ☐ Incentives
- ☐ Regular feedback
- ☐ Peer support networks
- ☐ Access to electronic health records
- ☐ Additional training
- ☐ Others (please specify):
-

• **Are there occasions where you do not follow guidelines when working in NHS 111 during OOH periods?**

- ☐ No
- ☐ Yes (please explain why/when):.....
-

• **Do you receive feedback on your antibacterial drug prescribing practices in NHS 111 hubs during OOH periods?**

- ☐ No
- ☐ Yes (please describe its nature/how often):.....
-

Thank you for taking the time to complete this questionnaire. Your input is vital in helping us understand the practices and needs of prescribers in NHS 111 clinical support hubs in order to contribute to improving the decision-making process related to antibacterial drug prescribing.

Chapter 7 Appendices

Appendix 7.1. Triangulation Table

Table A7.8: Triangulation

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
1	Oral antibacterial prescribing has declined over time IH and OOH (significant reduction from the first and last year examined)	Consultations and oral antibacterial prescribing have increased over time, including during OOH periods	Positive changes in primary care prescribing trends (declining) as a collective effort to meet prescribing targets and support the UK NAP	
2	Prescribing patterns and reduction magnitude varied across HBs	Variations across HBs in number of consultations and prescriptions	Factors needed considerations and may explain HB variations (e.g., introduction times of the NHS 111 services, OOH logistics of supply, demographics: urban, rural, population comorbidities, and socioeconomic factors: deprivation, industrial settings)	
3	IH prescribing by NMIPs increased over time (cannot distinguish prescriber groups in OOH and conditions)	Number of consultations and prescriptions by PIPs increased with time, including during OOH periods		
4	OOH prescribing represented small proportion of Wales primary care over years compared to IH.	PIPS consultation increased predominantly during IH periods, with OOH consultations representing 6.5% of all consultations, resulting in resulted in 1,950 prescriptions (6.7% of all prescriptions), 772 of which resulted in oral antibacterials (39.4% of OOH).		
5	Oral antibacterial prescribing (both in IH and OOH) reached its lowest in 2020–21		COVID-19 impacted oral antibacterial prescribing, with mixed views	

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
6		Most patients consulting were self-referred to the service and would see a GP if PIPS was not available (All time: 90.8%; OOH: 63.9%; OOH with antibacterial drug prescribed: 53%)		
7		Adults, females represented the highest all and OOH consultation attendees and those received oral antibacterial items.		
8		CPIPs managed different conditions, with UTIs and Nitrofurantoin being the most common managed infective condition/prescription		PIPs frequently handled a wide range of inquiries, including infections, across the full range of presenting patients
9		Although many were referred, some treated conditions in OOH periods were outside the PIPS contact, e.g., chest infections, and dental-related conditions.		PIPs usually reflect on their role and competence to manage cases, referring patients when beyond their expertise
10		Of 14 prescribed 4Cs, 11 were appropriate, 3 were deemed against MicroGuide recommendations but two of these were based on GP OOH advice		PIPs were viewed as good prescribers who follow guidelines and demonstrate strong diagnostic reasoning

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
11			GAS outbreak increased prescribing demand, lowered thresholds, heightened public concern with media coverage, putting pressure on services	
12			Budget, supply, and shortages issues may cause AMS prescribing misalignments and forcing use of available drugs	Prescribers adjust choices based on patient needs, experience, tolerability, allergies, adherence (especially in children), and drug shortages
13			Concerns about insufficient AMR public awareness, and changing behaviour is needed to enhance AMS and accountability	
14			Patient demand and pressure may lead some prescribers to prescribe to manage workload and quickly conclude visits. Their demands /expectations drive them to seek OOH care, reinforcing the perception of OOH as a guaranteed source of antibacterials	Non-prescribing decisions is generally well-received, with only occasional challenges from individuals. Referral for examination may be used to manage expectations around unnecessary antibacterial requests if faced
15			- Challenges in collecting, analysing, and comparing OOH data due to system limitations and free-text entries. - Lack of comprehensive, quality data hinders assessment of prescribing appropriateness in primary care, especially in OOH, where free-text data complicates analysis and auditing	

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
16			Data limitations, such as lack of OOH denominators, demographic details, standard documentation, impede appropriate analysis and AMS interventions	
17			• Manual audits are limited, resource- and time-intensive • Detailed practice-level audits should complement prescribing data to understand and identify locations /prescribers who struggle and target them effectively	Lack of adequate feedback on prescribing practices, with some receiving no audits or formal evaluations at all. Need for feedback loops
18			Improved integration, data sharing, and communication between IH/OOH services are needed to align/optimize practices	
19			Clear, compelling data is key to developing and supporting AMS interventions, as data-driven approaches are more likely accepted	
20			Limited IH and OOH overlap creates gaps in communication, affecting coordinated AMS	
21			Factors that affect prescribing in OOH services: limited time, patient volume, limited patient records, remote consultations, perceived urgency, lack of continuity, unfamiliarity with patients	Prescribers reported unique challenges related to working in NHS 111 CSHs, e.g., limited diagnostics, urgency and patient mix, remote consultations without physical exams, logistical factors (e.g., pharmacy hours, weekends, patient location), availability of other services, and access to patient records/lab results

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
22			Pressures in OOH services often lead prescribers to opt for immediate prescribing rather than using AMS strategies, highlighted a need for better resources in OOH settings, including full patient records, microbiology advice, guidelines, diagnostics, and POCTs to support prescribing decisions	Working in NHS 111 CSHs doesn't change their clinical approach but requires adaptation to the challenges faced
23			OOH prescribers were perceived to adopt defensive prescribing, due to concern, uncertainty, and limited safety-netting, especially in weekends and post-midnight which may indicate more serious conditions needing antibacterials	Safety-netting advice is routinely provided to guide patients monitor symptoms and when/where to seek care. It serves as a strategy to avoid unnecessary prescribing by educating and reassuring patients
24			OOH teams are harder to gather and engage due to their irregular schedules (may hinder communication)	
25			Continuous AMS training and education across primary care, including OOH services, was suggested to improve prescribing, with refresher courses, digestible educational materials, shared learning through peer reviews and educational session	Peer reviews, case discussions, and educational sessions—whether NHS-led or external—were valued.
26			Expert-led training was recommended to ensure quality AMS education, reinforce treatment rationale, and address inappropriate prescribing	Expert-led training was appreciated as it refreshes prescribers' knowledge and provide ongoing education through real scenarios, especially in complex cases without clear cut

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
27			A need to strengthen undergraduate AMS education and support for junior HCPs	
28			Strong/supportive leadership is crucial to drive AMS, promote intervention uptake, strengthen accountability, and improve practices	
29			Collaborative, cross-sector engagement strengthens AMS activities by enabling experience sharing, informed decision-making, and bridging gaps	Interprofessional collaboration in MDTs supports GPs and PIPs in refining clinical decisions, with the hub structure fostering consultation, mutual support, and shared learning on complex cases - Informal learning (e.g., image reviews and discussion with colleagues)
30			Most were unaware of antibacterial prescribing practices and AMS initiatives tailored to OOH settings	Participants did not cite OOH specific interventions or guidance but acknowledge the usefulness of the same guidelines and resources available for all, and availability of training related to NHS 111 joining (e.g., telephone triage)
31			Electronic resources, e.g., those within TARGET (education and training, patient leaflets and counselling materials, videos, and auditing tools), and guidelines e.g., NICE and MicroGuide were appreciated as efficient, accessible, and up-to-date resources.	Evidence-based tools and guidelines (e.g., NICE, MicroGuide, CKS, BMJ, BNF Open, FeverPAIN) are valued for supporting prescribing decisions

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
32			The value of implementing AMS strategies in OOH including delayed prescribing was highlighted by some	Delayed prescribing was valued as a tool but with limited application due to the urgent nature where immediate actions often needed; might be rarely and selectively considered (e.g., fluctuating overnight symptoms in children)
33			Face-to-face consultations were suggested to inform decisions in OOH services, especially when considering prescribing, as physical exams can reveal issues missed remotely	• Participants felt confident managing common conditions but found differential diagnosis challenging in telephone consultations • Referrals are used when further assessment or specialist input is needed
34			Evaluating individual interventions is challenging due to limited time and resources, multitasking, overlapping strategies, delayed outcomes, and unclear reporting processes	
35			A successful intervention meets its goals, supports monitoring, ensures patient safety, remains simple and sustainable, secures stakeholder buy-in, and receives positive user feedback and recommendations	
36				OOH care is guided by clinical judgment and provisional diagnoses, balancing timely treatment of acute issues with the constraints of the setting's diagnostic capacity

Table A7.8: Triangulation (continued)

Finding	CASPA	PIPS	Stakeholder Interviews	NHS 111 CSHs Interviews
37				Limited diagnostics require empirical treatment, which may not change prescribing decision but can affect care if patients return with worsened symptoms and sterilised cultures.
38				Patient-centred approach is applied when making decisions, tailoring them to individual cases
39				Cases are assessed for remote management suitability
40				Referrals are often made for complex, high-risk, or vulnerable patients
41				Strong communication and strategies (e.g., advanced questioning, safety-netting, shared decision-making, avoiding assumptions about expectation) are essential for safe and effective prescribing, managing uncertainty, patient acceptance
42				Training on eliciting patient information would be beneficial in these settings
43			Positive incentive schemes and incentivising positive prescribing behaviour were suggested to drive changes, but current schemes do not extend to OOH services and (NPIs viewed positively by GPs)	NPIs overlook OOH care's complexity and patient mix, leading to unfair evaluations compared to IH; case-based prescribing reviews instead of numeric targets would be more appropriate