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Clinical outcomes following acute sore throat assessment at community pharmacy versus general practice: a retrospective, longitudinal, data linkage study

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Background: To date, no research has compared longer-term outcomes (antibiotic provision; re-consultations; hospital admissions for quinsy; cost-effectiveness) following presentation with acute sore throat at general practice (GP) versus newer, pharmacy-led services.

Methods: A retrospective, longitudinal cohort study of sore throat consultations between 1 November 2018 and 28 February 2020 either with the Wales pharmacy-led sore throat test and treat (STTT) service or with a healthcare professional at GP. Individual-level pharmacy consultation data from the national Choose Pharmacy IT application were securely uploaded to the Secure Anonymised Information Linkage Databank and linked to routinely collected, anonymized, population-scale, individual-level, anonymized health and administrative data.

Results: Of 72 736 index consultations, 6495 (8.9%) were with STTT and 66 241 (91.1%) with GP. Antibiotic provision at the index consultation was 1382 (21%) with STTT and 25 506 (39%) with GP [adjusted odds ratio (AOR), 0.30; 95% CI, 0.27 to 0.32]. Antibiotic provision within 28 days of index occurred in 1820 (28%) STTT and 26 369 (40%) GP consultations (AOR, 0.44; 95% CI, 0.41 to 0.47). GP re-consultation rate within 28 days of index date was 21% ($n=1389$) with STTT compared with 7.4% ($n=4916$) with GP (AOR, 3.8; 95% CI, 3.5 to 4.1). Coding limitations may lead to overestimates of GP re-consultations rates in the STTT group. Hospital admissions for quinsy were rare in both STTT ($n=20$, 0.31%) and GP ($n=274$, 0.41%) (AOR, 0.68; 95% CI, 0.43 to 1.1). STTT was less costly than consultation with GP.

Conclusions: The pharmacy-led STTT service is safe, cost-effective, and contributes to antimicrobial stewardship.

Introduction

Primary healthcare is a key component of all high-performing health systems, and when adequately delivered can reduce unnecessary hospital admissions and inappropriate emergency department use.[1] However, some primary care providers have experienced continually increasing workloads. In the UK for example, between 2007 and 2014, general practitioners experienced an increase of 12% in consultation rates, 7% in consultation time and 16% in overall workload.[2–4] This has prompted health systems to seek to shift care to alternative primary care services to rebalance workload, whilst maintaining access and

quality. Internationally, efforts to address increasing workload for general practitioners have included schemes to allow pharmacists to manage patients with minor illness, with an increasing number of community pharmacy services launching over the past decade in countries such as Canada, Australia and New Zealand.[5–7] In the UK, national schemes such as Pharmacy First in Scotland and the Common Ailment Service in Wales, allow community pharmacists to provide advice, treatment and referral (as appropriate), for a range of self-limiting and non-urgent health conditions.[8,9] In 2023, a similar Pharmacy First service for seven common infections was launched in England, as part of the delivery plan for recovering access to primary care.[10,11] Although pharmacy services can have huge benefits for the wider healthcare system (reducing general practitioner workload) and the people who use them (extended opening hours, no requirement for prebooked appointments), concerns have been raised anecdotally that allowing antibiotic supply from pharmacies could lead to increased inappropriate use and antimicrobial resistance (AMR).[12,13] However, to date there are no data to support these concerns.

Our previous work reported pilot and short-term evaluations of the NHS-funded sore throat test and treat (STTT) service in Wales.[14–19] STTT began in 2018 and enables pharmacists to identify the likelihood of group A *Streptococcus* (GAS) pharyngitis using FeverPAIN/Centor scores, verified by rapid antigen detection test (RADT) where appropriate. If indicated, antibiotics are supplied via a Patient Group Direction in accordance with national guidance. The service has been found to be safe and effective, with appropriate use of RADT and antibiotics, and to have a 100% probability of being cost-effective, at a threshold of £20 000 per quality-adjusted life year (QALY).[20] STTT has been shown to be highly acceptable to patients and community pharmacists.[15,16] However, longer-term outcomes (beyond the index consultation) have not been described or compared with outcomes following sore throat consultations with healthcare professionals at general practice (GP).

To address the lack of evidence for the effectiveness of pharmacy-led infection services, we used a unique data-linkage capability in Wales using multi-source data to, for the first time, examine the longer-term outcomes for patients accessing antibiotics without prescription through a pharmacist-led intervention in primary care. We used individually linked pharmacy, GP and hospital admission data to estimate the effect of the community pharmacy STTT service on antibiotic prescribing, patient outcomes and health service utilization.

Methods

Study design

We undertook a retrospective, longitudinal cohort study of patients aged 6 years or older who had a sore throat consultation between 1 November 2018 and 28 February 2020.

Data sources and participants

Digital Health and Care Wales (DHCW) extracted individual-level data for all STTT consultations in two health boards (organizations responsible for planning and delivering NHS services across a specified geographical area) from the national Choose Pharmacy IT application. These data were pseudonymized, securely uploaded to the Secure Anonymised Information Linkage (SAIL) databank, and individually linked to GP and hospital admission records. Individuals who consulted with the STTT service in a community pharmacy comprised the exposed group. We used the Wales Longitudinal GP (WLGP) data to create a control group of unexposed patients who consulted with a healthcare professional in GP with a sore throat in the same two health boards, without any STTT record in Choose Pharmacy. Patients in both groups were Welsh residents and had to have had continuous WLGP data coverage for at least 28 days before their index consultation (Supplementary material, Section 1; available as Supplementary data at *JAC* Online). We excluded patients with a sore throat–related GP event or hospital admission in the 28 days prior to their first index event and those opting out from sharing their anonymized health records with the SAIL databank.

For study participants, we categorized sore throat consultations as 'index' or 're-consultations'. Index consultations were those with a sore throat–related clinical code, without a sore throat–related consultation in the 28 days before, clinically representing the first consultation for a new episode of acute sore throat. Patients could be included more than once if they experienced sore throat consultations that were more than 28 days apart, resulting in more than one 'index' consultation. Re-consultations were sore throat–related consultations in GP within 28 days of an index sore throat consultation.

In the STTT group, a small proportion of patients also had a GP consultation on the same day. GP data do not contain the consultation time. Therefore, we could not definitively distinguish which of the STTT or GP consultations were index and which were re-consultations. Discussion with service providers and users suggested these same-day consultations represented the following scenarios:

1. An administrative entry by the GP that the patient had consulted the STTT service for acute sore throat and thus *not* a re-consultation.
2. A direct referral from community pharmacy to GP in line with the service's clinical pathway, and thus a *planned* re-consultation.
3. An unplanned consultation with GP for a sore throat–related reason despite assessment by the STTT service, and thus an *unplanned* re-consultation.

A proportion of scenario 1 could be identified by the clinical code 'seen in pharmacy' in the GP record. A proportion of scenario 3 could be more reliably identified by a record of an antibiotic prescription issued from GP, which is unlikely to occur without a re-consultation.

Individuals were followed up for a maximum of 28 days after their index consultation. Any sore throat–related consultations during Days 1 to 28 were categorized as re-consultations. Follow-up ended at the earliest of: the study end date, date of death, migration out of Wales, loss to follow-up if moving to a non-providing SAIL GP, or 28 days after the index date (14 days for quinsy hospital admission, as more likely to be related to the index infection).

Covariates

When testing for differences between outcomes in the STTT group versus the GP group, we adjusted for baseline rates of sore throat consultations, hospital admissions, and all-cause antibiotic prescriptions in the 12 months before the index consultation. We also adjusted for health board, age, sex, deprivation, rural/urban location, smoking status, and the presence or absence of several comorbidities (Supplementary material, Section 2).

Outcomes

The outcomes were:

(a) antibiotic provision at index consultation;
(b) antibiotic provision on index date (to account for those in the STTT group who received antibiotics via a same-day GP re-consultation);

(c) antibiotic provision within 28 days of index date (to account for all antibiotic provision over the follow-up period);
(d) re-consultation for sore throat–related reason with GP within 28 days of index date;
(e) hospital admission for quinsy within 14 days of index date;
(f) consequences of subsequent healthcare resource use on cost-effectiveness of the service.

Quinsy was selected as the most prevalent complication of sore throat and thus the most likely for which a safety signal would be detected.[21] All lists of ICD-10 and Read codes used to generate fields are available at: https://osf.io/uk7x9/.

Statistical analysis

The groups were summarized using numbers and proportions, and medians alongside IQRs, to two significant figures. There were no missing data. Logistic regression modelling was used to compare outcomes between consulting with STTT compared with GP, adjusting for confounders of the association between exposure and outcomes (age, sex, deprivation, rural/urban location, comorbidities, smoking status, number of sore throat GP consultations, hospital admissions, antibiotic prescriptions in the 12 months prior to index date, year/month of index consultation, and health board—treated as fixed effects), and accounting for the clustering of index consultations within person (as a random effect). Model estimates are presented as adjusted odds ratios (AORs), 95% CIs and *P* values.

For the 28 day re-consultation outcome, due to the uncertainty around categorizing same-day STTT and GP consultations, we modelled three scenarios. In scenario 1 (best-case), re-consultations were those occurring 1 to 28 days after the index consultation and those where the same-day GP consultation resulted in an antibiotic prescription. In scenario 2 (most likely), re-consultations were those occurring 1 to 28 days after the index consultation, and GP consultations on the same day as the STTT consultation that did not have a 'seen in pharmacy' clinical code. In scenario 3 (worst-case), all GP consultations on Days 1 to 28 and on the same day as the STTT consultation were counted as re-consultations. Consultations resulting in a re-consultation (based on the most likely scenario) were characterized and compared with those not re-consulting. In sensitivity analyses we excluded index consultations for laryngitis and tracheitis in the unexposed group as these patients predominantly have hoarseness or cough as the main symptom and may not be consulting with the expectation of receiving antibiotics.

Economic analysis

Economic analysis was performed to assess the cost-effectiveness of the STTT service in comparison with standard care (GP sore throat consultations), using an updated version of the cost-utility model developed as part of the previous Health Technology Wales (HTW) assessment of RADT for diagnosing GAS infections in community pharmacies.[20] The analysis estimated overall costs and QALYs for separate hypothetical cohorts of children and adults. Cost inputs in the model were updated to reflect the most recent price year available within NHS Reference Costs (2021/22). Key inputs in the model were adjusted to match outputs of this study, including the probability of patients being directly referred to GP from pharmacy and the probability of re-consultation with a general practitioner, for the maximum possible health resource utilization (worst-case scenario). All other inputs including diagnostic accuracy and disease prevalence matched those used in the original HTW assessment. Cost-effectiveness was determined by comparing the incremental cost-effectiveness ratio (ICER) result against a threshold of £20 000 per QALY.

Microsoft Excel® v2306 was used to prepare the Choose Pharmacy extracts. Data were transferred to IBM SPSS® v23 for descriptive statistics; Stata v18 software was used for modelling.[22]

Ethical considerations

There were no identifiers that could link information to an individual in any of the data. No new patient information was collected from patients. A Data Protection Impact Assessment was approved by the National Information Governance Assurance and Support Lead and Head of Information Governance in DHCW. Data access for SAIL was approved by an independent Information Governance Review Panel, including patient representatives (ref-1357). The study was approved by Cardiff School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee (ref-2021-15) and the Research and Development department of Velindre University NHS Trust (ref-SE/53).

Results

We identified 72 736 consultations for acute sore throat, with 6495 (8.9%) index consultations in STTT (exposed group) and 66 241 (91.1%) in GP (unexposed group), amongst a total of 62 578 unique patients (Figure 1). Patient demographics and clinical history are reported in Table 1.

Main analyses

A total of 1382 (21%) STTT index consultations ended with antibiotic supply, compared with 25 506 (39%) GP index consultations (AOR, 0.30; 95% CI, 0.27 to 0.32). Additional antibiotic prescriptions from GP on the index day increased antibiotic provision in the STTT group to $n=1570$ (24%) (AOR, 0.36; 95% CI, 0.34 to 0.40). Antibiotic provision increased within 28 days (and inclusive) of the index date, to 1820 (28%) for STTT index consultations compared with 26 369 (40%) for GP index consultations (AOR, 0.44; 95% CI, 0.41 to 0.47) (Table 2, Figure 2).

Re-consultation with GP for sore throat–related reasons within 28 days of index date was observed for 926 (14%) STTT index consultations compared with 4916 (7.4%) GP index consultations (AOR, 2.3; 95% CI, 2.1 to 2.5) (Table 2, Figure 2, Figure S1). This outcome included GP re-consultations occurring 1 and 28 days after the index consultation [STTT: $n=752$ (12%) versus GP: 4916 (7.4%)] along with GP consultations where antibiotics were prescribed on the index date following an STTT index consultation ($n=174$), and represents the best-case scenario.

For STTT index consultations an additional 1075 sore throat consultations with GP were recorded on the index date (with no associated antibiotic prescribing). As no GP consultation time was recorded, the Read codes associated with the consultation were examined; 612 (53%) were found to contain the Read code 'seen in pharmacy' alongside a sore throat code, potentially indicating that contact with the STTT service was coded. 'Seen in pharmacy' contacts were more likely to have been referred into the STTT service by GP, less likely to have been referred back to the GP or other healthcare professional (HCP) by the STTT service, and less likely to have had antibiotic prescribed by GP when compared with consultations (Table S2). Given this evidence, the most likely scenario assumed that the 612 'seen in pharmacy' consultations were not re-consultations, but the 463 consultations were [STTT: $n=1389$ (21%) versus GP: 4916 (7.4%); AOR, 3.8; 95% CI, 3.5 to 4.1] (Table 2, Figure 2). A worst-case scenario assumed that all 1075 consultations were re-consultations, but this would most likely overestimate the re-consultation rate in the STTT group [STTT: $n=2001$ (31%) versus GP: 4916 (7.4%);

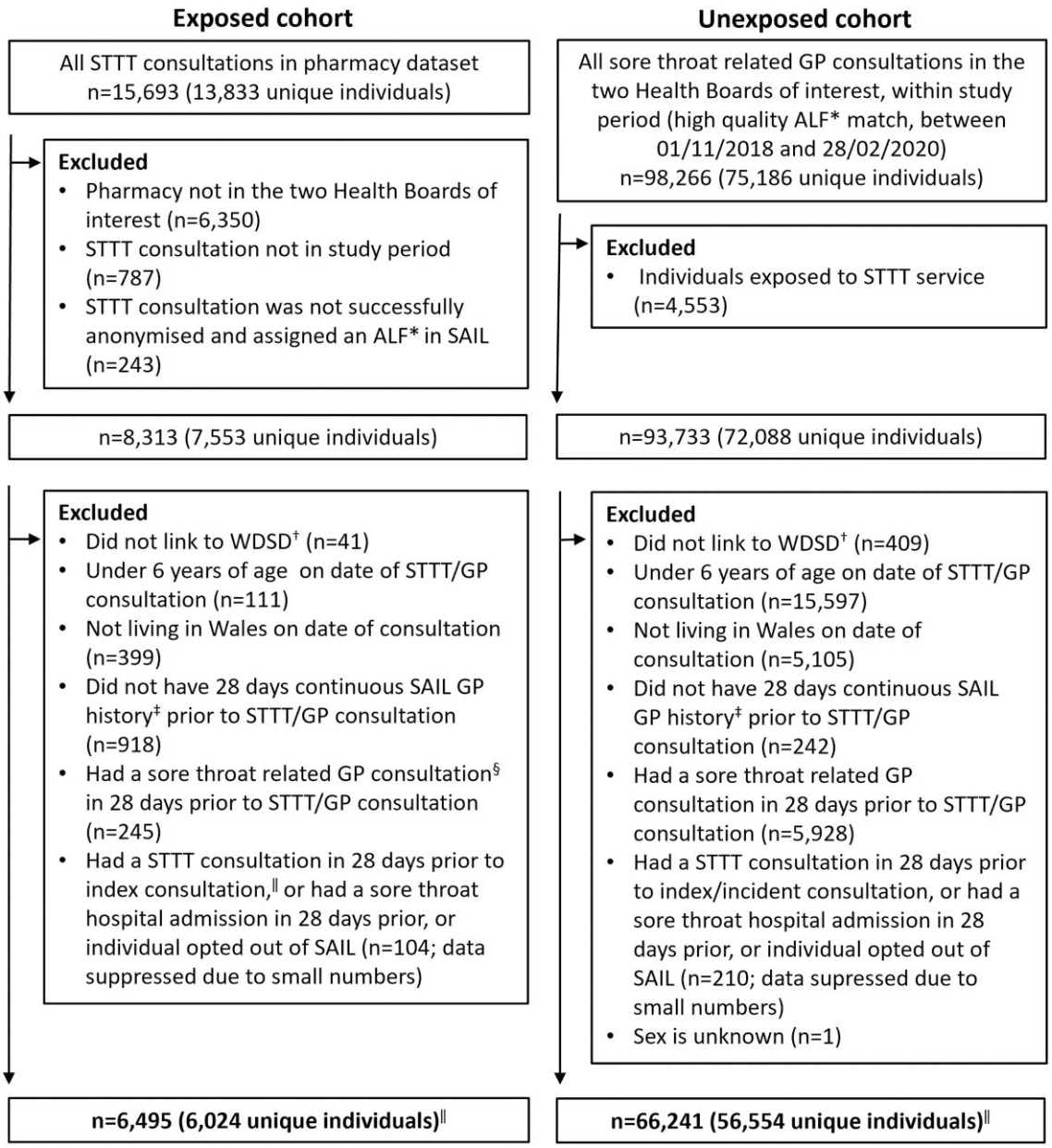

Figure 1. Inclusion/exclusion criteria and index consultation breakdown for exposed and unexposed cohorts. *ALF—enables individual-level, de-identified (double-encrypted) data to be linked across data sources within SAIL anonymously. †WDSD—comprises records for all GP registrations in Wales. Includes age, sex and the Lower-layer Super Output Area of residence. ‡Continuous SAIL GP coverage defined as the period between being registered as living in Wales (start date), and the final GP exit date [based on Welsh Longitudinal General Practice (WLGP) data] or living in Wales end date (WDSD)—whichever comes first. §Sore throat GP events and hospital admissions were identified in the WLGP, and Patient Episode Dataset for Wales (PEDW), respectively, using sore throat Read and ICD-10 codes developed by clinical members of the team (available at https://osf.io/uk7x9/). ‖Patients could be included more than once in the study if sore throat events were more than 28 days apart (all events defined as the 'index'). ALF, anonymized linkage field; CP, community pharmacy; GP, general practice; SAIL, Secure Anonymised Information Linkage; STTT, sore throat test and treat; WDSD, Welsh Demographic Service Dataset.

AOR, 6.7; 95% CI, 6.1 to 7.2). Re-consultations were less likely to have been provided with an antibiotic on the index consultation (17% versus 22%) and more likely to have been referred by the STTT service to the GP (19% versus 5%) when compared with consultations that did not result in a GP re-consult (Table S3).

Excluding GP re-consultations for laryngitis and tracheitis from index consultations for the unexposed group made little difference to the findings (Table S4). Hospital admissions for quinsy were rare in both groups [STTT: $n=20$ (0.31%) versus GP: $n=274$ (0.41%); AOR, 0.68; 95% CI, 0.43 to 1.1] (Table 2).

Table 1. Patient demographics and clinical history—all consultations

	Unexposed cohort		Exposed cohort	
	Sore throat consultations with GP		Sore throat consultations with STTT service	
	n	%	*n*	%
Number of consultations—all patients	66 241	91	6495	8.9
Age 6–14 y	13 358	22	1398	22
Age 15+ y	51 883	78	5097	79
Number of unique patients[a]	56 554	90	6024	9.6
Number of patients with one index consultation included in study period[b]	56 554	85	6024	93
2 index consultations	7714	12	431	6.6
3+ index consultations	1973	3.0	40	0.62
Sex: female (vs male)	42 617	64	4416	68
Age at index consultation[c]—all patients, median (IQR), y	28 (16 to 48)		26 (16 to 39)	
Age 6–14 y	10 (8 to 12)		10 (8 to 12)	
Age 15+ y	35 (23 to 54)		30 (21 to 45)	
Deprivation[d]				
1—most deprived	13 342	20	1276	20
2	15 223	23	2230	34
3	12 316	19	1337	21
4	13 287	20	961	15
5—least deprived	12 073	18	691	11
Rural area (vs urban)	25 041	38	2066	32
Smoking status				
Not known	23 659	36	2123	33
Ex-smoker	15 728	24	1456	22
Non-smoker	18 445	28	2054	32
Smoker	8409	13	862	13
At least one comorbidity	23 634	36	1929	30
Respiratory disease (COPD/asthma)	16 587	25	1440	22
Diabetes	5699	8.6	413	6.4
Cancer	3276	4.9	178	2.7
Renal disease	1812	2.7	91	1.4
Rheumatic disease	1430	2.2	69	1.1
Ischaemic heart disease	533	0.80	14	0.22
Liver impairment	228	0.34	10	0.15
Antibiotic prescriptions—12 mo prior to index				
No prescriptions	35 857	54	3822	59
1 prescription	15 395	23	1446	22
2 prescriptions	7085	11	666	10
3+ prescriptions	7904	12	561	8.6
Sore throat consultations—12 mo prior to index				
No consultations	51 492	78	5336	82
1 consultation	11 139	17	936	14
2 consultations	2691	4.1	166	2.6
3+ consultations	919	1.4	57	0.88
Sore throat–related hospital admissions—12 mo prior to index	669	1.0	53	0.82
Referred to STTT service by:				
GP	NA	NA	3409	53
Self-referral	NA	NA	2870	44
Other	NA	NA	216	3.3
Referral by STTT service to:				
GP	NA	NA	517	8.0

Continued

Table 1. *Continued*

	Unexposed cohort		Exposed cohort	
	Sore throat consultations with GP		Sore throat consultations with STTT service	
	n	%	*n*	%
Refer to other[e]	NA	NA	35	0.54
Not referred to another service	NA	NA	5943	92
Advice given to patient				
None			564	8.7
Seek medical advice if symptoms worsen or do not improve			5066	78
Return to pharmacy			771	12
Other			94	1.4

GP, general practice; NA, not applicable; STTT, sore throat test and treat; WLGP, Wales Longitudinal General Practice.
[a]Number of unique patients where sex is known.
[b]Source: WLGP.
[c]Number of exposed cases known to have consulted STTT service is low in patients over the age of 85 years, so the maximum has been censored at 85 years to restrict the ability to identify individuals.
[d]2019 Welsh Index of Multiple Deprivation based on address lower layer super output area (LSOA).
[e]Dentist, A&E, out of hours, optometry.

Economic analyses

For a hypothetical cohort of 1000 children and adults, STTT was found to be less costly than GP consultation in both populations (Table 3). In adults, STTT was also found to be marginally more effective than GP consultation and it could therefore be considered dominant (more effective and less costly). In children, STTT was found to have marginally fewer QALYs than GP consultation, due to a higher estimated disease prevalence in children in the HTW analysis. The ICER result (>£5 million per QALY) is above the threshold of £20 000 per QALY and indicates that the STTT service would be cost-effective (the intervention is less effective and less costly than the comparator and therefore values above the £20 000 per QALY threshold are considered cost-effective; higher values indicate greater savings for each QALY lost). The analysis was found to be insensitive to plausible variations in other inputs, which were varied in deterministic sensitivity analysis (diagnostic accuracy; disease prevalence; test costs; complication costs; quality of life weight). The conclusion of the analysis remained unchanged in all alternative modelled scenarios that were considered, with the STTT service found to be cost-effective or dominant. In probabilistic sensitivity analysis, the STTT service was found to have a 94% and 92% probability of being cost-effective in adults and children, respectively.

To reflect the uncertainty around the re-consultation rate, the analysis was re-run with different assumptions (Table S5).

Discussion

We addressed the absence of evidence for the effectiveness of pharmacy-led infection services by undertaking a longitudinal assessment of the Wales pharmacy-led STTT service, compared with sore throat assessment in GP. STTT and GP sore throat consultations included people with broadly similar characteristics in terms of age and sex. More patients from high-deprivation areas consulted with STTT compared with GP, widening access to healthcare for those populations. Areas of high deprivation have higher antibiotic use compared with areas of no or low deprivation,[23] further highlighting the potential contribution of the service towards AMS. Healthcare professionals in GP were more likely to see more patients with comorbidities (e.g. COPD, asthma). STTT consultations resulted in fewer same-day antibiotic prescriptions (by pharmacist or subsequently by GP) than GP sore throat consultations (24% versus 39%). The 28 day re-consultation rate for patients with sore throat was 7.4% for those who consulted in GP, and 21% for those who attended STTT, subject to assumptions used to classify same-day STTT/GP index consultation and accepting the most realistic scenario. However, 28 day antibiotic prescribing rates (accounting for prescribing during re-consults) remained lower for those who initially consulted STTT (28% versus 40%, a reduction of 12%; 95% CI, 11% to 13%). STTT was found to be less costly than GP consultation in adults and children, even when assigning all recorded incidents as possible further health resource utilization.

A previous study exploring the impact of the adapted STTT service during the COVID pandemic, which excluded the requirement for RADT, found that antibiotics were supplied in 48% of all consultations (95/199; 95% CI, 41% to 55%) and in 63% of consultations eligible for a RADT (93/147; 95% CI, 56% to 71%).[17] An initial report of data from the Pharmacy First service in England, which does not use RADT to support identification of bacterial sore throat, suggests antibiotics are supplied in 69% of consultations (8381/12 176).[24] The rates in both reports are higher than the 24% found in this study, suggesting that pharmacy services with a structured pathway excluding RADT may result in similar or higher supply rates than those reported

Table 2. Outcomes by exposure groups

Outcome	Unexposed cohort: sore throat consultations with GP *N* = 66 241		Exposed cohort: sore throat consultations with STTT service *N* = 6495		Absolute difference (STTT-GP) (95% CI)	AOR[a] (95% CI), *P* value
	n	%	*n*	%		
Antibiotic provision at index consultation	25 506	39	1382[b]	21	−17% (−18% to −16%)	0.30 (0.27 to 0.32), <0.001
Antibiotic provision on index date	25 506	39	1570[c]	24	−14% (−15% to −13%)	0.36 (0.34 to 0.40), <0.001
Antibiotic provision within 28 d of index date	26 369	40	1820	28	−12% (−13% to −11%)	0.44 (0.41 to 0.47), <0.001
Re-consultations for sore throat–related reasons with GP:						
Days 1–28 after index date	4916	7.4	752	12	4.2% (3.4% to 5.0%)	—
Within 28 d of index date (includes index date):						
Definition 1 (best-case)—index date GP contacts are not re-consultations[d]	4916	7.4	926	14	6.8% (6.0% to 7.7%)	2.3 (2.1 to 2.5), <0.001
Definition 2 (most likely)—some index date GP contacts are not re-consultations[e]	4916	7.4	1389	21	14% (13% to 15%)	3.8 (3.5 to 4.1), <0.001
Definition 3 (worst-case)—index date GP contacts are all re-consultations[f]	4916	7.4	2001	31	23% (22% to 25%)	6.7 (6.1 to 7.2), <0.001
Hospital admission for quinsy within 14 d of index date	274	0.41	20	0.31	−0.10% (−0.23% to 0.07%)	0.68 (0.43 to 1.1), 0.104

AOR, adjusted odds ratio; CP, community pharmacy; GP, general practice; STTT, sore throat test and treat.

[a]Adjusting for age, sex, deprivation quintile, rural/urban location, comorbidities, smoking status, number of sore throat GP consultations, hospital admissions, antibiotic prescriptions in year prior to index date, health board, year and month of index consultation, and for clustering of index consultations within person.

[b]Provision of antibiotics related to the setting of the index consultation (supplied by the STTT service in exposed group, supplied by a healthcare professional at GP in unexposed group).

[c]Includes *n* = 188 antibiotics prescribed by GP on index date to STTT index consultations (and not by CP).

[d]Definition 1 = 'Best-case scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date (*n* = 752), and also sore throat consultations on the index date where an antibiotic was prescribed by the GP (*n* = 174). Note: Of the 188 that had an additional antibiotic on index date by GP under outcome (b), *n* = 14 had a re-consultation between Days 1 and 28.

[e]Definition 2 = 'Most likely scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date (*n* = 752), sore throat consultations on the index date where an antibiotic was prescribed by the GP (*n* = 174), and sore throat consultations on the index date that were not prescribed an antibiotic and did not have a 'seen in pharmacy' clinical code (*n* = 463). Sore throat consultations on the index date that had a 'seen in pharmacy' clinical code (*n* = 612), were not classed as re-consultations but were an administrative entry by the GP that the patient had consulted the STTT service for acute sore throat.

[f]Definition 3 = 'Worst-case scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date (*n* = 752), sore throat consultations on the index date where an antibiotic was prescribed by the GP (*n* = 174), and sore throat consultations on the index date that were not prescribed an antibiotic (*n* = 1075).

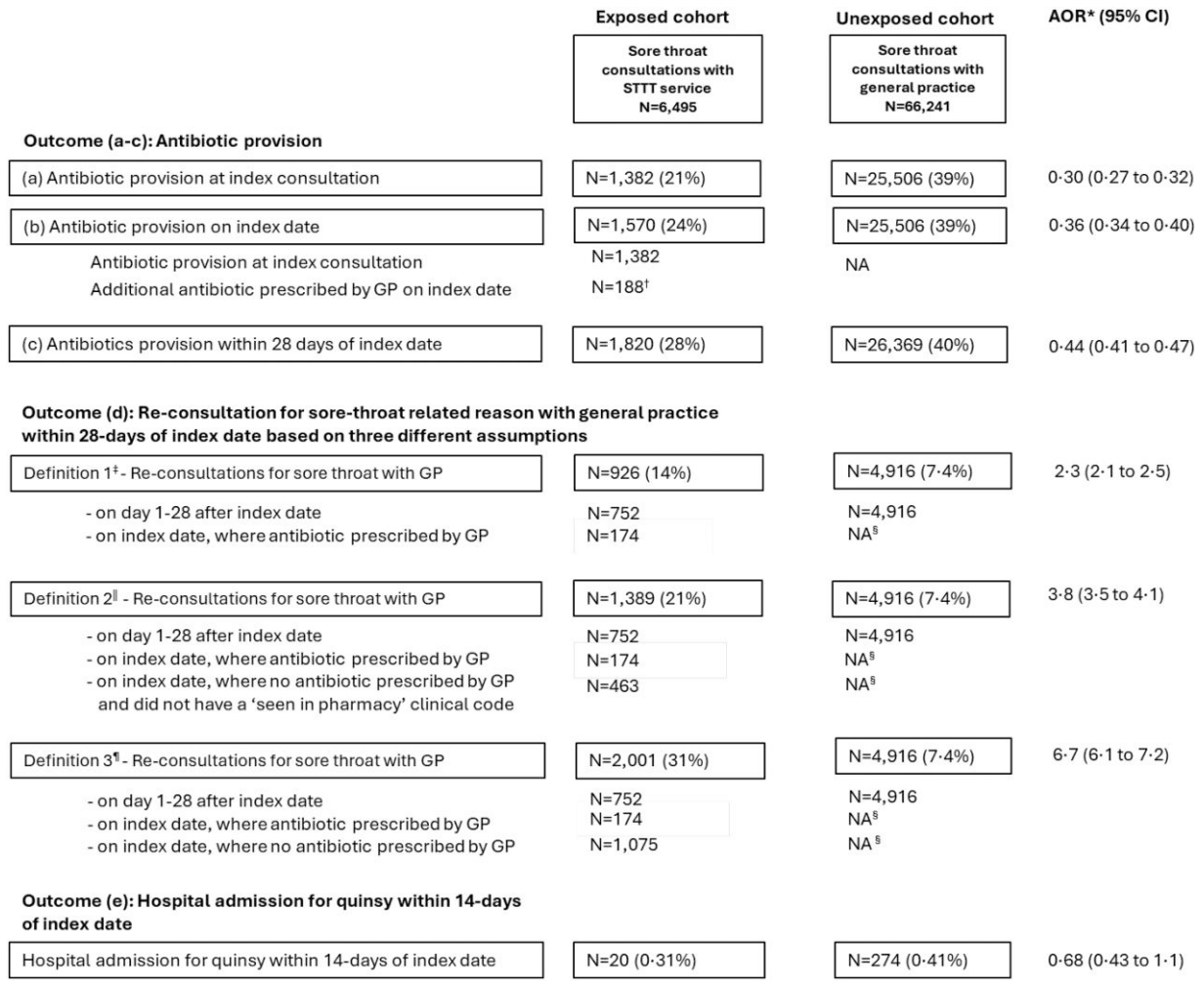

Figure 2. Summary of results. *Adjusting for age, sex, deprivation quintile, rural/urban location, comorbidities, smoking status, number of sore throat GP consultations, hospital admissions, antibiotic prescriptions in year prior to index date, health board, year and month of index consultation, and for clustering of index consultations within person. †No antibiotics previously supplied by CP at index consultation. ‡Definition 1 = 'Best-case scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date ($n = 752$), and also sore throat consultations on the index date where an antibiotic was prescribed by the GP ($n = 174$). Note: Of the 188 who had an additional antibiotic on index date by GP under outcome (b), $n = 14$ had a re-consultation between Days 1 and 28. §Re-consultations on index date in unexposed group could not be identified since GP does not contain the time of consultation. ‖Definition 2 = 'Most likely scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date ($n = 752$), sore throat consultations on the index date where an antibiotic was prescribed by the GP ($n = 174$), and sore throat consultations on the index date that were not prescribed an antibiotic and did not have a 'seen in pharmacy' clinical code ($n = 463$). Sore throat consultations on the index date that had a 'seen in pharmacy' clinical code ($n = 612$) were not classed as re-consultations but were an administrative entry by the GP that the patient had consulted the STTT service for acute sore throat. ¶Definition 3 = 'Worst-case scenario': Outcome includes sore throat consultations between Days 1 and 28 after the index date ($n = 752$), sore throat consultations on the index date where an antibiotic was prescribed by the GP ($n = 174$), and sore throat consultations on the index date that were not prescribed an antibiotic ($n = 1075$). AOR, adjusted odds ratio; CP, community pharmacy; GP, general practice; NA, not applicable; STTT, sore throat test and treat.

in GP settings. Current findings further reiterate that RADT in addition to clinical scoring may reduce antibiotic use for sore throat symptoms. This may have implications for commissioning of pharmacy services without diagnostics.

A total of 19% of re-consulting patients were referred directly to GP by the pharmacists. Of the remaining re-consulting patients, a proportion was likely due to a combination of appropriate pharmacist safety netting (deterioration of symptoms and/or complications developed) and patients wishing to see a general practitioner for reassurance or perceived need for antibiotic, despite having seen a pharmacist. Re-consultations resulting from direct referrals and safety netting reinforce the role of community pharmacists as an appropriate healthcare professional for triaging and managing apparently uncomplicated cases, in accordance with government strategies advocating increased clinical service provision by pharmacies.[9,10] Patients re-consulting with GP without clinical need is not a good use of NHS resources. However, even in the worst-case scenario in our

Table 3. Economic analysis results for maximum potential health resource use ('worst-case scenario'), and assuming that where an STTT index consultation and GP consultation are recorded on the same day, all GP contacts are re-consultations with a general practitioner

	Cost,[a] GBP		QALYs[b]		
Diagnostic strategy	Total	Incremental	Total	Incremental	ICER (cost per QALY),[c] GBP
Adults					
Sore throat consultations with GP	56 989		862.82	—	—
Sore throat consultations with STTT service	51 857	−5132	862.82	0.0027	Dominant
Children[d]					
Sore throat consultations with GP	60 420		862.77		—
Sore throat consultations with STTT service	55 437	−4983	862.77	−0.0009	5 274 887

GBP, pound sterling; GP, general practice; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year; STTT, sore throat test and treat.
[a]Estimated total cost for each strategy over the modelled time horizon of 1 year, including test costs, consultation costs, antibiotic costs and the cost of managing complications.
[b]Estimated effectiveness expressed as QALYs. These are estimated by combining life year estimates with quality of life values associated with being in a particular health state. Note that the observed differences in QALYs are entirely driven by differences in quality of life as it is not anticipated that there would be survival differences between the two strategies.
[c]Ratio of cost and benefits that is used to determine cost-effectiveness. It is calculated as the difference in cost divided by the difference in QALYs to give a 'cost per QALY'. Typically, a cost per QALY gained of less than £20 000 per QALY is considered cost-effective.
[d]Children are defined as 6–14 years old.

modelling, availability of the STTT service saves at least 69 GP consultations for every 100 patients with sore throat symptoms. We found low rates of quinsy admissions within 28 days of index consultation in both STTT and GP groups. These rates are similar to those reported in literature for GP consultations.[25]

The health economic analysis found that the STTT service was less costly than consulting with general practitioners. The benefits in the model were driven by reduced GP appointments and the lower cost of treating sore throats in pharmacies. Sore throat management without use of RADT will deliver the benefits at lower cost, but it is likely this would be at the expense of more antibiotics being prescribed.[17] We consider it unlikely that current models will show pharmacy consultation with RADT is more cost-effective than without, because models place insufficient value on preventing antibiotic exposure and selection pressure for resistance. Given the global importance of tackling AMR and the commitments made to wider use of RADT in the UK's recently published National Action Plan for antimicrobial resistance,[26] we propose that new economic models are needed, which properly value preventing AMR. This resonates with findings of a recent study in the Netherlands, which argues that future studies should be more focused on costs and health outcomes related to AMR,[27] and a recently proposed threshold-based approach that estimates the minimum resistance-related costs that would need to be averted by an intervention to make it cost-effective.[28]

Strengths

The Choose Pharmacy platform, with structured entry data for community pharmacy consultations and ability to link to SAIL so individual patients can be followed through their NHS journey, lays the foundation for rapid evaluation of similar services in future. Although this was an observational study, we controlled for confounders, and the large sample size is not feasible in a clinical trial. Despite this, for services that are all just becoming operational, there is opportunity for large scale decentralized data-enabled trials. The structured entry data are also helpful for recording presentations of Strep A pharyngitis that are often classed as self-limiting, and hence do not contribute to the officially recorded burden of sore throat and GAS infections.[29]

Limitations

Coding limitations need to be accounted for in the present study, as reported elsewhere.[29] Although the majority of primary care clinicians use Read code terminology, no standard data recording rules exist. GPs are encouraged to code STTT consultations with sore throat–related codes. However, it was not possible to differentiate these codes from codes entered in actual GP consultations, meaning that our estimates for GP re-consultations are likely to be overestimates. It was not possible to assess an outcome measure for re-consultation with a pharmacist within 28 days of the index date for a sore throat–related reason and associated medication supply in both exposure groups. A non-specific coding system of attendances in the Emergency Department Dataset meant that sore throat–related attendances were not available. Due to the low rate of quinsy hospital admissions, we were likely underpowered to detect a difference between GP and STTT, and therefore findings for this outcome should be interpreted with caution. The age of the data for this study is also a limitation. As awareness of this service grows and other similar services emerge and evolve in other parts of the UK, long-term outcomes should be regularly measured and compared. We lacked data on FeverPAIN/Centor scores in those that were assessed in GP and were therefore unable to account for differences in illness severity between the two groups.

Conclusions

We present the first study of longer-term outcomes for the STTT using individually linked pharmacy, GP and hospital admission

data, to our knowledge. We estimate that for every 100 patients presenting with sore throat at an STTT pharmacy, 15–18 antibiotics are saved. Accounting for all possible re-consultations within 28 days, this reduced to 12 antibiotic prescriptions saved, although coding assumptions make this a likely underestimate. Our study provides further evidence that the pharmacy-led STTT service is safe and cost-effective, and provides a blueprint for data-enabled rapid evaluations of community pharmacy services. Commissioners of similar pharmacy services should consider a structured approach including rapid diagnostics to support clinical assessment, where appropriate.

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Transparency declarations

None to declare.

Supplementary data

Supplementary material, Figure S1 and Tables S1 to S5 are available as Supplementary data at *JAC* Online.

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