Safe staffing in maternity services: A commissioned rapid scoping review for NHS England

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ABSTRACT

The overarching aim of this rapid scoping review was to provide a rapid appraisal of maternity academic papers, policy, literature, and evidence on safe staffing globally, in countries where the registered midwife role exists. The review addressed four questions relating to: (1) the impact of skill mix models on maternal and neonatal outcomes, patient satisfaction, and healthcare costs; (2) the impact of deployment models for healthcare professionals in maternity services; (3) the understanding and implementation of headroom provision and its effects on staffing and care; and (4) whether single-bedroom maternity wards require different staffing requirements and what outcomes support this.

There is limited high quality evidence from UK settings on the impact of skill mix models, including midwifery staffing, task shifting, maternity support workers and increased obstetric consultant presence, on maternal and neonatal outcomes, patient satisfaction and healthcare costs. In contrast, high quality evidence consistently shows that midwifery led continuity of care is as effective as other models for low risk women and may offer cost saving benefits for intrapartum care. Further research is required for women who are at higher risk or who have additional health complications. Findings from a pilot study also indicate that midwifery continuity of care combined with access to a specialist obstetric clinic may provide a safe and beneficial option for women at elevated risk of preterm birth, although larger and adequately powered trials are needed to confirm these results.

Evidence for the impact of caseload midwifery compared with standard care, and for midwife led compared with physician led care in UK settings, remains limited. However, findings from Australia suggest that caseload midwifery for women at low risk is associated with fewer interventions, higher satisfaction with care, more positive birth experiences and reductions in costs when compared with other models of care. More broadly, midwifery led care in Australia and the UK appears to be cost effective because of lower rates of preterm birth and episiotomy, although the evidence remains limited for women who have pregnancy related risk. In low and middle income countries, midwifery led care reduces neonatal intensive care admissions, lowers episiotomy rates and is associated with higher rates of vaginal birth, although there is no clear evidence of an effect on preterm birth or early exclusive breastfeeding.

Headroom within the NHS takes account of all types of leave and should be compared with actual utilisation using retrospective data from the previous two years. There is substantial variation in headroom levels and staff unavailability across NHS Trusts as recorded in e rostering systems, yet there is insufficient evidence to determine how headroom provision affects staffing ratios, workforce planning or the quality of care outcomes.

There is also a lack of evidence directly assessing whether single bedroom maternity wards require different staffing levels or how such differences might influence patient outcomes. Most available evidence instead examines single room maternity care as a care model in the United States, Canada and the Netherlands. This evidence indicates that single room maternity care can improve staff skills and experience by reallocating resources to employ more registered nurses, while maintaining comparable intrapartum safety to traditional models of care. Women experience shorter hospital stays, greater satisfaction with care and potential cost savings, particularly for those at low risk. However, some studies suggest that traditional maternity care may offer greater cost savings in certain contexts.

Safe staffing in maternity services

A commissioned rapid scoping review for NHS England

EXECUTIVE SUMMARY

What is a Rapid Scoping Review?
This Rapid Scoping Review was completed in four months and aims to explore and summarise available evidence. On the request of the commissioners, quality appraisal was also conducted. It is based on a systematic search of the literature (including grey literature), conducted in July 2023. Priority was given to studies representing robust evidence synthesis, although if these were not identified, primary studies were explored. However, due to the volume of evidence retrieved no overarching narrative synthesis was conducted, and the summary should therefore be interpreted with caution.

Who is this summary for?
NHS England - Maternity Services Improvement Resource Professional Reference Group.

Background / Aim of Rapid Scoping Review
Between 2017-18, the National Quality Board issued specialty-specific improvement resources, along with the "Developing Workforce Safeguards", encompassing workforce planning, reporting, and governance recommendations. Since then, evolving practices, including COVID-19-related changes, have highlighted the need to update and align these resources to current guidelines. This rapid scoping review will be used to inform recommendations that will contribute to updating the National Quality Board's improvement resource for safe staffing for maternity services.

The overarching aim of this rapid scoping review is to provide a rapid appraisal of maternity academic papers, policy, literature and evidence on safe staffing globally, where the registered midwife role exists, including low- and middle-income countries. The commissioning brief set out three initial areas of interest, and a further question was added later:

Question 1:
"What is the current evidence on the impact of skill mix models in maternity care on maternal and neonatal outcomes, patient satisfaction, and healthcare costs?"

Question 2:
"What is the current evidence on the impact of optimal deployment models for healthcare professionals in the maternity service, including midwives, nurses, allied health professionals, and support staff, on maternal and neonatal outcomes?"

Question 3:
"What is the current understanding and implementation of headroom provision in maternity care, including its impact on staffing ratios, workforce planning, and quality of care outcomes?"

Question 4:
"Do single bedroomed wards in maternity services require a variation on staffing requirements and what, if any, patient outcomes support this?"

Results
Recency of the evidence base

- The previous maternity services evidence review (published in 2017) was taken as a starting point.

- The review therefore included evidence from January 2016 to July 2023 (Q1, Q2, Q3) and from January 2016 to March 2024 (Q4).

Extent of the evidence base

Question 1: Impact of skill mix models

- Four reviews with research from the UK (n=2), LMICs (n=2), LMICs & HICs (n=1) and seven primary studies with research from USA (n=1), UK (n=4), Austria (n=1).
- One systematic review with meta-analysis (high quality [+]), two systematic reviews without meta-analysis (critically low quality [--]), one scoping review (critically low quality [-]); three retrospective cohort studies (two moderate quality [+] and one low quality [-]), one prospective cohort study (moderate quality [+]) and two descriptive studies (survey evidence).
- Focus: staffing levels (n=4); task shifting (n=2); maternity support workers (n=2) and obstetrician presence on the labour ward (n=4).

Question 2: Impact of deployment models

- Six reviews with research from the Australia, Canada, Ireland and UK (n=1), UK and Australia (n=1), OECD countries (n=1), LMICs (n=1), Australia (n=2) and eight primary studies conducted in Australia (n=5), Norway (n=1), UK (n=1), US (n=1).
- One systematic with meta-analysis (high quality [+]), three systematic reviews without meta-analysis (two critically low quality [--] and one high quality [+]), two scoping reviews (one critically low quality [--] and one high quality [+]); six RCTs (one moderate quality [+] and five high quality [++]) and two health economics studies (not rated).
- Focus: midwife continuity models of care versus other models of care (n=4); caseload midwifery versus standard antenatal care (n=3); caseload midwifery compared to other models of care (n=1), midwifery-led care versus physician led care (n=4); a range of midwifery-led care models compared to other models of care (n=1); and two different midwifery continuity of care models (n=1).

Question 3: Headroom provision

- One primary study and four grey literature publications from the UK.
- Three guidance documents, one National Quality Board improvement resource and one descriptive study (survey evidence).
- Focus: headroom provision for midwifery (n=4), headroom provision for nursing (n=1).

Question 4: Single bedroomed wards

- Fourteen primary studies with research from Canada (n=8), USA (n=5) and the Netherlands (n=1).
- Focus: staffing levels (n=1); clinical outcomes (n=3), length of stay (n=2), staff satisfaction (n=4), patient satisfaction (n=7)) and costs (n=3).

Staffing levels

Increased staffing levels in maternity units appear to offer positive benefits, such as reducing postpartum haemorrhage and maternal readmissions, along with a composite measure of healthy mother -delivery without caesarean, episiotomy, or a second-, third- or fourth-degree perineal tear, uterine damage) (critically low quality evidence). However, the impact on certain outcomes like perineal damage remains uncertain (critically low quality evidence). While higher staffing ratios were associated with increased complications, this might be influenced by varying patient risk levels (critically low quality evidence). Notably, the nurse-to-birth ratio

seemed to improve maternal outcomes, whereas a higher midwife-to-birth ratio correlated with elevated risks of severe maternal outcome (critically low quality evidence).

Increased staffing in maternity units was associated with lower rates of neonatal resuscitation and higher breastfeeding rates (critically low quality evidence). However, the impact on other neonatal outcomes such as admission to neonatal unit and Apgar scores, was inconclusive with no significant effects on stillbirth, neonatal death, birth asphyxia, neonatal length of stay, perinatal complications, or the overall health of the baby (critically low quality evidence).

Regarding events in labour, increased staffing in maternity units was linked to better partogram completeness at the beginning and middle of shifts, continuous foetal monitoring, reduced likelihood of foetal distress, and quicker caesarean section transfers (critically low quality evidence). The impact on epidural use, oxytocin augmentation, and labour duration is inconclusive (critically low quality evidence) with no significant effect on end-of-shift partogram completeness, record-keeping, or appropriate foetal monitoring (critically low quality evidence).

The relationship between staffing levels and various birth outcomes like emergency caesarean, instrumental, spontaneous vaginal, and straightforward births is inconclusive (critically low quality evidence), with no significant effect on instrumental and straightforward births (critically low quality evidence). Although it was demonstrated that low-risk, healthy women who gave birth at centres with both midwives and doctors were less likely to have unplanned caesarean births (moderate quality evidence).

The relationship between staffing levels and patient satisfaction is inconclusive (critically low quality evidence). Employing more midwives at the Trust level improved patient experiences, especially in timely information provision and smoother discharges. However, postnatal ward staffing (measured as Hours Per Patient Day) didn't significantly impact patient experience (survey evidence). Variations in hospital staffing were linked to differing postnatal care experiences; better-staffed hospitals had fewer reported discharge delays and more timely assistance and information provision (survey evidence).

Task-shifting
Interventions involving task-shifting in maternal and newborn care have been proven to be effective in low and middle-income countries (critically low quality evidence).

Maternity support assistants
Increasing the numbers of maternity support assistants was not associated with improved patient outcomes (critically low quality evidence), although significant improvements in some aspects of patient experience are reported (survey evidence).

Obstetric consultant presence
Increasing the presence of obstetric consultants on maternity wards does not lead to significant differences in maternal and neonatal outcomes (high quality evidence). However, an increase in consultant presence per week was associated with a significantly lower likelihood of emergency caesarean sections and a significantly higher likelihood of non-instrumental vaginal deliveries (high quality evidence).

Introducing 24/7 resident consultant obstetrician presence on the labour ward did not change the trend of increasing adverse neonatal outcomes, except for babies born after 37 weeks of gestation, where it improved outcomes (moderate quality evidence). Additionally, uncomplicated deliveries managed by less experienced staff had no negative impact on perinatal outcomes, and riskier pregnancies tended to have better outcomes when delivered by senior staff (moderate quality evidence).

The introduction of 24/7 obstetric consultant presence appeared to mitigate the negative impact associated with the absence or delay of obstetric consultants, as indicated by serious untoward incident reviews (low quality evidence).

Midwifery continuity of care compared to other models (Australia, Canada, Ireland, UK))
There were no significant differences in the intention to attempt a vaginal birth after a previous caesarean section and in maternal or neonatal outcomes between the two distinct antenatal continuity of care models (high quality evidence).

Women experiencing midwifery-led continuity of care compared to those experiencing other models of care were significantly less likely to undergo certain medical interventions such as amniotomy and episiotomy compared to those under other care models (high quality evidence) and there were also no significant differences in a range of maternal outcomes such as intact perineum, induction of labour, antenatal hospitalisation, antepartum haemorrhage, perineal lacerations, and postpartum haemorrhage (high quality evidence).

Women who received midwifery-led continuity of care compared to those who received other models of care experienced a significantly lower likelihood of preterm birth (before 37 weeks), foetal loss both before and after 24 weeks, and neonatal death in comparison to those who received other care models (high quality evidence). Additionally, there were no significant effects for a range of other neonatal outcomes such as foetal loss occurring equal to or after 24 weeks, neonatal death, breastfeeding initiation, having a low birthweight infant, achieving a five-minute Apgar score equal to or less than seven, encountering neonatal convulsions, neonatal admissions to special care or neonatal intensive care units, or the average duration of neonatal hospital stays (high quality evidence).

Women who received midwifery-led continuity care compared to those who received other models of care had significantly lower rates of regional analgesia use, longer labour durations, and were more likely to be attended by a known midwife during birth compared to those receiving other models of care (high quality evidence). Importantly, there were no increased risk of adverse maternal or neonatal outcomes (high quality evidence) and they also reported higher levels of maternal satisfaction (high quality evidence).

The evidence on neonatal outcomes for women receiving midwifery continuity care in Australia compared to standard care is inconclusive due to mixed study results (critically low evidence). However, those in midwifery care consistently had more spontaneous, normal vaginal births, fewer caesarean sections, and reduced reliance on medical interventions (critically low evidence).

In midwifery-led continuity care models, women were less likely to experience instrumental vaginal birth, while they were more likely to have spontaneous vaginal births and undergo labour without intrapartum analgesia or anaesthesia compared to other care models (high quality evidence). However, there were no significant differences in the likelihood of having a caesarean birth, receiving labour augmentation with artificial oxytocin, or using opiate analgesia (high quality evidence).

For women at a higher risk of preterm birth who received midwifery continuity of care and had access to a specialist obstetric clinic there were no significant differences in the primary combined outcome (involving various interventions related to the prevention and management of preterm labour and birth) or any of its individual components, when compared to women receiving standard care (high quality evidence). Additionally, there were no significant differences in most secondary neonatal outcomes, including gestational age, birth weight, Apgar scores, cord clamping, skin-to-skin contact, breastfeeding initiation, perinatal mortality, neonatal admission reasons, length of hospital stays, and infant transfers to tertiary care centres (high quality evidence).

The evidence on neonatal outcomes for women receiving midwifery continuity care in Australia compared to standard care is inconclusive due to mixed study results. However, those in midwifery care consistently had more spontaneous, normal vaginal births, fewer caesarean sections, and reduced reliance on medical interventions (critically low quality evidence).

A small number of Australian and UK studies indicate cost-saving benefits in intrapartum care when comparing midwifery-led continuity of care to other models of care (high quality evidence). The evidence for the cost savings for postnatal care however are inconclusive and are not based on the level of obstetric risk (critically low quality evidence).

Caseload midwifery compared to other models (Australia)
Among pregnant women in Australia at low risk, those who received caseload midwifery care during the antenatal period were less likely to undergo a caesarean section compared to those who received standard care (high quality evidence) and described a more positive birth experience (high quality evidence). Regardless of their risk level, women assigned to caseload midwifery consistently rated various components of antenatal care more positively (moderate quality evidence). Two months after giving birth, women who received caseload midwifery care reported higher levels of satisfaction across all aspects of care, spanning the antenatal, intrapartum, and postpartum periods (high quality evidence).

Comparing caseload midwifery with other models of care (Australia)
In Australian settings caseload midwifery care was 22% less expensive than other care models, while maintaining similar Quality-Adjusted Life Years, indicating that caseload midwifery care not only provides similar health outcomes but also has the potential to reduce costs per individual (quality not rated).

Comparing midwifery-led care with physician led care
The evidence regarding improvements in birth outcomes, such as preterm birth, low or very low birth weight, or NICU admission, for vulnerable women in the care of midwives compared to those receiving physician-led care across OECD countries is inconclusive (high quality).

In both Australian and UK settings, while evidence supports cost savings in midwifery-led care compared to obstetric consultant-led units, the evidence base for cost-effectiveness in women with pregnancy risk is limited (critically low evidence). When comparing midwife-led care to obstetrician-led care in 10,000 simulated scenarios, midwife-led care consistently resulted in lower costs (quality not rated). On average, the cost difference for births to low-risk women in Australia receiving midwife-led care was $2421 less than the cost of births to low-risk women cared for by obstetricians (quality not rated). These cost differences can be attributed to the lower rates of preterm births and episiotomies for women who received midwife-led care compared to women who received obstetrician-led care (quality not rated).

In Norway, low-risk women in midwifery units reported higher overall satisfaction with intrapartum care compared to those in obstetric units (high quality). However, low-risk women with obstetrician involvement during labour were less satisfied (high quality). The mode of operative delivery and epidural use negatively impacted overall satisfaction, regardless of the care unit (high quality).

Comparing midwifery-led care with other models of care (LMICs)
In LMICs, women who received midwifery-led care experienced shorter neonatal intensive care unit admission times and a lower likelihood of episiotomy during birth compared to those receiving other care models (high quality). However, there were no significant effects for preterm birth or early initiation of exclusive breastfeeding (high quality). Additionally, women who received midwifery-led care had significantly reduced risks of emergency caesarean sections and increased odds of vaginal birth compared to other care models (high quality).

Headroom provision

Headroom represents the percentage increase applied to an establishment to accommodate expected absences, including annual leave, study leave, sick leave, and maternity leave in the NHS. This uplift should encompass both planned and unplanned leave, and key performance indicators should incorporate comparisons between agreed headroom and its utilization. Achieving "appropriate and prospective uplift" involves collecting retrospective data from the previous two years.

Headroom provision within the NHS involves ensuring coverage for a range of elements essential for smooth operation. This includes accounting for annual leave, sickness absences, parenting leave, and study leave, which is contingent on team size and includes mandatory and role-specific training as well as continuous professional development. Additionally, specific allocated time is reserved for additional roles like link nurses, along with attending relevant meetings, engaging in student assessment and mentoring, and fulfilling administrative and management duties.

Across 87 NHS Trusts in the UK, there are substantial variations in unavailability (ranging from 15.5% to 33.6%) and contrasting levels of headroom (ranging from 16% to 26%) in e-rostering systems (survey evidence).

Analysing roster policies from 20 NHS Trusts, generic headroom averaged at 22.1%, spanning from 18% to 25%. Annual leave accounted for 14.3%, sickness 4.0%, and study leave 2.6% on average across all 20 Trusts. Parenting leave averaged at 2.3%, mentioned in the roster policies of only 6 out of 20 Trusts. Furthermore, non-clinical work was included in headroom in 9 Trusts, averaging at 1.8% (survey evidence).

Single room maternity care (USA, Canada and the Netherlands)

By reallocating resources to hire more registered nurses and reducing the number of licensed practical nurses in single room maternity care settings, staff competency and experience increased, enabling greater patient supervision (low quality).

The evidence shows that after the implementation of single room maternity care, the number of infants experiencing hypoglycaemia decreased. Intrapartum interventions and adverse outcomes remained similar to traditional maternity care, except for less frequent electronic foetal monitoring in single room settings (low quality). Maternal length of stay was significantly shorter for women in single room maternity care compared to traditional maternity care settings (low quality).

Staff satisfaction findings were mixed in one study comparing traditional care with data from one year prior when the unit followed a single room model. Other studies, however, found that both physicians and nurses reported increased job satisfaction, which improved over time, with most preferring single room maternity care over traditional models. (low quality).

Women consistently reported high satisfaction with single room maternity care (low quality), with significant improvements noted in areas such as information provision, physical environment, nursing care, patient education, and privacy (low quality). Women receiving single room care were significantly more satisfied than those in traditional settings (low quality and survey evidence). Key factors contributing to satisfaction included the quiet atmosphere, family togetherness, privacy and positive experiences with labour and delivery nurses (high quality).

Costs were reduced in single room maternity care settings compared to traditional care settings across two studies (low quality). However, another study, inferred cost savings when care was delivered within a traditional maternity care setting compared to the previous single room model (low quality).

Conclusions

There is limited high quality evidence from a UK setting for the impact of skill mix models (midwifery staffing, task shifting, maternity support workers and increasing obstetric consultant presence) on maternal and neonatal outcomes, patient satisfaction, and healthcare costs.

High quality evidence indicates that midwifery-led continuity of care is just as effective as other models of care for low risk women. The available evidence for potential cost savings is limited and of variable quality but is suggestive of having cost-saving benefits for intrapartum care. Further research is required for high risk women or those with health complications.

Findings from a pilot study suggest that midwifery continuity of care with access to a specialist obstetric clinic may hold promise as a safe and advantageous choice for women at an elevated risk of preterm birth. However, larger, adequately powered trials are required to confirm these findings.

There is limited high quality evidence for the impact of caseload midwifery compared to standard care and for midwife care compared to physician led care from UK settings on maternal and neonatal outcomes.

The review does suggest however, that in Australian settings caseload midwifery care, especially for low-risk pregnancies, is associated with fewer interventions, heightened satisfaction with care, and more positive birth experiences for women and offers cost savings when compared with other models of care.

Midwifery-led care in Australia and the UK is cost-effective due to reduced costs linked to lower rates of preterm births and episiotomies. However, the evidence for women with pregnancy risk is limited.

Midwifery-led care in low- and middle-income countries reduces neonatal intensive care admissions, lowers episiotomy rates, and favours vaginal births, but doesn't show clear links to preterm birth or early exclusive breastfeeding.

Headroom in the NHS considers all types of leave and should be compared to actual utilization using retrospective data from the previous two years.

E-rostering systems in different NHS Trusts across the UK show significant differences in terms of unavailability and headroom levels

There is insufficient evidence available regarding the impact of headroom provision on staffing ratios, workforce planning, and quality of care outcomes in maternity services.

The review revealed a lack of studies directly addressing whether single bedroom wards in maternity services require variations in staffing requirements or how such changes might influence patient outcomes. Most of the available evidence instead focused on the implementation of single room maternity units as a care model in the USA, Canada, and the Netherlands.

What the evidence does show is that single room maternity care can improve staff skills and experience through resource allocation toward hiring more registered nurses. Outcomes were comparable to traditional maternity care in terms of intrapartum interventions and patient safety, while women experienced shorter hospital stays, cost savings especially for low-risk women, and high staff and patient satisfaction. However, although single room maternity care generally reduces costs, some studies suggest that traditional care may offer greater savings in certain contexts.

TABLE OF CONTENTS

Abbreviations:

Acronym	Full Description
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
HICs	High income countries
LMICs	Low and middle-income countries
NHS	National Health Service
NICE	Neonatal intensive care unit
NQB	National Quality Board
NICE	National Institute for Health and Care Evidence
NICU	Neonatal Intensive Care Unit
OECD	Organisation for Economic Co-operation and Development
RCTs	Randomised Controlled Trials
RCOG	Royal College of Obstetricians and Gynaecologists
SIGN	Scottish Intercollegiate Guidelines Network
SRMC	Single room maternity care
TMC	Traditional maternity care

1. CONTEXT

In 2017-18, under the banner of the National Quality Board (NQB), NHS Improvement published eight speciality specific improvement resources. The complementary resource, Developing Workforce Safeguards, was published in 2018 and is a comprehensive set of guidelines and regulatory reporting elements on workforce planning and recommendations on workforce reporting and governance. Changes in practice, some of which have emerged as a result of the COVID-19 pandemic restrictions and new patterns of care delivery, have confirmed the need to update, strengthen and align these publications as current guidance.

NHS England has been commissioned by NQB to establish a programme to oversee the development of a contemporary suite of improvement resources for safer staffing. The programme aims to provide the NHS in England with a robust, up to date set of resources and guidance which is relevant to current practice and with which NHS boards, NHS managers, staff and patients can be assured and reassured that the decisions they are taking with regards to their workforce continue to be as safe, efficient, effective and sustainable as possible. This has particular resonance given the extraordinary pressures the NHS workforce endured during the pandemic, and the often significant changes in working practice that this prompted. The programme aims to update the existing improvement resources via working groups chaired by strategic influencers and attended by subject matter experts.

A key principle of the NQB Effective Staffing programme terms of reference is that each setting-specific group (in this case, the Maternity Services Improvement Resource Professional Reference Group) will utilise the best available evidence on safe, sustainable staffing models, where it exists, to inform recommendations and the development of their setting-specific improvement resource. To facilitate this, each group was enabled to commission a focused evidence review arising from questions the subgroup identified. This was to include production of a written summary of the review/s that present a synthesis of the available evidence for inclusion in an appendix in the setting-specific resource which will, in turn, be used to inform recommendations that contribute to updating and the development of the National Quality Board's improvement resource for safe staffing for maternity services. The current maternity services improvement resource was informed by an evidence review (Sandall et al. 2017). This evidence review provided an update to the evidence base generated for the NICE guideline NG4 which makes recommendations on safe midwifery staffing requirements for maternity settings, based on the best available evidence (NICE 2015).

The current maternity resource describes the principles for safe maternity staffing across the multi-professional team to ensure women and their families receive joined-up care appropriate to their needs and wishes. It builds on standards and recommendations from the Royal College of Midwives, Royal College of Obstetrics and Gynaecology (RCOG), Royal College of Anaesthetists and the Care Quality Commission, and is informed by the NICE Midwifery staffing guideline (NG4). The purpose of this rapid scoping review is, therefore, to present an update of the best available evidence on safe, sustainable staffing models for maternity services.

2. RESEARCH QUESTION(S)

The overarching aim of this review is to provide a rapid appraisal of maternity academic papers, policy, literature and evidence on safe staffing globally, where the registered midwife role exists, including low and middle income countries. The commissioning brief set out three initial areas of interest and a further question was added later:

Question 1:

> “What is the current evidence on the impact of skill mix models in maternity care on maternal and neonatal outcomes, patient satisfaction, and healthcare costs?"

Question 2:

> "What is the current evidence on the impact of optimal deployment models for healthcare professionals in the maternity service, including midwives, nurses, allied health professionals, and support staff, on maternal and neonatal outcomes?"

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> "What is the current understanding and implementation of headroom provision in maternity care, including its impact on staffing ratios, workforce planning, and quality of care outcomes?"

Question 4:
Do single bedroomed wards in maternity services require a variation on staffing requirements and what, if any, patient outcomes support this.

3. BACKGROUND

Skill mix models in maternity care

The first question explores the evidence around skill-mix across the maternity pathway focusing on the addition and contribution of other clinical support roles and the relationship to outcomes; including midwifery sensitive outcomes, patient experience data, colleague experience and value for money. For the purpose of this review, skill mix refers to the combination of healthcare professionals such as midwives, obstetricians, nurses, and other support staff, who work together to provide care for women during pregnancy, childbirth, and the postnatal period. Skill mix models need to be effective in meeting the needs of patients, healthcare professionals, and the healthcare system. Sandall et al. (2011) published a scoping review that examined deployment practices and the safety of maternity care in high- and middle-income countries (Sandall et al. 2011). The findings suggested that implementation of an effective skill mix model has the potential to improve maternal and neonatal safety, increase access to care, improve patient satisfaction and reduce healthcare costs (Sandall et al. 2011). The evidence review that was published by Bazian in 2014 to inform the development of the current NICE guidelines on safe staffing for maternity services (NICE 2015) identified a lack of specific evidence examining midwifery staffing and outcomes at the individual level for women and babies, as well as at the level of individual shifts. Additionally, there was limited evidence directly identifying the relationship between midwifery staffing and maternal or neonatal outcomes. Furthermore, where data was available, there was a lack of evidence establishing clear links between midwifery staffing levels, skill mix, and their impact on outcomes (Bazian 2014). However the studies within the evidence review did indicate that higher ratios of consultant midwives to midwives were associated with reduced maternal readmissions. Higher ratios of obstetric medical staff to midwives, particularly consultants, may be linked to improved outcomes, while higher levels of nurses to midwives or support workers to midwives may be associated with poorer outcomes. An evidence update published in 2017 found no further published work in this area (Sandall et al. 2017).

Task shifting and extending roles can be an integral component of skill mix models in midwifery care. It involves the redistribution of tasks from highly skilled professionals, such as obstetricians, to other healthcare providers with appropriate training and competence, such as midwives (Sandall et al. 2011). The findings of a scoping review suggested that where midwives take on expanded responsibilities and assume tasks traditionally performed by junior

doctors, there is potential to maintain and improve outcomes (Sandall et al. 2011). Two further evidence updates found very little further published work for task shifting and extending roles in midwifery care and safe staffing (Bazian 2014; Sandall et al. 2017).

In the UK maternity support workers have been widely employed to free up midwives and doctors, enabling them to focus on complex tasks (Sandall et al. 2011). Their role is defined by the Royal College of Midwives (2016p. 7) as those who "*assist with caring for women, babies and their families throughout their maternity journey, working under supervision and within agreed guidelines and protocols when providing care to women and their families*". The aim of incorporating maternity support workers into the workforce skill mix is to utilise them as a complementary resource to midwives, rather than as a substitute for them (National Quality Board 2018). Although anecdotal evidence recognises maternity support workers as having a significant contribution in maternity services, there is limited research that has evaluated their effectiveness in terms of safety, and task division between midwives and maternity support workers (Bazian 2014, Sandall et al. 2011).

There has been a broad consensus among policy makers supporting the notion of having a consultant obstetrician available 24 hours per day in the labour ward to improve the safety of childbirth (Royal College of Obstetricians & Gynaecologists 2016). The evidence review conducted by Sandall et al. (2020) identified one systematic review that focused on this area (Knight et al. 2015). However, Knight et al. (2015) reported that no reliable evidence was found to draw robust conclusions regarding intrapartum outcomes supporting the model of 24-hour resident consultant presence on the labour ward versus other models of consultant cover.

Deployment models for healthcare professionals in the maternity service

The second question focuses on the optimum deployment models to support safe care across maternity services; specifically, midwifery, nursing, allied health professionals and support workers. There are several different deployment models for healthcare professionals in maternity care which are often dependent on the availability of resources, the preferences of healthcare professionals and women, and the level of risk and complexity of care required.

A midwifery-led continuity of care model is characterised by midwives taking the primary role in providing comprehensive care during a woman's pregnancy and birth journey. This can either be through caseload midwifery in which the midwife takes responsibility for the care of a group of individuals or through team midwifery in which continuity of care is provided through a team of midwives sharing a caseload (Sandall et al. 2016). The Better Births report published by the National Maternity Review in 2016 recommended that a midwifery continuity of carer model should be rolled out within the NHS (NHS England 2016). The full guidance on how this can be implemented across NHS trusts was published in 2021 (NHS England 2021).

Other models of care include consultant-led models which are those in which obstetricians take the lead role in providing care to women during pregnancy, birth, and the postnatal period, particularly in situations where specialised medical expertise and management are required (Sandall et al. .2016). Sutcliffe conducted a systematic review of reviews to assess the effects of maternity care led by midwives, as opposed to care led by physicians, specifically for low-risk women. It was reported that for some maternal and neonatal outcomes there were no differences in the level of care a woman received and that for some outcomes care by a midwifery-led care can be beneficial (Sutcliffe et al. 2012).

The Royal College of Midwives (2017) reported that the model of maternity care plays a crucial role in influencing a wide range of health and clinical outcomes for both mothers and babies. Different models of maternity care can have distinct impacts on the experiences and outcomes of mothers and infants. The midwifery-led continuity of care model has been shown to

contribute to improving the quality and safety of maternity care with high quality evidence indicating that women who are recipients of this type of care are more likely to have effective care, a better experience and improved clinical outcomes. The previous evidence review conducted by Sandall et al. (2017) did not report on this question.

Implementation of headroom provision in maternity care

The third question focuses on service specific composition of headroom provision and its implementation within maternity services or translatable services. In the context of nursing and healthcare, "headroom provision" refers to the percentage uplift to an organisation's staffing establishment to take into account predictable absences, such as annual leave, study leave, sick leave, and maternity leave. It is intended to ensure that staffing levels remain sufficient even during periods of staff absence (Royal College of Midwivies 2016). In the context of maternity care, headroom provision (also known as uplift) is an important consideration for ensuring safe and effective staffing levels in maternity services. Ensuring that staffing levels are maintained, even during periods of staff absence has the potential to contribute to better outcomes for mothers and babies, as well as improved staff morale and job satisfaction (Dani et al. 2020, Dharni et al. 2021). However, the previous evidence review conducted by Sandall et al. (2017) found a lack of evidence regarding the impact of staffing ratios including uplift for midwives working in maternity settings.

Single bedroomed wards

The final question asks do single bedroomed wards in maternity services require a variation on staffing requirements and what, if any, patient outcomes support this. As part of the New Hospital Programme, the UK government is planning a substantial transformation of NHS hospitals. This initiative entails a shift towards the adoption of single bedrooms over open wards in the construction of new hospital facilities (National Audit Office 2023). The implementation of single bedroomed wards may require either increasing staffing levels or adjusting the staff skill mix. The previous evidence review by Sandall et al. (2017) did not address this question.

Single room maternity care (SRMC) units represent a model of care widely used in the USA and Canada. In these units, a childbearing woman and her family remain in one room from admission through discharge, with the newborn staying with the family at all times (Harris et al 2004). This contrasts with traditional maternity care where labouring women are admitted to the labour and delivery unit and then transferred to the postpartum unit within hours of birth (Ali et al. 2020). The SRMC model promotes continuity of care, with all registered nurses trained in providing antenatal, intrapartum, newborn and postpartum care (Ali et al. 2020).

4. SUMMARY OF THE EVIDENCE BASE

4.1. Type and amount of evidence available for question 1

The searches for question one identified one systematic review with meta-analysis (Reid et al. 2017); two systematic reviews without meta-analysis (Raams et al. 2018; Wekesah et al. 2016); one scoping review (Turner et al. 2021), three retrospective cohort studies (Carlson et al. 2020; Morad et al. 2021; Shawer et al. 2019) one prospective cohort study across two publications (Pfniss et al. 2023; Reif et al. 2017) and two descriptive studies (Turner et al. 2022a, b). The details are provided in Tables 1 and 2.

The evidence focused on staffing levels (Carlson et al. 2020; Turner et al. 2021; Turner et al. 2022a, b), task shifting (Wekesah et al. 2016; Raams et al. 2018), maternity support workers (Turner et al. 2021, 2022b) and obstetrician presence on the labour ward (Reid et al. 2017; Reif et al. 2017; Morad et al. 2021; Pfniss et al. 2023 Shawer et al. 2019).

A summary of the evidence is provided below:

- A scoping review that sought to determine what is known (and unknown) about the relationship between staffing levels and patient outcomes (Turner et al. 2021, critically low quality evidence [--]). The scoping review included 21 studies (three randomised controlled trials, 11 cohort studies, one case control study and six cross sectional studies) from across 10 countries and included all eight studies from the evidence synthesis conducted by Bazian in 2014 for the NICE guideline on safe staffing (NICE 2015). Formal quality assessment was not conduced although sources of bias were acknowledged by taking study design, measurement of exposure and outcomes, and risk of adjustment into consideration.
- A cross sectional secondary analysis of 13,264 women from 123 post-natal wards within 93 English NHS hospital Trusts that explored the relationship between staffing levels in midwifery services and women's experiences of postnatal care in inpatient wards (Turner et al. 2022a, survey evidence).
- A cross sectional secondary analysis of linked routinely collected datasets in 129 English hospital Trusts which included 17,611 women to examine whether the quality of postnatal care reported by women is associated with variation in midwifery staffing levels (Turner et al. 2022b, survey evidence).
- A systematic review that sought to establish effective non-drug interventions for improving outcomes and quality of maternal health care in sub-Saharan Africa (Wekesah et al. 2016, critically low quality evidence [--]). Of the 73 studies in the systematic review, two focused on task-shifting interventions:
    - Retrospective cohort study - performance of emergency caesarean sections by non-physician clinicians in Tigray, Ethiopia.
    - Quasi-experimental study - antenatal counselling by lay nurse aids with training and supervision by job aids in Benin.
- A systematic review that examined task-shifting of specific active management of the third stage of labour components to unskilled birth attendants or self-administration in LMICs (Raams et al. in 2018, critically low quality evidence [--]).
- A systematic review with meta-analysis that explored the effects of increased consultant presence across NHS maternity units and the determinants of these effects. The publications identified in the searches for the review were published between 1969 to 2016 (Reid et al. 2017, quality score high [++]).
- A retrospective cohort study that evaluated the association between unit level presence of midwives and rates of caesarean birth for low risk healthy women of different BMI ranges in the USA (Carlson et al. 2020, moderate quality evidence [+]).
- A retrospective cohort study that explored the effect of introducing 24/7 resident labour ward consultant presence on neonatal and maternal outcomes in an obstetric unit in England (Morad et al. 2021, moderate quality evidence [+]).
- A retrospective cohort study that explored the impact of consultant presence on safety and experience of women and babies in England. Analysis was conducted using clinical incident investigation reports that occurred between September 2011 and September 2017 (Shawer et al. 2019, low quality evidence [-]).
- Two publications from a multicentre, prospective cohort study in 10 maternity units in Austria (moderate quality evidence [+]).

- Reif et al. (2017) investigated the impact of time of birth, unit volume and staff seniority on neonatal outcomes in neonates born ≥ 34 weeks of gestation from perinatal data from January 2004 and December 2015.
- Pfniss et al. (2023) explored the effect of the same factors on the incidence of maternal complications in deliveries ≥ 34+0 gestational weeks. Intrapartum and postpartum data were collected from births between January 2004 and December 2015.

4.2. Type and amount of evidence available for question 2

The searches for question 2 identified, one systematic review with meta-analysis across two publications (Sandall et al. 2016; NICE 2016), three systematic reviews without meta-analysis (Donnellan-Fernandez et al. 2018; Fikre et al. 2023; Kilpatrick 2016), two scoping reviews (McRae et al. 2016a, Talukdar et al. 2021), six RCTs (Allen et al. 2019; Bernitz et al. 2016; Fernandez Turienzo et al. 2020; Forster et al. 2016; Horner et al. 2022; McLachlan et al. 2016) and two health economics studies (Attanasio et al. 2019; Callander et al. 2021). The details are provided in Tables 3 and 4. We also found reference to an evidence review of midwifery continuity models of care conducted for the Scottish Government to inform the five-year forward plan for maternity and Neonatal care (The Scottish Government 2017). However, we were unable to source the original evidence review. The search and analysis in the Cochrane systematic review (Sandall et al. 2016) was updated specifically in relation to midwifery-led continuity models, and further subgroup analysis and GRADE (Grading of Recommendations, Assessment, Development and Evaluation) was carried out by the National Institute for Health and Care Excellence (NICE) team as published as a Clinical Guideline Addendum (NICE 2016). However, no additional references were retrieved.

The evidence was focused on midwife continuity of models of care versus other models of care (Donnellan-Fernandez et al. 2018; Fernandez Turienzo et al. 2020, NICE 2016, Sandall et al. 2016, Talukdar et al. 2021); caseload midwifery versus standard antenatal care (Allen et al. 2019; Kilpatrick 2016, McLachlan et al. 2016), caseload midwifery compared to other models of care (Callander et al. 2021), midwifery-led care versus physician led care (Attanasio et al. 2019; Bernitz et al. 2016; Donnellan-Fernandez et al. 2018; McRae et al. 2016a), a range of midwifery-led care models compared to other models of care (Fikre et al. 2023) and two different midwifery continuity of care models (Horner et al. 2022).

A summary of the evidence is provided below:

- A Cochrane systematic review with meta-analysis (Sandall et al. 2016) that updates the work of Sandall et al. (2015) which included 15 trials involving 17,674 women to compare midwifery-led continuity models of care with other models of care for childbearing women and their infants. The primary research took place in four countries (UK, Australia, Canada and Ireland) in a wide variety of settings and health systems. Midwifery-led continuity models of care included either team (n=10) or caseload midwifery (n=4), and women were classified as at low or mixed risk. Other models of care included a shared model of care (n=8); medical-led models of care (n=3) or various options of standard care including shared, medical-led and shared care (n=3) provided by obstetricians or family physicians, or both, collaborating with nurses and midwives in a variety of organisational settings. A further update of this Cochrane review is expected in late 2023 reporting on an additional two trials (Sandall et al. 2023, high quality evidence [++]).
- A scoping review that that synthesised the existing evidence regarding outcomes and experiences of care received in different maternity models in Australia (Talukdar et al. 2021, low quality evidence [--]).

- A systematic review that sought to determine the effect of caseload antenatal care on caesarean section rates, in comparison to standard antenatal care which retrieved two primary studies that were both conducted in Australia (Kilpatrick 2016, critically low quality evidence [--]).
- A systematic review that assessed the effectiveness of midwifery-led care on pregnancy outcomes in low- and middle-income countries (Fikre et al. 2023, high quality evidence [++]).
- A scoping review that examined whether, over the last 25 years in high-resource countries, midwives' patients from low socioeconomic positions were at a higher or lower risk of adverse infant birth outcomes versus physicians' patients (McRae et al. 2016a, high quality evidence [++]).
- A systematic review that summarised the evidence relating to the combined cost-effectiveness, resource use and clinical effectiveness of midwifery continuity models for women who experience complex pregnancies and their babies in developed countries Donnellan-Fernandez et al. 2018; critically low quality evidence [--]).
- A RCT that compared pregnant women's (all risk levels) perceptions of antenatal care when receiving caseload midwifery care versus standard care in Australia (Allen et al. 2019, moderate quality evidence [+]).
- A paper reporting the secondary outcome of a RCT conducted in Norway. The secondary outcome involved assessing possible differences in satisfaction with intrapartum care among low-risk women randomly assigned to a Midwifery Unit or Obstetric Unit (Bernitz et al. 2016, high quality evidence [++]).
- A RCT aiming to assess differences in clinical outcomes between women receiving midwifery continuity of care versus standard maternity care for women at increased risk of preterm birth in the UK (Fernandez Turienzo et al. 2020, high quality evidence [++]).
- A paper exploring the secondary outcome of a RCT conducted in Australia. The secondary outcome was to evaluate the effect of caseload midwifery on satisfaction with care in comparison to those receiving standard care (Forster et al. 2016, high quality evidence [++]).
- An Australian RCT aiming to determine whether midwifery continuity of care increases the number of women attempting vaginal birth after a previous caesarean section (Homer et al. 2022, high quality evidence [++]).
- A paper presenting the secondary outcome of a RCT conducted in Australia to determine the effect of midwifery caseload care in comparison to standard care on women's experiences of childbirth (McLachlan et al. 2016, high quality evidence [++]).
- A study that examined the cost utility of a publicly funded Midwifery Group Practice caseload model of care compared to other models of care in Australia (Callander et al. 2021, not rated for overall quality).
- A US study using a decision analysis model to compare the costs between midwifery-led care and obstetrician-led care in low risk pregnancies (Attanasio et al. 2019, not rated for overall quality).

4.3. Type and amount of evidence available for question 3

The searches for question identified three guidance documents (Royal College of Midwivies 2016, NHS England and NHS Improvement 2019, NHS England and NHS Improvement 2020) and one NQB improvement resource (National Quality Board 2018) that referred to headroom. However, we did not find any primary or secondary research evidence that explored the

concept of headroom within maternity services. An additional search across the nursing literature identified one descriptive study (Drake et al. 2020).

A summary of the evidence is provided below:

- The Royal College of Midwives guidance (The Royal College of Midwives 2016) on implementing the NICE safe staffing guidelines on midwifery staffing in maternity services (NICE 2015).
- Two guidance documents on e-rostering and the clinical workforce (including maternity services) system that takes into account sickness and leave (NHS England and NHS Improvement 2019, 2020).
- The National Quality Board improvement resource for maternity services (National Quality Board 2018).
- A retrospective cohort study that collected data from the e-rostering systems of 87 NHS Trusts and compared this with published data from 35 roster policies to investigate the disparities between planned unavailability ("headroom") and actual staff unavailability (Drake et al. 2020 – survey evidence).

4.4. Type and amount of evidence available for question 4

The initial searches for question 4 identified three systematic reviews (Ali et al. 2020, Bertuzzi et al. 2023, Voigt et al. 2018). Across these three reviews there were 11 unique studies that were relevant to the question (Bergeron 2001, Drum 2011, Gerrits et al. 2013, Harris et al. 2004, Hickey 1994, Janssen et al. 2006, Janssen et al. 2001, Janssen et al. 2000, Olson & Smith 1992, Rogner 1995, Williams & Mervis 1990)[1]. Three further primary studies (Ali et al. 2019, Hall et al. 2023, Hall et al. 2019) were identified from the initial searches. In total there were 10 quantitative studies, two qualitative studies and two mixed methods studies conducted in Canada (n=8), USA (n=5), Netherlands (n=1). Details are provided in Tables 6 and 7.

A summary of the review evidence is provided below:

- A systematic review without meta-analysis of SRMCs that sought to describe and evaluate the SRMC model and its influence on patient, provider and system outcomes. Searches were conducted from 1985 to August 2018 (Ali et al. 2020, high quality evidence [++]).
- A systematic review that assessed the impact of single rooms versus multioccupancy accommodation on inpatient healthcare outcomes and processes. Of the 145 included studies three were found that assessed maternity care. Searches were conducted up to February 2022 (Bertuzzi et al. 2023, not rated).
- A systematic review that presented the evidence for the single bedded rooms in low-acuity hospital care settings. Of the 49 included studies two were found that assessed maternity care. Searches were conducted from 1980 to September 2016 (Voigt et al. 2018, not rated).

A summary of the primary research evidence is provided below:

- A qualitative ethnographic study that explored the culture and practices of the healthcare team in a SRMC setting in Canada (Ali et al. 2019, qualitative evidence).

[1] The systematic review by Ali et al 2020 included all 11 studies, The systematic review by Voigt et al. 2018 contained two of the studies and the systematic review by Bertuzzi et al. 2023 contained three of the studies.

- A mixed methods comparative study of single use obstetric rooms within an army community hospital in the USA focusing on staffing levels, costs and patient satisfaction (Bergeron 2001, low quality evidence [-]).
- A descriptive evaluative study that explored costs, staff satisfaction, and patient satisfaction of separate labour, deliver and recovery unit with a separate post-partum setting and compared this to a SRMC setting in the USA (Drum 2011, low quality evidence [-]).
- A retrospective cohort study that investigated whether there was a decrease in the number of infants with hypoglycaemia after a SRMC setting had been implemented in a hospital in the Netherlands (Gerrits et al. 2013, low quality evidence [-]).
- A mixed methods study (questionnaires and interviews) that compared healthcare providers' job satisfaction and team collaboration between a SRMC setting and a TMC setting in Canada (Hall et al. 2019, mixed methods evidence).
- A cross-sectional study that compared mother's perceptions of readiness for discharge and satisfaction, and health outcomes between a SRMC setting and a TMC setting in Canda (Hall et al. 2023, survey evidence).
- A pre-test / post-test study that compared perinatal outcomes and costs of care for women delivering in the SRMC setting versus TMC settings (Harris et al. 2004, low quality evidence [-]).
- A descriptive study that examined nurses' attitudes toward practicing in a SRMC setting in the USA after having practiced in a TMC setting (Hickey 1994, low quality evidence [-]).
- Three pre-test / post-test studies assessed levels of satisfaction in a SRMC setting in Canada, two studies were conducted before and after the opening of the SRMC unit (one with patients, one with nurses) and the third described the development of a 40-item satisfaction scale (Janssen et al. 2000, 2001, 2006).
- A descriptive study of patient and nurse satisfaction in a SRMC setting in the USA (Olson and Smith 1992, low quality evidence [-]).
- A qualitative phenomenological study in the USA that explored the birthing experience in rooms that combined labour, delivery, recovery and postpartum care (Rogner 1995, high quality evidence [++]).
- A retrospective cohort study from the USA that reviewed the first 15 months' experience in a labour-delivery-recovery room unit where all patients were admitted for single room care regardless of risk (Williams and Mervis 1990, low quality evidence [-]).

5. KEY FINDINGS

The findings are presented as a series of narrative summaries for each of the three research questions.

5.1 Question 1

The evidence regarding the impact of skill mix models in maternity care is presented separately below for staffing levels (1a), task-shifting and maternity support assistants (1b) and obstetric consultant presence (1c). The findings are further categorised by the following outcomes: maternal outcomes, neonatal outcomes, events during labour, mode of birth, serious untoward incidents or adverse events, patient satisfaction or experience and economic considerations alongside the quality score.

5.1.1. Question 1a: staffing levels

Maternal outcomes (review evidence)

- Increased staffing levels were associated with reduced rates of postpartum haemorrhage, lower maternal readmission and improved delivery with bodily of integrity (a composite measure that included delivery without caesarean, episiotomy, or a second-, third- or fourth-degree perineal tear, uterine damage) (Turner et al. 2021, critically low quality evidence [--]).
- The relationship between staffing levels and perineal damage during childbirth showed inconclusive findings, as the studies included in the review presented a mix of significant and non-significant results (Turner et al. 2021, critically low quality evidence [--]).
- There were no differences between staffing levels and a composite measure of healthy mother (delivery without caesarean, episiotomy, or a second-, third- or fourth-degree perineal tear, uterine damage), and maternal infection (endometritis / amnionitis) (Turner et al. 2021, critically low quality evidence [--]).
- Higher staffing ratios were associated with more complications overall. However, the lack of risk adjustment in this study for confounding factors means that women with higher risks may have had higher staffing levels due to their increased risk (Turner et al. 2021, critically low quality evidence [--]).
- The nurse to birth ratio and the midwife to birth ratio had contrasting effects on severe maternal outcomes (death or near miss). A higher nurse to birth ratio in maternity units was linked to a decreased risk of severe maternal outcomes. Conversely, the likelihood of a woman experiencing a severe maternal outcome (death or near miss) rose when admitted to units with a higher midwife to birth ratio (Turner et al. 2021, critically low quality evidence [--]).

Neonatal outcomes (review evidence)

- Increased staffing was associated with lower rates of neonatal resuscitation (excluding bag/mask only) and higher breastfeeding rates (Turner et al. 2021, critically low quality evidence [--]).
- The relationship between staffing and neonatal resuscitation using advanced measures, admission to neonatal units and Apgar score, showed inconclusive findings, as the studies included in the review presented a mix of significant and non-significant results (Turner et al. 2021, critically low quality evidence [--]).
- There were no significant differences between staffing levels and stillbirth, neonatal death, birth asphyxia, neonatal length of stay, perinatal complications and a composite measure of healthy baby (weight 2.5-4.5kg, gestation 37-42 weeks, live baby) (Turner et al. 2021, critically low quality evidence [--]).

Events during labour (review evidence)

- Increased staffing levels were associated with completeness of the partogram both at the beginning and middle of the shifts, there was a greater likelihood of continuous foetal monitoring, a lower likelihood of foetal distress and quicker speed of theatre transfer for caesarean sections (Turner et al. 2021, critically low quality evidence [--]).
- The relationship between staffing levels and monitoring epidural use, augmentation of labour (oxytocin use), and length of labour was inconclusive as the studies included in the review presented a mix of significant and non-significant results (Turner et al. 2021, critically low quality evidence [--]).

- There were no significant differences for the completeness of the partogram at the end of the shift, completeness of record keeping and appropriate foetal monitoring in relation to staffing levels (Turner et al. 2021, critically low quality evidence [--]).

Mode of birth (primary research evidence)

- Low risk healthy women who underwent labour at centres equipped with both midwives and physicians had a reduced odds of experiencing unplanned caesarean births and also had longer durations of labour compared to women who delivered at centres with only physicians (Carlson et al. 2020, moderate quality evidence [+]).

Mode of birth (review evidence)

- The relationship between staffing levels and rates of emergency caesarean birth, instrumental birth, spontaneous vaginal/normal births and straightforward births was inconclusive, as the studies included in the review presented a mix of significant and non-significant results (Turner et al. 2021, critically low quality evidence [--]).
- There were no significant differences for instrumental birth and straightforward births in relation to staffing levels (Turner et al. 2021, critically low quality evidence [--]).

Patient satisfaction or experience (review evidence)

- The relationship between staffing levels and satisfaction with care was inconclusive as the studies included in the review presented a mix of significant and non-significant results (Turner et al. 2021, critically low quality evidence [--]).

Patient satisfaction or experience (primary research evidence)

- There was no significant relationship between the number of obstetric and gynaecology doctors per 100 births and patient experience (Turner et al. 2022a – survey evidence).
- At Trust level, some aspects of patient experience were significantly better when more midwives were employed. Specifically, more women reported that they were given information and explanations when they needed them and had a better patient experience in terms of discharge without delay (Turner et al. 2022a - survey evidence).
- However, when focussing on postnatal ward staffing, measured as Hours Per Patient Day, there was no evidence of a relationship between registered midwife/nurse staffing and patient experience (Turner et al. 2022a - survey evidence).
- At Trust level variations in staffing between hospitals were found to be linked to differences in patient-reported experiences of postnatal care, even after adjusting for other variables. Women were significantly less likely to report they had experienced a delay in discharge and were significantly more likely to report that staff always helped them in a reasonable length of time and that they were always given the information or explanations they needed (Turner et al. 2022b - survey evidence).

5.1.2. Question 1b: task-shifting and maternity support assistants

Maternal outcomes (review evidence)

- The relative risks of the incidence of post-partum haemorrhage occurring in favour of the administration of the intramuscular oxytocin by auxiliary midwives or community health workers in LMICs was inconclusive as the studies included in the review presented a mix of significant and non-significant results (Raams et al. 2018, critically low quality evidence [--]).
- Increases in midwifery assistants were not significantly related to a composite measure of healthy mother (delivery without caesarean, episiotomy, or a second-, third- or fourth-

degree perineal tear, uterine damage) (Turner et al. 2021, critically low quality evidence [--]).

- There were improvements in maternal knowledge on prenatal care, birth preparedness and recognition of danger signs in pregnancy among women when antenatal counselling was delegated to lay nurse aids, versus those counselled by nursing midwives in in sub-Saharan Africa (Wekesah et al. 2016, critically low quality evidence [--]).
- Similar rates of maternal deaths arising from obstetric complications were reported when comprehensive emergency obstetric care was performed by non-physician clinicians when versus physicians in sub-Saharan Africa. Additionally, length of stay did not statistically differ by type of attending staff (Wekesah et al. 2016, critically low quality evidence [--]).

Neonatal outcomes (review evidence)

- Increases in midwifery assistants were not significantly related to the risk of readmission within 30 days, and a composite measure of healthy baby (weight 2.5-4.5kg, gestation 37-42 weeks, live baby) (Turner et al. 2021, critically low quality evidence [--]).
- Similar rates of foetal deaths arising from obstetric complications were reported when comprehensive emergency obstetric care was performed by non-physician clinicians compared with physicians in sub-Saharan Africa (Wekesah et al. 2016, critically low quality evidence [--]).

Mode of birth (review evidence)

- Increases in midwifery assistants were not significantly related to the probability of emergency section, instrumental birth or normal birth (Turner et al. 2021, critically low quality evidence [--]).

Events during labour (review evidence)

- Regarding the safety of either women self-administering misoprostol tablets or receiving tablets from traditional birth attendants in LMICs, the correct dose administered was reported between 83.4% to 99.8% over five studies with a total of 4719 women. The correct timing of administration was more varied, ranging between 63% to 100% over nine studies and a total of 6757 women (Raams et al. 2018, critically low quality evidence [--]).
- Although mild-to-moderate adverse effects of misoprostol (nausea, vomiting, shivering and/or fever) and oxytocin in the community in LMICs were mentioned in 14 studies, there were no significant differences in mild-to-moderate adverse effects of misoprostol (nausea, vomiting, shivering and/or fever) between women self-administering tablets or receiving tablets from traditional birth attendants of no uterotonics – ergometrine (n=1 study) and methergine (n=1 study) (Raams et al. 2018, critically low quality evidence [--]).

Patient satisfaction or experience (review evidence)

- Women in LMICs were accepting of task shifting in active management of the third stage of labour (Raams et al. 2018, critically low quality evidence [--]).

Patient satisfaction or experience (primary research evidence)

- Higher levels of support worker hours were significantly associated with some aspects of patient experience. More women reported they had been discharged without delay, they had been treated with kindness and understanding and were being helped when they needed it (Turner et al. 2022a, survey evidence).

5.1.3. Question 1c: Obstetric consultant presence

Maternal outcomes (review evidence)

- There were no significant differences in postpartum haemorrhage or perineal tears between lesser obstetric consultant presence and increased obstetric consultant presence (Reid et al. 2017, high quality evidence [++]).

Neonatal outcomes (review evidence)

- There were no significant differences in neonatal intensive care unit (NICU) admission, neonatal death, stillbirth, postpartum haemorrhage or perineal tears between lesser obstetric consultant presence and increased obstetric consultant presence (Reid et al. 2017, high quality evidence [++]).

Neonatal outcomes (primary research evidence)

- The management of uncomplicated deliveries by less experienced staff showed no negative impact on perinatal outcome. When confounding factors are considered higher risk pregnancies managed by senior staff in a tertiary centre in Austria favour a better outcome (Reif et al. 2017, moderate quality evidence [+]).
- The introduction of resident consultant obstetrician presence 24/7 on the labour ward was not associated with a change in a pre-existing trend of increasing adverse neonatal outcomes. However, for babies born >37 weeks gestation, 24/7 presence was associated with a decrease in increasing adverse neonatal outcomes (Morad et al. 2021, moderate quality evidence [+]).

Mode of birth (review evidence)

- There were no significant differences in emergency caesarean section rates, non-instrumental deliveries, instrumental deliveries between lesser obstetric consultant presence and increased obstetric consultant presence (Reid et al. 2017, high quality evidence [++]).
- When data were stratified by comparison type, the likelihood of emergency caesarean section was significantly lower and the likelihood of non-instrumental vaginal delivery was significantly higher when the rostered hours of consultant presence per week were increased (Reid et al. 2017, high quality evidence [++]).

Serious untoward incidents or adverse events (primary research evidence)

- The introduction of 24/7 obstetric consultant presence was reported to have reduced the negative impact caused by a lack of, or delay in, obstetric consultant presence as identified by serious untoward incident reviews. Although no statistical analyses were conducted to confirm these findings (Shawer et al. 2019, low quality evidence [-]).
- In maternity units in Austria, staff seniority appears to become more protective against maternal adverse outcome with increasing pregnancy risks and for healthy, lower risk patients, midwifery care appears protective (Pfniss et al. 2023, moderate quality evidence [+]).

Economic considerations

- There is insufficient evidence available regarding the financial implications of increased obstetric consultant presence.

5.3 Question 2

The evidence regarding the impact of optimal deployment models for healthcare professionals in the maternity service, including midwives, nurses, and allied health professionals is presented below. The approaches that have been compared are: types of midwifery-led continuity models compared to each other or other models of care, caseload midwifery with standard care, midwifery-led care with physician led care and midwifery-led models with other models of care. The findings are further categorised in relation to the following outcomes maternal outcomes, neonatal outcomes, interventions given to prevent and/or manage potential preterm labour and birth events during labour, mode of birth, patient satisfaction or experience, adverse effects and economic considerations alongside the quality score.

5.3.1. Comparing different types of midwifery-led continuity models

Maternal outcomes (primary research evidence)

- There were no significant differences in maternal outcomes between two different antenatal continuity of care models. One that provided continuity across the full spectrum of childbearing (antenatal, labour and birth and postnatal) and one that provided only antenatal continuity on an unplanned or ad hoc basis (Horner et al. 2022, high quality evidence [++]).

Neonatal outcomes (primary research evidence)

- There were no significant differences in neonatal outcomes between two different antenatal continuity of care models (one that provided continuity across the full spectrum of childbearing (antenatal, labour and birth and postnatal) and one that provided only antenatal continuity on an unplanned or ad hoc basis) (Horner et al. 2022, high quality evidence [++]).

Mode of birth (primary research evidence)

- There were no significant differences on the intention to attempt a vaginal birth after a previous caesarean section between two different antenatal continuity of care models (one that provided continuity across the full spectrum of childbearing (antenatal, labour and birth and postnatal) and one that provided only antenatal continuity on an unplanned or ad hoc basis) (Horner et al. 2022, high quality evidence [++]).

5.3.1. Comparing midwifery-led continuity models of care with other models of care

The evidence here is focused on midwife continuity of models of care versus other models of care. It was outside of the remit of this rapid scoping review to incorporate the additional findings arising from the subgroup analysis conducted by NICE (2016) for the Cochrane reviews (Sandall et al. 2016) variations in midwifery-led model of care (caseload / team), variations in risk status (low risk / mixed risk) and variations in parity.

Maternal outcomes (review evidence)

- Women who experienced midwifery-led continuity models of care were on average less likely to experience amniotomy and episiotomy compared to women who experienced other models of care (Sandall et al. 2016, high quality evidence [++]).

- There were no differences between women who experienced midwifery-led continuity models of care and the maternal outcomes of intact perineum[2], induction of labour[3], antenatal hospitalisation, antepartum haemorrhage, perineal laceration requiring suturing and postpartum haemorrhage compared to women who experienced other models of care (Sandall et al. 2016, high quality evidence [++]).

Maternal outcomes (primary research evidence

- For women who were considered to be at increased risk of preterm birth who experienced midwifery continuity of care with access to a specialist obstetric clinic, there were no statistically significant differences in any of secondary maternal outcomes compared to women experiencing standard care as part of the POPPIE[4] study (Fernandez Turienzo et al. 2020, high quality evidence [++]).

Neonatal outcomes (primary research evidence)

- For women who were considered to be at an increased risk of preterm birth who experienced midwifery continuity of care with access to a specialist obstetric clinic there were no statistically significant differences for the majority of the secondary neonatal outcomes with the exception that infants were significantly more likely to have skin-to skin contact after birth, more to have it for a longer time, and to breastfeed immediately after birth and at hospital discharge compared to women experiencing standard care as part of the POPPIE study (Fernandez Turienzo et al. 2020, high quality evidence [++]).

Interventions given to prevent and/or manage potential preterm labour and birth

- For women at an increased risk of preterm birth who experienced midwifery continuity of care with access to a specialist obstetric clinic there were no statistically significant differences in the primary composite outcome[5] (initiation and timing of one or more interventions for the prevention and/or management of preterm labour and birth) or any of its components (antibiotics for urinary tract infections, transvaginal scan assessments of the cervix, foetal fibronectin assessments, cerclage insertion, progesterone administration, corticosteroid administration, tocolysis, magnesium sulphate administration, admission for observation, in utero transfer, smoking cessation, and domestic violence referrals) compared to women experiencing standard care as part of the POPPIE study (Fernandez Turienzo et al. 2020, high quality evidence [++]).

Neonatal outcomes (review evidence)

- Women who experienced midwifery-led continuity models of care were on average less likely to experience preterm birth less than 37 weeks[6], all foetal loss before and after 24 weeks plus neonatal death compared to women who experienced other models of care (Sandall et al. 2016, high quality evidence [++]).
- There were no differences between women who experienced midwifery-led continuity models of care groups with regards foetal loss equal to/after 24 weeks and neonatal death, [7]breastfeeding initiation[8], low birthweight infant, five minute Apgar score less than or equal

[2] Low quality evidence from 10 RCTs with 13186 participants showed there may be no difference in intact perineum (NICE 2016).
[3] Low quality evidence from 12 RCTs with 15856 participants showed no difference in induction of labour (NICE 2016).
[4] POPPIE study (Pilot study Of midwifery Practice in Preterm birth Including women's Experiences)
5 The authors noted that as this was a pilot study, it was not sufficiently powered to detect significant improvements in the primary outcome.
[6] Low quality evidence from 8 RCTs with 13238 participants showed there may be lower preterm births (< 37 weeks) with midwifery-led continuity of care (NICE 2016).
[77] Moderate quality evidence from 13 RCTs with 17527 participants showed there may be lower perinatal mortality defined as all foetal loss before and after 24 weeks plus neonatal death with midwifery-led continuity of care. However, very low quality evidence from 12 RCTs with 10359 participants showed no difference perinatal mortality defined as foetal loss equal to/after 24 weeks and neonatal death (NICE 2016).
[8] Very low quality evidence from 2 RCTs with 2050 participants showed there may be no difference in breastfeeding initiation although a clinically important reduction, or increase, cannot be excluded (NICE 2016).

to seven, neonatal convulsions, admission of infant to special care or neonatal intensive care unit(s) or in mean length of neonatal hospital stay (days) compared to women who experienced other models of care (Sandall et al. 2016, high quality evidence [++]).

- The evidence was inconclusive for the neonatal outcomes of admission to neonatal units and Apgar score <7 for women who received midwifery continuity care compared to women who received standard models (and private obstetric care in) across Australia as the studies included in the review presented a mix of significant and non-significant results (Talukdar et al. 2021, critically low quality evidence [--]).

Mode of birth (review evidence)

- Women who experienced midwifery-led continuity models of care were on average less likely experience instrumental vaginal birth[9] compared to women who experience other models of care (Sandall et al. 2016, high quality evidence [++]).
- Women who experienced midwifery-led continuity models of care were on average more likely to experience spontaneous vaginal birth[10] and no intrapartum analgesia/anaesthesia compared to women who experience other models of care (Sandall et al. 2016, high quality evidence [++]).
- There were no significant differences between women who experienced midwifery-led continuity models of care and the likelihood of upgoing a caesarean births[11], receiving augmentation/artificial oxytocin during labour[12] or opiate analgesia compared to women who experience other models of care (Sandall et al. 2016, high quality evidence [++]).
- Women who received midwifery continuity care in Australia were consistently more likely to have spontaneous and normal vaginal births, less likely to experience caesarean sections and experienced lower use of interventions i.e., use of analgesia, episiotomies and induction of labour compared to those in standard care (and private obstetric care in one study) (Talukdar et al. 2021, critically low quality evidence [--]).

Events during labour (review evidence)

- Women who experienced midwifery-led continuity models of care were on average less likely to experience regional analgesia[13], a longer mean length of labour and to be attended at birth by a known midwife compared to women who experience other models of care (Sandall et al. 2016, high quality evidence [++]).

Adverse effects (review evidence)

- There was no evidence of an increased likelihood of adverse outcomes for women or their infants who were assigned to a midwifery-led continuity model of care (Sandall et al. 2016, high quality evidence [++]).

[9] Moderate quality evidence from 13 RCTs with 17965 participants using midwifery-led continuity of care showed less instrumental vaginal birth compared to other models of care (NICE 2016).
[10] Moderate quality evidence from 12 RCTs with 16687 participants showed more spontaneous vaginal birth with using midwifery-led continuity of care (NICE 2016).
[11] Moderate quality evidence from 14 RCTs with 17658 participants showed there may be no difference in caesarean birth (NICE 2016).
[12] Very low quality evidence from 12 RCTs with 15196 participants showed lower augmentation / artificial oxytocin during labour with midwifery-led continuity of care yet this effect did not reach minimum important difference (NICE 2016)
[13] Low quality evidence from 14 RCTs with 17674 participants using midwifery-led continuity of care showed less use of regional analgesia (epidural or spinal) compared to other models of care, yet this effect did not reach minimum important difference (NICE 2016).

Patient satisfaction or experience (review evidence)

- Women who experienced midwifery-led continuity models of care report a higher level of maternal satisfaction[14] compared to women who experience other models of care (Sandall et al. 2016, high quality evidence [++]).
- Women who received midwifery continuity care experienced more continuity of care reported increased self-control and satisfaction compared to women who received standard care (Talukdar et al. 2021, critically low quality evidence [--]).

Economic considerations (review evidence)

- All studies suggest a cost-saving effect in intrapartum care. One study suggests a higher cost, and one study no differences in cost of postnatal care when midwifery-led continuity of care is compared with medical-led maternity care (Sandall et al. 2016, NICE 2016, high quality evidence [++]).
- Australian and UK studies that compared the cost of continuity of midwife care and/or team midwifery to standard care have suggested a cost saving in intrapartum care in the midwifery model. One study suggested higher cost and one study showed no difference in cost of postnatal care in the midwifery model compared with the medical-led model. However the cost results for postnatal care were not stratified by level of obstetric risk (Donnellan-Fernandez et al. 2018, critically low quality evidence [--])[15].
- There is limited evidence to support the cost-effectiveness of midwifery continuity of care for women with complex pregnancy (Donnellan-Fernandez et al. 2018, critically low quality evidence [--]).

5.3.2. Comparing caseload midwifery with standard care

Mode of birth (review evidence)

- Pregnant women with low risk who received caseload care for the antenatal period in Australia had a lower likelihood of a caesarean section as opposed to those receiving standard care (Kilpatrick 2016, critically low quality evidence [--]).

Patient satisfaction or experience (primary research evidence)

- Regardless of level of risk, women randomised to caseload midwifery in Australia were significantly more likely to rate components of antenatal care more highly than those allocated to standard care (for example feeling informed, being actively involved in decision-making, receiving emotional reassurance and support, and perceiving care practitioners were competent) (Allen et al. 2019, moderate quality evidence [+]).
- At two months postpartum, women allocated to caseload midwifery care had higher satisfaction ratings for all aspects of antenatal, intrapartum and postpartum care in Australia (Forster et al. 2016, high quality evidence [++]).
- Pregnant women who were low risk and received caseload care in Australia were significantly more positive about their overall birth experience than women who received standard care. They also felt more in control during labour, were more proud of themselves, less anxious, and more likely to have a positive experience of pain (McLachlan et al. 2016, high quality evidence [++]).

[14] Very low evidence from 1 RCT with 623 participants showed greater maternal satisfaction with midwifery-led continuity of care. (NICE 2016).
[15] Included the same studies that we included in the Cochrane review by Sandall et al. 2016.

5.3.2. Comparing caseload midwifery with other models of care

Economic considerations (primary research evidence)

- The cost of caseload midwifery care was 22% lower than alternative care models in Australian settings, after adjusting for variations in baseline characteristics (Callander et al. 2021, quality not rated).
- There were no significant differences in Quality-Adjusted Life Years between caseload midwifery and other models of care in Australian settings. Caseload care midwifery produced comparable health outcomes, suggesting a potential advantage in terms of lower costs per woman (Callander et al. 2021, quality not rated).

5.3.2. Comparing midwifery-led care with physician led care

Maternal outcomes (primary research evidence)

- Low risk women who received midwife-led care in Australian settings were significantly less likely to undergo an episiotomy during labour compared to low risk women who received obstetric led care (Attanasio et al. 2019, quality not rated).

Neonatal outcomes (review evidence)

- There were inconclusive findings for improvements in birth outcomes (preterm birth, low or very low birth weight, or NICU admission) for vulnerable women in the care of midwives when compared to women receiving physician-led care across OECD countries, as the studies included in the review presented a mix of significant and non-significant results (McRae et al. 2016a, high quality evidence [++]).

Events during labour (primary research evidence)

- There were no differences between low-risk women who experienced midwife-led continuity models of care and the likelihood of undergoing certain events in labour - epidural, induction with and without definitive medical reasons compared to low risk women who experienced obstetric-led care other models of care (Attanasio et al. 2019, quality not rated).

Mode of birth (primary research evidence)

- There were no differences between low-risk women who experienced midwife-led continuity models of care and the likelihood of a planned caesarean section or assisted vaginal birth compared to low risk women who experienced obstetric-led care other models of care (Attanasio et al. 2019, quality not rated).

Patient satisfaction or experience (primary research evidence)

- Overall satisfaction with intrapartum care was significantly higher among low-risk women in Norway randomized to a midwifery unit compared to an obstetric unit (Bernitz et al. 2016).
- Low-risk women in Norway who had an obstetrician involvement during labour or delivery were less satisfied than those who did not (Bernitz et al. 2016, high quality evidence [++]).
- In Norwegian settings the mode of operative delivery and epidurals influenced the level of overall satisfaction in a negative direction regardless of whether a women gave birth in a midwifery-led unit or an obstetric unit (Bernitz et al. 2016, high quality evidence [++]).

Economic consideration (review evidence)

- In Australian and UK settings although the evidence demonstrates cost savings of midwifery-led care when compared to obstetric consultant led units the evidence base for

cost-effectiveness of continuity of midwifery care for women with pregnancy risk is limited (Donnellan-Fernandez et al. 2018, critically low quality evidence [--]).

Economic considerations (primary research evidence)

- In Australian settings, low-risk women receiving midwife-led care experienced an average cost reduction of $2421 compared to those under obstetrician care (Attanasio et al. 2019, quality not rated).
- These cost differences can be attributed to the lower rates of preterm births and episiotomies for women who received midwife-led care compared to women who received obstetrician-led care (Attanasio et al. 2019, quality not rated).

5.3.4. Comparing midwifery-led care with other models of care

Neonatal outcomes (review evidence)

- The average neonatal admission time in neonatal intensive care unit for women who received midwifery-led care were significantly reduced compared to women receiving other models of care in LMICs (Fikre et al. 2023, high quality evidence [++]).
- There were no significant associations for women who received midwifery-led care and preterm birth and early initiation of exclusive breastfeeding compared to women receiving other models of care in LMICs (Fikre et al. 2023, high quality evidence [++]).

Events during labour (review evidence)

- The use of episiotomy during birth for women who received midwifery-led care were significantly decreased compared to women receiving other models of care in LMICs (Fikre et al. 2023, high quality evidence [++]).

Mode of birth (review evidence)

- There were significantly reduced risks of emergency caesarean sections and increased odds of vaginal birth for women who received midwifery-led care compared to other models of care in LMICs (Fikre et al. 2023, high quality evidence [++]).

5.3 Question 3: Headroom provision

The evidence regarding the current understanding and implementation of headroom provision in maternity care is presented below and the primary research study is detailed in Table 5.

- Headroom is the % uplift to the establishment applied to take account of predictable absences including annual leave, study leave, sick leave and maternity leave NHS (NHS England and NHS Improvement 2020).
- Uplift should include planned and unplanned leave (National Quality Board 2018).
- Key performance indicators should include comparisons between agreed headroom and headroom used (NHS England and NHS Improvement 2019).
- “Appropriate and prospective uplift”- can be achieved through the collection of retrospective data (previous two years) (The Royal College of Midwives 2016).
- The components of headroom provision include cover for the following:
    - Annual leave (National Quality Board, 2018; NHS England and NHS Improvement, 2019; NHS England and NHS Improvement, 2019, 2020; The Royal College of Midwives 2016).

- Sickness absence (National Quality Board, 2018; NHS England and NHS Improvement, 2019; NHS England and NHS Improvement, 2019, 2020; The Royal College of Midwives 2016).
- Parenting leave (National Quality Board 2018; NHS England and NHS Improvement 2019), also defined as maternity leave (NHS England and NHS Improvement 2020, The Royal College of Midwives 2016) and paternity leave (The Royal College of Midwives 2016).
- Study leave (National Quality Board 2018; NHS England and NHS Improvement 2019, 2020, The Royal College of Midwives 2016). This will vary depending on numbers of new and newly qualified staff in the team (National Quality Board 2018) and includes mandatory training (National Quality Board, 2018; The Royal College of Midwives 2016), role specific training (National Quality Board, 2018), and continuous professional development (The Royal College of Midwives 2016).
- Specific additional roles that require allocated time, e.g. link nurses (National Quality Board 2018).
- Attending relevant meetings, assessment and mentoring of students and administrative and management duties (National Quality Board 2018).

- There are wide variations in unavailability (15.5% to 33.6%) and contrasting levels of headroom (16% to 26%) across e-rostering systems across 87 NHS Trusts in the UK (Drake et al. 2020).
- The headroom components data from roster policies across 20 NHS Trusts were described. Generic headroom was 22.1% ranging between 18 and 25%. Annual leave was 14.3% and sickness was 4.0% on average across 20 out of 20 NHS Trusts. Study leave was 2.6% on average across 18 out of 20 NHS Trusts with two not including this in headroom, while parenting leave was 2.3% on average with only 6 NHS Trusts out of 20 mentioning these in roster policies. Non-clinical work was only included in headroom across 9 NHS Trusts, with an average of 1.8%.

5.4 Question 4: Single bedroomed wards

The evidence regarding the impact of single bedroomed wards is presented below and the findings are categorised by the following outcomes: staffing levels, clinical outcomes, length of stay, staff satisfaction, patient satisfaction, costs, alongside the quality score.

6. CONCLUSIONS

6.1. Question 1: Impact of skill mix

- This rapid scoping review has identified some evidence of an association between staffing levels in midwifery units and improved maternal and neonatal outcomes, events in labour, mode of birth.
- However, the evidence is limited by the methodological quality of the studies. Additionally, there is limited evidence to indicate any substantial harms or benefit from employing maternity support assistants.
- The relationship between staffing levels and patient satisfaction and experience is inconclusive. Nevertheless, the data suggests that employing more midwives and maternity support assistants has the potential to improve postnatal care experiences.
- There is insufficient available evidence regarding the benefit of task shifting in high income countries.

- Increased obstetric consultant presence on maternity units influences the mode of delivery and has the potential to mitigate against adverse maternal and neonatal outcomes for babies born at term and high risk pregnancies.
- There is insufficient available evidence regarding the financial implications of staffing levels, task shifting, maternity support assistants and obstetric consultant presence.

Question 2: The impact of deployment models

- There were no significant differences in the intention to attempt a vaginal birth after a previous caesarean section and in maternal or neonatal outcomes between different antenatal continuity of care models.
- Women receiving midwifery-led continuity of care were less likely to undergo certain medical interventions like amniotomy and episiotomy compared to other care models. There were no significant differences in various maternal outcomes.
- Women receiving midwifery-led continuity care had a significantly lower likelihood of preterm birth, foetal loss (both before and after 24 weeks), and neonatal death compared to other care models. However, there were no significant differences in several other neonatal outcomes.
- Women in midwifery-led continuity care had a significantly lower likelihood of preterm birth, foetal loss (both before and after 24 weeks), and neonatal death compared to other care models. However, there were no significant differences in several other neonatal outcomes.
- In midwifery-led continuity care models, women were less likely to experience instrumental vaginal births but more likely to have spontaneous vaginal births and undergo labour without intrapartum analgesia or anaesthesia.
- For women at a higher risk of preterm birth who received midwifery continuity of care and had access to a specialist obstetric clinic, there were no significant differences in primary combined outcome or most secondary neonatal outcomes.
- There is some evidence suggesting cost-saving benefits in intrapartum care when comparing midwifery-led continuity of care to other models, but the evidence for postnatal care cost savings is inconclusive and lacks risk stratification.
- The evidence on neonatal outcomes for women receiving midwifery continuity care in Australia compared to standard care is inconclusive but suggests favourable trends toward more spontaneous vaginal births and fewer caesarean sections.
- Further evidence from Australian settings suggests that caseload midwifery, when compared to standard care, offers several advantages:
    - Low-risk pregnant women in caseload care had lower rates of caesarean sections and reported higher satisfaction with their antenatal care.
    - Postpartum satisfaction was consistently high across all care phases.
    - Moreover, low-risk pregnant women in caseload care had more positive overall birth experiences, feeling greater control, less anxiety, and more pride, highlighting the benefits of this approach.
    - Caseload midwifery care offers cost savings (22%) without compromising health outcomes (comparable quality-adjusted life years), making it an attractive choice for maternal care.
- The evidence on birth outcomes for vulnerable women in midwifery care versus physician-led care is inconclusive.

- Low-risk women in Norway were more satisfied with intrapartum care in midwifery units than in obstetric units. However, satisfaction decreased with obstetrician involvement and was negatively affected by operative delivery and epidural use, regardless of the care setting.
- While the evidence from Australia and the UK indicates cost savings in midwifery-led care compared to obstetric consultant-led units, the available evidence base for the cost-effectiveness of continuity of midwifery care for women with pregnancy risk is limited.
- In Australian settings simulations show an average cost reduction of $2421 for low-risk women for midwife-led care due to lower rates of preterm births and episiotomies.
- In LMICs, midwifery-led care is linked to shorter neonatal intensive care unit stays, reduced episiotomy use, fewer emergency caesarean sections, and higher odds of vaginal birth. However, it shows no significant associations with preterm birth or early breastfeeding initiation.

6.3. Question 3: Headroom provision

- Headroom in the NHS accounts for predictable absences, including planned and unplanned leave, and key performance indicators should compare agreed headroom to its utilization through the collection of retrospective data from the past two years.
- Across 87 NHS Trusts in the UK, there are substantial variations in unavailability (ranging from 15.5% to 33.6%) and contrasting levels of headroom (ranging from 16% to 26%) in e-rostering systems.
- When looking at roster policies across 20 NHS Trusts in the UK, the average headroom for various components varied among, including annual leave, sickness, study leave, and parenting leave. Some Trusts also considered non-clinical work in their headroom calculations.

6.4. Question 4: Single bedroomed wards

- The available evidence is limited by the methodological quality of the studies and does not directly explore whether single bedroom wards in maternity services require a variation in staffing requirements or how such variations might affect patient outcomes.
- The evidence explores the use of single room maternity units as a model of care across the USA, Canada and the Netherlands and offers the following insights.
    - Shifting resources to hire more registered nurses instead of licensed practical nurses in single room maternity care settings improved the skills and experience of staff, allowing better supervision of patients.
    - Intrapartum interventions, adverse outcomes, and perinatal mortality rates showed no significant differences between single room maternity care and traditional maternity care, indicating comparable outcomes between the two approaches.
    - Women in single room maternity care settings experienced shorter hospital stays compared to those in traditional maternity care settings.
    - Implementing single room maternity care for women who are at low risk for intrapartum complications can offer cost savings without affecting perinatal outcomes.
    - Staff preferred single room maternity care compared to traditional maternity care and expressed increased levels of job satisfaction, with satisfaction increasing over time.
    - Women consistently reported high satisfaction with single room maternity care across various studies, citing factors such as the quiet atmosphere, family togetherness, and privacy. Additionally, single room maternity care was associated with significant improvements in patient satisfaction across various aspects compared to traditional maternity care in the majority of studies.
    - Costs were reduced in single room maternity care settings compared to traditional maternity care settings across two studies; however, in another study, cost savings were inferred when care was delivered within a traditional maternity care setting compared to the previous single room maternity care model.

Table 1: Summary of included review evidence for question 1

Citation	Evidence type* Number of studies Tyes of studies Recency (Search dates)	Review characteristics Appraisal Confidence in the review findings	Key findings of the review
Turner et al. 2021 Midwifery and nurse staffing of inpatient maternity services –A systematic scoping review of associations with outcomes and quality of care *Midwifery. 2021 Dec;103:103118.* https://doi.org/10.1016/j.midw.2021.103118	Scoping review 21 included studies (across 23 reports) RCT (n=3) Cohort studies (n=11) Case-control (n=1) Descriptive studies (n=6) Search dates Inception to 6th April 2020	Participants Pregnant women: Nine studies had over 30,000 participants and five studies had over 400,000 participants Six studies included only participants at low risk of complications Three studies included only complex cases such as women having postpartum haemorrhage, those having oxytocin in labour or caesarean section Staff: Midwife (nurse midwives or equivalent) (n=16) Assistant staff working under the supervision of professionals (n=3) Medical staffing: obstetricians, anaesthetists or neonatal doctors (n=8) Setting UK (n=9); USA, Canada, France, Germany, Italy, Indonesia, Korea, Thailand and Iran Focus To identify and summarize studies which examine the association between staffing levels of midwives and the outcomes for mothers and neonates Outcomes Maternal outcomes - severe maternal outcome (death or near miss), perineal trauma, post-partum haemorrhage, maternal readmission, satisfaction, and maternal infection (endometritis / amnionitis) delivery with bodily integrity[a], composite measure entitled healthy mother[b] (9 studies)	Maternal outcomes in relation to staffing *Severe maternal outcome (death or near miss)* Favours more nurses -1 study Favours less midwifery staff – 1 study *Intact perineum/trauma* Favours more staff -1 study Point estimate favours more staff but not significant – 2 studies *Improved delivery with bodily integrity* Favours more staff -1 study *Postpartum haemorrhage* Favours more staff -1 study *Composite healthy mother* Point estimate favours more staff but not significant – 1 study *Lower maternal readmission* Favours more staff - 2 studies *Satisfaction/preference* Favours more staff -1 study Point estimate favours more staff but not significant – 1 study *Multiple complications* Favours less staff – 1 study *Reduced rates of endometritis* Point estimate favours more staff but not significant – 1 study *Reduced rates of amnionitis* Point estimate favours more staff but not significant – 1 study Neonatal outcomes in relation to staffing *Apgar score* Point estimate favours more staff but not significant – 2 studies Favours less staff – 1 study

		Neonatal outcomes – Apgar scores, birth asphyxia, need for neonatal resuscitation, breastfeeding, admission to neonatal unit, stillbirth, neonatal death and a composite measure entitled healthy baby[c] (10 studies) Events during labour - the quality of record keeping, continuous foetal monitoring in low risk women, foetal distress, augmentation of labour (oxytocin use), epidural use, speed of theatre transfer for caesarean section, and length of labour. (10 studies) Mode of birth - examining rates of emergency caesarean section, instrumental birth and spontaneous vaginal birth (10 studies) Effects of midwifery assistant staff (3 studies) Costs (2 studies) <u>Appraisal scale</u> Sources of bias were identified by considering the study design, measurement of exposure and outcomes, and risk of adjustment <u>Appraisal rating</u> Not conducted <u>Review appraisal score</u> 6 out of 11 in the JBI checklist for systematic reviews and research syntheses <u>Confidence in the results of the review</u> -- Critically low	*Lower birth asphyxia* Point estimate favours more staff but not significant – 1 study Point estimate favours less staff but not significant – 1 study *Lower rates neonatal resuscitation using advanced measures* Favours more staff – 1 study Point estimate favours more staff but not significant – 1 study *Lower rates of neonatal resuscitation (excluding bag/mask only)* Favours more staff – 1 study *Lower stillbirth* No difference or no data on direction – 1 study *Lower neonatal death* No difference or no data on direction – 2 studies *Composite healthy baby* Point estimate favours more staff but not significant – 1 study *Higher breastfeeding rates* Favours more staff – 1 study *Lower admission to neonatal unit* Favours more staff – 1 study Point estimate favours more staff but not significant – 2 studies Point estimate favours less staff but not significant – 1 study *Neonatal length of stay* Point estimate favours less staff but not significant – 1 study *Perinatal complications* No difference or no data on direction – 1 study <u>Events during labour:</u> *Completeness of partogram* Favours more staff – 1 study (hrs 0-8 of shift) Point estimate favours more staff but not significant – 1 study (hrs 8-12 of shift) *Completeness of note keeping* Point estimate favours more staff but not significant – 1 study (hrs 0-8 of shift) Point estimate favours less staff but not significant – 1 study (hrs 8-12 of shift) *Continuous foetal monitoring*

			Favours more staff – 1 study *Appropriate foetal monitoring* Point estimate favours more staff but not significant – 1 study (low risk women) Point estimate favours less staff but not significant – 1 study (high risk women) *Less foetal distress* Favours more staff – 1 study *Less oxytocin use / augmentation* Favours more staff – 1 study (in multiparous) Point estimate favours more staff but not significant – 3 studies (1 study in primiparous) *Time to delivery interval for caesarean-section* Favours more staff – 1 study *Less epidural use* Favours more staff – 1 study Point estimate favours more staff but not significant – 3 studies (1 study in nulliparous) *Shorter Length of labour* Favours more staff – 1 study Point estimate favours more staff but not significant –1 study <u>Mode of birth:</u> *Lower emergency caesarean birth rate* Favours more staff – 2 studies (1 study elective cs) Point estimate favours more staff but not significant – 5 studies (1 study emergency cs) Point estimate favours less staff but not significant – 4 studies (1 study in multiparous, 1 study elective cs, 1 study urgent or intrapartum cs) Favours less staff – 1 study (in nulliparous) *Lower instrumental birth* Point estimate favours more staff but not significant – 4 studies (1 study in nulliparous) Point estimate favours less staff but not significant – 3 studies (1 study in multiparous) *Increased spontaneous vaginal birth/ normal birth* Favours more staff – 1 study

			Point estimate favours more staff but not significant – 2 study Point estimate favours less staff but not significant – 2 study (1 study in multiparous) *Increased straightforward birth* Point estimate favours less staff but not significant – 1 study (1 study in nulliparous) Point estimate favours less staff – 1 study (1 study in multiparous) <u>Effects of midwifery assistant staff:</u> 1 study found that increases in assistants were not significantly related to the probability of emergency section, instrumental birth or normal birth 1 study found that increasing the total number of nurses, both licenced and unlicensed was not significantly associated with the risk of readmission within 30 days 1 study found that assistant staffing levels were not statistically related to any of the three healthy mother and healthy baby indicators in the adjusted analysis <u>Economic analyses</u> 1 study noted that considerable investment would be required to implement one-to-one care for patients undergoing Oxytocin induction or augmentation. They found insufficient evidence of benefit in their trial to justify the additional costs 1 study found that higher midwifery staffing was associated with increased delivery costs A third study which performed secondary analysis on the study above identified that an increase in one FTE midwife per 100 births provided an incremental cost effectiveness ratio of £85,560 per additional healthy mother and £193,426 per mother with bodily integrity
Reid et al. 2017 The effect of senior obstetric presence on maternal and neonatal outcomes in UK NHS maternity units: a	Systematic review Non-randomised studies (n=15) Inception to May 2017	<u>Participants</u> Pregnant women of any age who gave birth in a UK NHS maternity unit (a total of125 856 births) <u>Interventions</u> Any increase in obstetric consultant presence; thus, any studies that involved a comparison of outcomes during lesser consultant	<u>Findings for lesser consultant presence versus increased consultant presence</u> *Emergency caesarean section* Studies (n=14); Births (n=119,397 (94.9%)) Women during consultant presence (n= 64,285 (53.8%)) OR: 0.98; 95% CI 0.92 to 1.05

systematic review and meta-analysis BJOG 124(9):1321–1330. https://doi.org/10.1111/1471-0528.14649		presence versus increased consultant presence were included (e.g. outcomes during a nightshift covered by a registrar only with a consultant off-site versus a nightshift covered by a resident consultant) Setting UK, NHS maternity Units Focus The impact of consultant presence on the outcomes of women who have given birth in UK NHS maternity units Primary outcomes Mode of delivery Secondary outcomes Rate of postpartum haemorrhage Third- and fourth-degree tears Outcomes of interest Emergency caesarean section rate Non-instrumental vaginal delivery rate Instrumental delivery rate Stillbirth rate Neonatal death rate Perinatal mortality rate Maternal death rate Admission to a NICU admission Appraisal scale Newcastle–Ottawa Quality Assessment Scale Appraisal rating Low risk of bias (n=10) Medium risk of bias (n=4) High risk of bias (n=1) Review appraisal score 10 out of 11 in the JBI checklist for systematic reviews and research syntheses Confidence in the results of the review	*Non-instrumental vaginal deliveries* Studies (n=14); Births (n=117.684 (93.5%)) Women during consultant presence (n= 64,773 (55.0%)) OR: 1.00; 95% CI 0.95 to 1.06 *Instrumental deliveries* Studies (n=14); Births (n=17.684 (93.5%)) Women during consultant presence (n= 64,773 (55.0%) OR: 1.04; 95% CI 0.98 to 1.10 Secondary outcomes Postpartum haemorrhage Studies:(n=4); Births (n=24,564) Women during consultant presence (n=12,243 (49.8%)) OR: 1.55; CI 0.72 to 3.33 Third and fourth-degree tears Studies (n=4); Births (n=24,220) Women during consultant presence (n=11,811 (48.8%)) OR:1.09; CI 0.90 to 1.32 Neonatal death Studies (n=3); Births (n=15,090) Women during consultant presence (n= 5,939 (39.4%)) OR: 1.27; CI 0.51 to 3.18 Stillbirth: Studies (n=4); Births (n=36,860) Women during consultant presence (n=16,335 (44.3%)) OR: 1.17; CI 0.76 to 1.80 When data were stratified by comparison type, the likelihood of emergency caesarean section was significantly lower (OR 0.91; 95% CI 0.86 to 0.96) and the likelihood of non-instrumental vaginal delivery was significantly higher (OR 1.07; 95% CI 1.02 to1.12) when the rostered hours of consultant presence per week were increased.

		+ High	
Wekesah et al. 2016 Effective non-drug interventions for improving outcomes and quality of maternal health care in sub-Saharan Africa: a systematic review Systematic Reviews (2016) 5:137 https://doi.org/10.1186/s13643-016-0305-6	Systematic review 73 studies Searches 2000 to 2015	Participants Not reported Interventions Task-shifting (n=2) Setting Sub-Saharan Africa (Benin and Ethiopia) Focus Antenatal counselling by lay nurse aids Performance of emergency caesarean sections by non-physician clinicians Outcomes Maternal morbidity and mortalities Quality of maternal health care (as defined by the Institute of Medicine 2001 to comprise safety, effectiveness, efficiency, timeliness, patient centeredness, and equitability) Appraisal scale Modified Newcastle-Ottawa scale for case/cohort/cross-sectional studies 5-point Jadad scale for experimental studies/RCTs Appraisal rating Not conducted Review appraisal score 4 out of 10 in the JBI checklist for systematic reviews and research syntheses Confidence in the results of the review -- Critically low	Study 1 (Gessessew et al. 2011. Task shifting and sharing in Tigray, Ethiopia, to achieve comprehensive emergency obstetric care. Int J Gynaecol Obstet. 2011 Apr;113(1):28-31) Retrospective cohort study Participants: 25,629 deliveries and 11,059 obstetric procedures (3369 of which were major surgical interventions Intervention: Non-physician clinicians performing comprehensive emergency obstetric care Comparison: Physicians Findings *Indications for caesarean section by type of staff* Physicians performed 63.9% of elective caesarean sections Non-physician clinicians performed 55.9% of emergency caesarean sections *Length of stay* The mean postoperative hospital stay was 7.3 days for women regardless of the type of staff who performed the caesarean delivery *Maternal and foetal deaths* There were 17 maternal and 506 foetal deaths during the studied period, with no statistical differences in mortality by type of attending staff Study 2 Jennings et al. 2011. Task shifting in maternal and newborn care: a non-inferiority study examining delegation of antenatal counselling to lay nurse aides supported by job aids in Benin. Implement Sci. 2011 Jan 6;6:2sign Quasi-experimental study Participants: Pregnant women (n=409) Intervention: Maternal and newborn counselling (203 pregnant women) by lay nurse aides assisted by job aids (n=27) Comparison: Maternal and newborn counselling (206 pregnant women) by nurse-midwives (n=21) Findings

			Content of communication: No significant differences appeared in the content of communication provided. *Communication techniques and duration* No significant differences appeared in communication techniques and duration *Maternal knowledge* Maternal knowledge among women counselling by lay nurse aides was superior in three of the five topic areas: - prenatal care (23.8, 95%CI: 15.7 to 32.0) - birth preparedness (12.7, 95% CI: 5.2 to 20.1 - recognition of danger signs (8.6, 95%CI: 3.3 to 13.9) There were no significant differences in maternal knowledge by provider type for - clean delivery (2.1, 95%CI: -14.1 to 9.9) - newborn care (9.9 95% CI: -0.3 to 20.1)
Raams et al. 2018 Task shifting in active management of the third stage of labor: a systematic review BMC Pregnancy and Childbirth (2018) 18:47 https://doi.org/10.1186/s12884-018-1677-5	Systematic review RCTs (n=5) Quasi-experimental trials (n=16) Inception to 2015	<u>Participants</u> Women delivering in a community setting or health facility centre in LMIC without skilled birth attendants present Skilled birth attendants are defined as accredited health professionals (midwife, nurse) who are trained to assist pregnancies and postpartum care <u>Interventions</u> Task-shifting of specific active management of the third stage of labour components to unskilled birth attendants or self-administration <u>Setting</u> LMIC in Africa (48%, n=10) Asia (43%, n=9) and Central America (2%, n=2) <u>Focus</u> To evaluate the effect, acceptance and safety of task shifting of specific aspects of AMTSL to unskilled birth attendants Tasks were shifted to community health workers (19%, n=4), auxiliary midwives (19%, n=4), traditional birth attendants (38%, n=8) or self-administered by delivered women (48%, n=10)	<u>Post partum haemorrhage</u> (15,197 women, 13 studies) The relative risks of PPH incidence varied from 0.16 to 1 in favour of task shifting For seven of thirteen articles relative risks were statistically significant <u>Acceptance of task shifting</u> (6445 women, 7 studies) 80% to 99.7% recommended taking misoprostol tablets at delivery to family or friends (2677 women, 5 studies) 80% to 99.4% would use the drug at next delivery (6090 women, 7 studies) Willingness to pay for uterotonics varied from 54.6% to 100% <u>Safety of task shifting</u> (4719 women, 5 studies) The correct dose was reported for 83.4% to 99.8% (6757 women, 9 studies) The correct timing was reported for 63% to 100%

		All studies assessed the administration of uterotonics; misoprostol tablets or oxytocin injections Misoprostol tablets for self-administration were distributed at antenatal (home) visits (n = 5), at delivery (n = 12) or both (n = 4) <u>Primary outcome</u> Incidence of post-partum haemorrhage <u>Secondary outcomes</u> Acceptance and safety of task shifting Adverse effects of uterotonics <u>Appraisal scale</u> Cochrane Risk of Bias tool <u>Appraisal rating</u> Blinding of researcher: Unclear (n=17) / Low risk (n=4) Completeness of data: Unclear (n=3) / High risk (n=1) / Low risk (n=17) Origin of data: Low risk (n=21) Clear definition of outcome: High risk (n=3) / Low risk (n=18) Assessment of outcome: High risk (n=5) / Low risk (n=8) / N/A (n=8) Confounders: Unclear (n=15) / Low risk (n=6) <u>Review appraisal score</u> 6 out of 11 in the JBI checklist for systematic reviews and research syntheses <u>Confidence in the results of the review</u> -- Critically low	<u>Adverse effects of uterotonics</u> Adverse effects of misoprostol or oxytocin in the community setting were mentioned in 14 studies Mild-to-moderate adverse effects of misoprostol included nausea, vomiting, shivering and/or fever There were no significant differences in these adverse effects between intervention and control groups of no uterotonics ergometrine (n = 1 study) or methergine (n = 1 study)

Key: AMTSL: active management of the third stage of labour; CI: confidence interval; FTE: full time equivalent; LMIC: low and middle income countries, NICU: neonatal intensive care unit; OR: odds ratio; PPH: post-partum haemorrhage; RCT: randomised controlled trials

[a] Delivery with bodily integrity -= delivery without caesarean, episiotomy, or a second-, third- or fourth-degree perineal tear, uterine damage.
[b] Composite measure healthy mother = delivery with bodily integrity, plus no instrumental birth, no sepsis, no anaesthetic complications, home within 2 days, no readmission within 28 days, intact perineum.
[C] Composite measure healthy baby = weight 2.5-4.5kg, gestation 37-42 weeks, live baby.

Table 2: Summary of included primary research evidence for question 1

Participants **Setting / Country** **Study design** **Analysis** **doi**	**Focus** **Staffing measures** **Data sources**	**Outcome/s** **Outcome measures** **Appraisal score** **Quality rating**	**Potential confounders measured and included in analysis**	**Relevant findings**
Carlson et al. 2020				
Participants Low risk healthy pregnant women (n=23,193) 9,655; 41.65% classed as obese Women who gave birth in medical centres with (n=9,795) or without the unit-level presence of midwives (n=13,398) Setting 12 clinical centres (USA) Study design Retrospective cohort study Multicentre Analysis Secondary analysis of routinely collected data Descriptive statistics Cox regression analysis https://doi.org/10.1111/jmwh.13022	Focus To evaluate association between unit level presence of midwives and rates of caesarean birth in women of different BMI ranges Staffing measures Level of obstetric and neonatal care including the composition of the maternity care team, such as the unit-level presence of midwives Medical centres with unit-level presence of both midwives and physicians versus unit-level presence with physicians only Data sources Consortium of Safe Labour dataset between 2002 and 2008	Outcome/s Associations between unit-level midwifery presence and 1. the incidence of unplanned caesarean birth 2. in-hospital labour durations with stratification by maternal BMI and adjustment for maternal demographic and pregnancy factors Appraisal score 7 out of 8 on the SIGN methodology checklist 3 for cohort studies (retrospective) Quality rating Moderate	Confounders Maternal race Maternal age Type of health insurance Gestational age at labour admission. Unplanned caesarean birth Parity Mode of labour onset	Midwifery unit-level presence *Caesarean birth* 16% decreased odds of unplanned caesarean birth versus care in a unit without midwives (AOR, 0.84; 95% CI, 0.77 to 0.93) Analyses repeated and stratified by maternal BMI group showed unit-level midwifery presence was associated with lower adjusted odds of unplanned caesarean birth only in women whose BMI at the time of labour admission was less than 35 kg/m2 In women with BMIs higher than 35 kg/m2, the adjusted odds of unplanned caesarean birth were similar, regardless of unit-level midwifery presence *Duration in labour* The median labour duration in women labouring in units with a midwifery presence was 14.3 hours (95% CI, 13.5 to 15.3) vs. 11.2 hours (95% CI, 10.6 to 11.7) in units without a midwifery presence (p <0.001) However, when these analyses were repeated after stratifying by maternal BMI group, there was no difference by midwifery unit-level presence on time durations when women's BMI was normal weight or above 35 kg/m2

				Only in women whose BMI was 25–34.99 kg/m2 did providers in midwifery units wait a median of 1.9 to 3.1 hours longer than providers in non-midwife units prior to unplanned caesarean Median labour durations were 2.6 hours longer in hospitals with midwifery unit-level presence for women whose BMI was 30–34.99 kg/m2 (23.2 hours in midwife units vs. 20.6 hours in non-midwife units (p=0 02 in adjusted analysis) and 5.5 hours longer for overweight and obese II groups in midwifery units versus durations among similar women in centres without midwives
Morad et al. 2021				
Participants 33,434 babies born (33,051 women who gave birth) over six years; this comprised 17,324 babies (17,131 women) before and 16,110 babies (15,920 women) after 24/7 consultant presence Setting One obstetric unit in large tertiary (Birmingham UK) Study design Retrospective time sequence analysis Single centre Analysis Logistic regression supplemented by interrupted time series analysis https://doi.org/10.1371/journal.pone.0249233	Focus To explore the effect of introducing 24/7 consultant presence Staffing measures 24/7 resident consultant presence (i.e. 168 hours/week) Data sources Routinely collected data between 2011 and 2017 National survey of practice	Primary composite outcome/s 1. Composite neonatal outcome which comprised - Stillbirth - Neonatal death - Babies requiring therapeutic hypothermia - Admission to NICU within 3 hours of delivery Secondary outcome/s 1. Secondary neonatal outcomes included individual components of the primary composite plus - 5 min Apgar score <7 - Babies that required ventilation (any mechanical respiratory support via an endotracheal tube) - Babies with seizures within the first 28 days - Stillbirth	Confounders Time of delivery (because pre 24/7 presence there is a consultant present in day time hours) Care pathway that was introduced during the study period resulted in risk profiles differing and more cases being referred to another hospital are both recognised as impacting Measured potential confounding factors: Maternal demographics Method of delivery Number of weeks gestation	Primary (composite) outcome Primary outcome increased by 0.65%, from 2.07% (359/17324) before 24/7 consultant presence to 2.72% (438/16110) after 24/7 consultant presence (OR 1.32, 95% CI 1.15 to 1.52) which was consistent with an upward trend over time already well established before 24/7 consultant presence began (OR 0.93, 95% CI 0.79 to 1.09) Overall, there was no change in this trend associated with the transition to 24/7 *Subgroup analyses* However, in babies born ≥37 weeks gestation, the upward trend was reversed after implementation of 24/7 OR 0.67, 0.49 to 0.93 This included a reduction in the upward trend for term babies admitted to NICU (OR 0.63, CI 0.44 to 0.89) and term babies requiring therapeutic hypothermia (OR 0.45; CI 0.22 to 0.93) No substantial differences were shown in other outcomes or subgroups

		- Early neonatal death (before 7 completed days of life) - Late neonatal death (after 7 completed days but before 28 days after birth) 2. Secondary maternal outcomes included - Mode of birth (spontaneous vaginal, instrumental unplanned caesarean - Postpartum haemorrhage >]000ml - Use of Fresh Frozen Plasma or cryoprecipitate <u>Appraisal score</u> 7 out of 8 on the SIGN methodology checklist 3 for cohort studies (retrospective) <u>Quality rating</u> Moderate	Time of birth	<u>Secondary outcomes</u> *Neonatal outcomes.* Overall increases were seen in admission to NICU (OR 1.35, 95% CI 1.17 to 1.58) and babies requiring ventilation (OR 1.41 95% CI 1.19 to 1.66) but these were not associated with the implementation of 24/7 consultant presence (OR 0.92, 95% CI 0.77 to 1.09 and OR 0.95, 95% CI 0.78 to 1.14 respectively) *Maternal outcomes.* An overall increase was seen in emergency caesarean (OR 1.08, 95% CI 1.02 to 1.15), but this was not associated with the implementation of 24/7 consultant presence (OR 1.05, 95% CI 0.98 to 1.12) *National survey* 109/196 (56%) UK maternity units responded. Of those that responded only one reported providing 24/7 labour ward consultant presence For the 28 units delivering >5000 babies per annum, the median number of hours of consultant presence per week on labour ward was 97.5 (IQR 83–98)
Reif et al. 2017				
<u>Participants</u> 87,065 neonates delivered in the period 2004–2015. Singleton and multiple pregnancies 34+^{0} weeks gestation <u>Setting</u> Ten public hospitals 2 perinatal tertiary centres with consultants for obstetrics, a neonatologist and an anaesthetist 24/7 1 department >1000 deliveries per year	<u>Focus</u> Time of delivery, unit volume, and the seniority of the attending staff during delivery <u>Staffing measures</u> *Staff attending delivery* (i) midwife only (n=1,673) (ii) midwife + intern/GP (n=13,864) (iii) midwife + O&G resident (n=37,295)	<u>Primary (composite) outcome</u> 'Severely adverse neonatal outcome': defined as arterial umbilical cord blood pH of ≤7.00, a 5-minute Apgar score of ≤3, cardiac massage /cardiopulmonary resuscitation, or intrapartal or early neonatal mortality (death within 7 days after live birth)	<u>Confounders</u> Parity Singleton / Multiple gestation Maternal BMI Maternal age Foetal gender Gestational age	<u>Primary composite outcome</u> Adverse neonatal outcomes 4852 cases (5.6%) *Severely adverse neonatal outcome.* 764 cases (0.9%) *Staff attending delivery* Resident versus midwife Severely adverse outcomes OR 0.26; 95% CI 0.06 to 1.04 Adverse outcomes

4 departments with 500-1000 deliveries per year 3 units with <500 deliveries per (Provence of Styria, Austria) Study design Prospective cohort study Multi centre Analysis Descriptive statistics Generalised linear mixed models Sensitivity analysis https://doi.org/10.1111/1471-0528.15000	(iv) midwife +consultant (n=33,935) Data sources Perinatal data from all public obstetric departments were prospectively gathered in the Central perinatal patient record system (ViewPoint; GE Healthcare)	Secondary (composite) outcome 'Adverse outcome': defined as an arterial umbilical cord blood pH of ≤7.05, a 5-minute Apgar score ≤6, admission to NICU within 24 hours of birth, or respiratory support (ventilation, oxygen support or intubation) Appraisal score 9 out of 12 on the SIGN methodology checklist 3 for cohort studies (prospective) Quality rating Moderate		OR 0.57; 95% CI 0.40 to 0.82 *Resident versus intern/GP* Severely adverse outcomes OR 0.47; 95% CI 0.31 to 0.72 Adverse outcomes OR 0.71; 95% CI0.63 to 0.81 *Resident versus consultant* Severely adverse outcomes OR. 3.28; 95% CI 2.77 to 3.89 Adverse outcomes OR 1.74; 95% CI 1.63 to 1.86 Sensitivity analysis Staff seniority has an association with neonatal adverse and severely adverse events, with a higher risk for deliveries attended by senior obstetrical staff; however, the sensitivity graphs indicate that this result needs to be interpreted with caution, as staff seniority appears to become protective against adverse events when the odds of pregnancy risks (gamma) exceeds a value of approximately 2.3 for adverse outcome and 6.0 for severely adverse outcome, respectively
Pfniss et al. 2023				
Participants 87065 deliveries of singleton and multiple deliveries occurring between January 1 2004 and December 31 2015 Setting 10 public maternity units (Styria, Austria) Study design Prospective cohort study	Focus Investigating the impact of time of birth, unit volume and staff seniority on the incidence of maternal complications in deliveries ≥ 34+gestational weeks Staffing measures *Staff attending delivery* (i) midwife only (n=1,661)	Primary (composite) outcome Maternal adverse outcomes (defined as uterine atony, postpartum hysterectomy, postpartum haemorrhage, impaired wound healing, post partum infections requiring antibiotics, sepsis, or maternal death) Appraisal score	Confounders High risk pregnancies vs low risk pregnancies Gestational age Maternal BMI Parity	Primary composite outcome Maternal adverse outcomes 1042 cases (1.33%) *Staff attending delivery* Resident versus midwife AOR 0.21; 95% CI 0.07 to 0.64 Resident versus intern/GP AOR 0.77, 955 CI 0.61 to 0.98 Resident versus consultant AOR 1.13; 95% CI 0.98 to 1.30

Multi centre Analysis based on 78 627 deliveries Descriptive statistics Generalised linear mixed models Sensitivity analysis https://doi.org/10.1111/birt.12663	(ii) midwife + intern/GP (n=13,468) (iii) midwife + O&G resident (n=32,071) (iv) midwife +consultant (n=31,427) Data sources Intrapartum and postpartum data was collected. Obstetric data record system (ViewPoint; GE Healthcare)	9 out of 12 on the SIGN methodology checklist 3 for cohort studies (prospective) Quality rating Moderate		Sensitivity analysis Staff seniority appears to become more protective against maternal adverse outcome with increasing pregnancy risks However, for healthy, lower risk patients, midwifery care appears protective
Shawer et al. 2019				
Participants 53,726 births between September 2011-September 2017 41 patient safety incidents reported met the inclusion criteria (before implementation of 24-7 consultant presence) 31 patient safety incidents reported met the inclusion criteria (after implementation of 24-7 consultant presence) = 72 patient safety clinical incidents included Setting NHS obstetric department in a large teaching hospital (Manchester, UK) Study design Retrospective cohort study Single centre Analysis Retrospective review of the included incident investigation reports Descriptive statistics	Focus The impact of consultant presence on safety and experience provided for women and babies Staffing measures 24/7 consultant presence Data sources Clinical incidents reported via the National Patient Safety Agency instrument from the Trust's electronic (Ulysses) incident reporting system	Outcome/s The number of clinical incidents reported before and after the implementation of 24-7 consultant presence were grouped in 5 categories 1. Consultant not involved in management 2. Consultant involved but had neither a positive nor negative effect on the outcome of incident 3. The consultant had an overall positive impact 4. The consultant had an overall negative effect on the management of the incident 5. The lack of, or delay in, consultant presence carried a negative impact on the outcome of the incident. Appraisal score	Confounders A number of other contributory factors were identified in these SUIs "Staffing levels and capacity" was identified as a contributory factor in 10 incidents, which was evenly distributed between the before and after groups	Serious untoward incidents The proportion of SUIs was not statistically significant between the two time periods (0.63 vs 0.39 per cent; p=0.25) Catastrophic level 5 incidents accounted for 19.5% of the total number of reviewed incidents before implementing the 24/7 consultant presence, as opposed to 29% of those occurring after (p=0.40) Consultant involvement increased from 75.6% (31) to 96.8% (30) after implementation of the 24/7 consultant presence (p=0.02) Reported negative impact due to lack of consultant presence decreased from 22% of the incidents before 24/7 consultant presence to 9.7% of incidents afterwards Reported positive impact of consultant presence increased from 14.6% to 32.3% following the implementation of 24/7 consultant presence Consultants had a negative impact on the management of 3 incidents (1 before implementation and 2 afterwards). For example, due to a consultant being more

https://doi.org/10.1108/IJHG-12-2018-0079		5 out of 8 on the SIGN methodology checklist 3 for cohort studies (retrospective) Quality rating Low		likely to persist with a vaginal or instrumental delivery where a more junior doctor may opt for a Caesarean Section earlier A negative impact due to lack of or delay in consultant presence was identified in 3 of the 6 incidents before the implementation of 24/7 consultant presence
Turner et al. 2022a				
Participants Pregnant women (n=13,264) Setting 123 postnatal wards within 94 NHS Trusts (England, UK) Study design Cross sectional Multicentre Analysis Secondary analysis of routinely collected data Descriptive statistics Multilevel logistic regression model https://doi.org/10.1371/journal.pone.0266638	Focus Association between midwifery staffing levels and the experiences of mothers on postnatal wards Staffing measures Organisation staffing: FTE staff employed at each Trust per 100 births (midwives and medical staff) Postnatal wards staffing: HPPD for registered staff (combined nurses and midwives) and healthcare support staff Data sources Care HPPD dataset from NHS England website from February 2019	Outcome/s Women's experiences of quality of care Outcome measures Four items from 2019 Care Quality Commission Maternity Survey *Discharge without delay* On the day you left hospital, was your discharge delayed for any reason? *Help when needed it* If you needed attention while you were in hospital after the birth, were you able to get a member of staff to help you when you needed it? *Information / explanations* Thinking about the care you received in hospital after the birth of your baby, were you given the information or explanations you needed? *Kindness and understanding* Thinking about the care you received in hospital after the	Confounders Mothers' age group Ethnicity Parity Type of birth	Staffing levels Median FTE per 100 births Midwives: 3.58 (IQR 3.33 to 3.84) equivalent to one midwife for every 28 births Obstetric/gynaecology doctors 0.92 (IQR 0.83, 1.04) Median HPPD Registered staff 4.69 (IQR 3.75, 5.80) Support staff 2.46 (IQR 1.91, 3.18) Relationship between whole Trust staffing and patient experience *Discharge without delay* High tertile versus Low tertile AOR 1.14. 95% CI 1.01 to 1.31) *Help when needed it* No significant findings for adjusted analysis *Information / explanations* Continuous FTE AOR 1.16, 95% CI 1.00 to 1.35 High tertile versus Low tertile OR 1.18, 95% CI 1.03 to 1.36 *Kindness and understanding* No significant findings for adjusted analysis Relationship between staff recorded on postnatal wards (HPPD) and patient experience *Discharge without delay*

		birth of your baby, were you treated with kindness and understanding? <u>Appraisal score</u> 8 out of 8 in JBI checklist for analytical cross-sectional studies <u>Quality rating</u> Not rated		HPPD registered staff – continuous variable No significant findings for adjusted analysis HPPD registered staff – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis HPPD support worker – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis HPPD registered support workers AOR 1.06, 95% CI 1.00 to 1.13 *Help when needed it* HPPD registered staff – continuous variable No significant findings for adjusted analysis HPPD registered staff – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis HPPD registered support workers AOR 1.09, 95% CI 1.01 to 1.18 HPPD support worker – categorical variable (High tertile versus Low tertile) AOR 1.28, 95% CI 1.07 to 1.54 *Information / explanations* HPPD registered staff – continuous variable No significant findings for adjusted analysis HPPD registered staff – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis HPPD registered support workers No significant findings for adjusted analysis HPPD support worker – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis *Kindness* HPPD registered staff – continuous variable No significant findings for adjusted analysis

				HPPD registered staff – categorical variable (High tertile versus Low tertile) No significant findings for adjusted analysis HPPD registered support workers AOR 1.07, 95% CI 1.00 to 1.16 HPPD support worker – categorical variable (High tertile versus Low tertile) AOR 1.24, 95% CI 1.03 to 1.49 *There was no significant relationship* between Obstetrics and Gynaecology doctors per 100 births and patient experience
Turner et al. 2022b				
Participants 17,611 women Setting 129 NHS Trusts (England, UK) Study design Cross sectional Multicentre Analysis Secondary analysis of routinely collected data Descriptive statistics Multilevel logistic regression model https://doi.org/10.1016/j.wombi.2022.02.005	Focus Relationship between women's experience of postnatal care and reported staffing measures Staffing measures FTE midwives per 100 births Data sources NHS Workforce Statistics Dataset from February 2018 Hospital Episode Statistics	Outcome/s Women's experiences of quality of care Outcome measures Four items from 2018 Care Quality Commission Maternity Survey *Discharge without delay* On the day you left hospital, was your discharge delayed for any reason? *Help when needed it* If you needed attention while you were in hospital after the birth, were you able to get a member of staff to help you when you needed it? *Information / explanations* Thinking about the care you received in hospital after the birth of your baby, were you given the information or explanations you needed?	Confounders Staffing and number of births per year Ethnicity Parity Age group Type of birth	Staffing levels Median FTE per 100 births Midwives: 3.55 (IQR 3.26 to 3.78) Relationship between FTE midwives per 100 births and patient experience *Discharge without delay* AOR 0.849, 95% CI 0.753 to 0.959 Help when *needed* it AOR 1.200, 95% CI 1.052 to 1.369 *Information/explanations* AOR 1.150, 95% CI 1.040 to 1.271 Kindness and understanding No significant findings for adjusted analysis Relationship between High FTE 100 births 3.707-5.217 and patient experience *Discharge without delay* AOR 0.789, 95% CI 0.697 to, 0.894 Absolute risk difference 18 (11-37) *Help when needed it* AOR 1.191, 95% CI 1.037 to, 1.367 Absolute risk difference 24 (14-111)

		Kindness and understanding Thinking about the care you received in hospital after the birth of your baby, were you treated with kindness and understanding? <u>Appraisal score</u> 8 out of 8 in JBI checklist for analytical cross-sectional studies <u>Quality rating</u> Not rated		*Information/explanations* AOR 1.130, 95% CI 1.018 to 1.255 Absolute risk difference 37 (20-250) Kindness and understanding No significant findings for adjusted analysis

Key: AOR: adjusted odds ratio; APGAR: score based on appearance, pulse, grimace, activity, and respiration; CI: confidence interval; FTE: full time equivalent; GP: general practitioner; HPPD: Hours Per Patient Day; NHS: National Health Service; NICU: neonatal intensive care unit; O&G: obstetricians & gynaecologists; OR: odds ratio; SUI: serious untoward incident

Table 3: Summary of included review evidence for question 2

Citation	Evidence type* Number and Types of studies Recency (Search dates)	Review characteristics Appraisal Confidence in results of the review	Key findings of the review
Donnellan-Fernandez et al. 2018 Cost-effectiveness of continuity of midwifery care for women with complex pregnancy: a structured review of the literature Health Econ Rev. 2018 Dec 5;8(1):32. https://doi.org/10.1093/intqhc/mzab084	Systematic review Systematic reviews (n=3) RCTs with economic evaluation (n=4) Quasi-experimental cost studies (n=2) 1994 to 2018	Participants Women with complex pregnancies Interventions Continuity of midwifery care and/or team midwifery Midwifery-led care Control Obstetric-led care Standard Care Setting Systematic reviews (n=2) UK Primary studies (n=6) all undertaken in Australia Focus To summarise the evidence related to cost resource use, and clinical outcomes of care for women with complex pregnancies who received care in a continuity of midwifery care model compared with other maternity models Outcomes Cost Clinical effectiveness Appraisal tool Eight quality appraisal questions from the recommended checklist for appraising the costs and benefits of economic evaluation studies by the National Health and Medical	Cost of midwifery-led versus obstetric consultant led units Two systematic reviews in the UK showed an estimated mean cost saving for each eligible woman of £12.38 in the continuity of midwifery care model, providing aggregate health savings of £1.16 million per year if half of all eligible women received continuity of midwifery care Sensitivity analysis included all risk categories where risk ratio for overall fetal/neonatal death was systematically varied with 95% confidence interval of 0.79 to 1.09 Reported an annual net monetary benefit ranging from a gain of £472 million to a loss of £202 million. Net health benefit ranged from an annual gain of 15723 QALYs to a loss of 6738 QALYs Cost of continuity of midwife care and/or team midwifery compared to standard care Only one study identified cost savings specific to women from high-risk groups who had continuity of midwifery care compared to obstetric led standard care A mixed risk Australian study showed a median cost saving of A$566 for women who received continuity of midwifery care compared to standard. Reported no significant outcome difference between continuity of midwifery and standard care

		Research Council, Australian Government Publishing Service Appraisal rating Evidence hierarchy level: Level I (n=3) Level II (n=3) Level III and IV (n=2) Review appraisal score 7 out of 11 on JBI critical appraisal checklist for systematic reviews and research synthesis Confidence in results of the review --Critically low	Cost analysis of Australian community-based continuity of midwifery care for all risk women reported mean savings of A$804 RCT studies identified reduced birth interventions and modest cost savings for women of all risks. One cost effectiveness study identified a mean cost reduction for birth of 4.5% for midwifery groups Cost effectiveness of continuity of midwifery care for Aboriginal women vs standard care One study reported cost saving of A$703 from first antenatal visit (all risk) to six weeks post-partum after implementing continuity of midwifery-led care, this was not significantly different to baseline costs. There were no significant difference in major birth outcomes, but antenatal attendance and hospital admissions increased and average length of stay in special care nursery decreased In another study a cost analysis revealed downstream savings in the health sector of A$1200 per woman Patterns of antenatal care for women of high obstetric risk and comparative provider costs Three RCTs reported reduced costs for care provided by midwives for high risk and mixed risk samples and increased costs in two (non-RCT) studies
Fikre et al. 2023 Effectiveness of midwifery-led care on pregnancy outcomes in low and middle-income countries: a systematic	Systematic review RCTs (n=2) Quasi-experimental (n=2) Cohort studies (n=3)	Participants Pregnant women (n=32,079) from low- and middle-income countries Interventions	Findings from meta-analysis *Maternal outcomes* Women who received midwifery-led care were more likely to experience increased rate of vaginal births

review and meta-analysis BMC Pregnancy and Childbirth (2023) 23:386 https://doi.org/10.1186/s12884-023-05664-9	Mixed-methods study (n=1), Comparative study (n=1) Case-control study (n=1) January 1, 2000 to July 30, 2022	Midwifery-led care, care provided by nurse-midwives (n=1) Care provided by caseload team approach, team of midwifery-led care model (n=7) Comparison of midwifery-led care with conventional care (n=2) <u>Control</u> Other models of care <u>Setting</u> Iran (n=1), Ethiopia (n=1), China (n=4), Palestine (n=2), South Africa (n=1), Nepal (n=1) <u>Focus</u> To assess the effectiveness of midwifery-led care on pregnancy outcomes in low- and middle-income countries <u>Outcomes</u> Maternal outcomes: Vaginal birth Modes of birth (caesarean section vs instrumental birth) Episiotomy Neonatal outcomes: Birth status (live birth, stillbirth or early neonatal death, preterm birth) APGAR score at 5 min Birth weight Admission to NICU Breastfeeding within one hour <u>Appraisal tool</u> The JBI critical assessment checklist <u>Appraisal rating</u> Low risk of bias (n=9) Moderate risk of bias (n=1)	(OR: 1.14, 95% CI: 1.04 to 1.23) Studies (n=2) Women who received midwifery-led care had a lower likelihood of Emergency Caesarean section (OR: 0.49, 95% CI: 0.27 to 0.72) Studies (n=4) Women who received midwifery-led of care had a lower likelihood of having a episiotomy (OR: 0.46, 95% CI: 0.10 to 0.82) Studies (n=2) There were no statistical associations for women who received midwifery-led care and preterm birth (OR: 0.61, 95% CI: 0.21 to 1.0) Studies (n=2) *Neonatal outcomes* Women who received midwifery-led of care had a decreased average neonatal admission time in the ICU (OR: 0.59, 95% CI: 0.44 to 0.75) Studies (n=3) There were no statistical associations for women who received midwifery-led of care and early initiation of exclusive breastfeeding (OR: 1.88, 95% CI: 1.00 to 2.77) Studies (n=3) Other findings based on the results of single studies indicated that midwifery-led care significantly lowered the rate of postpartum haemorrhage and reduced the rate of birth asphyxia ($p<0.0001$) and that women receiving midwifery-led care showed improved outcomes, with fewer medical interventions

		Review appraisal score 11 out of 11 in the JBI checklist for systematic reviews and research syntheses Confidence in results of the review -- Critically low	
Kilpatrick 2016 What is the effect of caseload antenatal care compared with women receiving standard care in pregnancy? *MIDIRS Midwifery Digest,* 26;1, March 2016, 48-52 *No doi available*	Systematic Review RCTs (n=2) 16th January 2015 to 13th March 2015 (eight weeks)	Participants Pregnant women with low risk (n=4043) Interventions Caseload care Control Standard care Setting Not explicitly stated (*further reading of the two original RCTs in Kilpatrick's review discovered that they were conducted in* ***Australia****)* Focus To determine the effect of caseload antenatal care on caesarean section rates, in comparison to standard antenatal care Outcome 1. Caesarean birth Appraisal tool Cochrane Risk of Bias Appraisal rating Low risk of bias (n=2) Review appraisal score 7 out of 11 in the JBI checklist for systematic reviews and research syntheses Confidence in results of the review -- Critically low	Outcomes Caseload care versus standard care Caesarean section: RR 0.83, 95% CI; 0.72 to 0.96 (GRADE rating: moderate certainty)

McRae et al. 2016a Is model of care associated with infant birth outcomes among vulnerable women? A scoping review of midwifery-led versus physician-led care SSM Popul Health. 2016 Mar 18;2:182-193 http://dx.doi.org/10.1016/j.ssmph.2016.01.007	Scoping review Retrospective cohort studies (n=6) RCTs (n=2) Prospective cohort study with a /retrospective chart review (n=1) Search conducted between 8th to 10th of June 20	Participants Pregnant women from low socioeconomic position - defined as low income, education or prestige (n=95,537) Studies must have: - been conducted in an OECD country - compared antenatal care exclusively or predominantly delivered by midwives with physician-led care Interventions Midwifery-led care Control Physician led care Setting OECD countries: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Republic, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, UK, USA Focus To investigate if, in countries belonging to the OECD midwives' patients of low socio-economic position were at greater or lesser risk of adverse infant birth outcomes versus physicians' patients Outcomes PTB, IUGR, SGA birth Apgar score, birth weight (including mean, low and very low birth weight) NICU admission	Adverse birth outcomes *Preterm birth* One of five studies for preterm birth found a 30% statistically significant reduction favouring midwifery care (AOR 0.70, p<0.01 *Low birth weight*: One of nine studies for low birth weight found a statistically significant lower risk (41%) of LBW among midwives' patients (RR 0.59, 95% CI: 0.46, 0.73) versus physicians' patients *Very low birth weight* One of three studies for very low birth weight found significant associations favouring midwifery care *Mean birth weight* One of three studies investigating higher mean birth weight found significant associations favouring midwifery care *NICU admission* No association was found for overall admission rates to NICU Corrigendum published (McRae et al. 2017) A study included in the scoping review by Jackson et al. (2003) in which infants born to women receiving collaborative care in a birth centre versus obstetric resident care had an adjusted risk difference for NICU stays (1–3 days) of -1.8 (95% CI: -3.9 to 0.2). It was identified authors had incorrectly interpreted the risk difference as statistically significant

		Appraisal tool The Effective Public Health Practice Project Quality Assessment Instrument Appraisal rating Moderate rating (n=8) Weak rating (n=1) Review appraisal score 10 out of 11 in the JBI checklist for systematic reviews and research syntheses Confidence in results of the review + High	
Sandall et al. 2016[a] Midwifery-led continuity models versus other models of care for childbearing women Cochrane Database of Systematic Reviews 2016, Issue 4. Art. No.: CD004667. https://doi.org/10.1002/14651858.cd004667.pub4	Systematic review 15 studies RCTs Quasi-experimental trials Search conducted in January 2016	Participants Pregnant women (n=17,674) Interventions Midwifery-led continuity of care, and other or shared care on the basis of the lead professional in the antepartum and intrapartum periods Other models of care included obstetricians or family physicians, or both, collaborating with nurses and midwives in a variety of organisational settings Setting Australia, Canada, Ireland and UK in a wide variety of settings and health systems Focus To compare midwifery-led continuity models of care with other models of care for childbearing women and their infants Primary outcomes 1. Preterm birth (less than 37 weeks) 2. All foetal loss before and after 24 weeks plus neonatal death	Primary outcomes Women who had midwifery-led continuity models of care were less likely to experience Regional analgesia RR 0.85, 95% CI 0.78 to 0.92; n=17,674; RCTs = 14; high quality Instrumental vaginal birth RR 0.90, 95% CI 0.83 to 0.97; n=17,501; studies = 13; high quality Preterm birth less than 37 weeks RR 0.76, 95% CI 0.64 to 0.91; n=13,238; RCTs = 8; high quality All foetal loss before and after 24 weeks plus neonatal death RR 0.84, 95% CI 0.71 to 0.99; n=17,561; RCTs = 13; high quality Women who had midwifery-led continuity models of care were more likely to experience Spontaneous vaginal birth RR 1.05, 95% CI 1.03 to 1.07; n= 16,687; RCTs = 12; high quality

		3. Spontaneous vaginal birth (as defined by trial authors) 4. Caesarean birth 5. Instrumental vaginal birth (forceps/vacuum) 6. Intact perineum 7. Regional analgesia (epidural/spinal) <u>Appraisal tool</u> Cochrane Risk of Bias <u>Appraisal rating</u> Allocation: Low risk (n=11) / Unclear risk (n=3) High risk (n=1) Blinding of participants and personnel: High risk (n=6) Unclear risk (n=9) Blinding of outcome assessment: Low risk (n=1) Unclear (n=10) High risk (n=4) Incomplete outcome data: Low risk (n=12) Unclear (n=3) Selective reporting: Low risk (n=13) Unclear (n=2) Other bias: Low risk (n=13) Unclear (n=2) <u>Review appraisal score</u>	There were no differences between groups for caesarean births (n= 17674; RCTs = 14) or intact perineum (n=13,186; 10 RCTs) <u>Secondary outcomes</u> Women who had midwifery-led continuity models of care were less likely to experience Amniotomy RR 0.80, 95% CI 0.66 to 0.98; n=3253; studies = 4 Episiotomy RR 0.84, 95% CI 0.77 to 0.92; n=17,674; studies = 14 Foetal loss less than 24 weeks and neonatal death RR 0.81, 95% CI 0.67 to 0.98; n=15,645; studies = 11 Women who had midwifery-led continuity models of care were more likely to experience No intrapartum analgesia/anaesthesia RR 1.21, 95% CI 1.06 to 1.37; n=10,499; studies = 7 Have a longer mean length of labour (hours) (MD 0.50, 95% CI 0.27 to 0.74; n=3328; studies = 3 To be attended at birth by a known midwife RR 7.04, 95% CI 4.48 to 11.08; n=6917; studies = 7 There were no differences between groups for foetal loss equal to/after 24 weeks and neonatal death, induction of labour, antenatal hospitalisation, antepartum haemorrhage, augmentation/artificial oxytocin during labour, opiate analgesia, perineal laceration requiring suturing,

		11 out of 11 in the JBI checklist for systematic reviews and research syntheses <u>Confidence in results of the review</u> + High	postpartum haemorrhage, breastfeeding initiation, low birthweight infant, five minute Apgar score <u>≤</u> 7, neonatal convulsions, admission of infant to special care or NICU or in mean length of neonatal hospital stay (days) *Adverse effects* Did not find any increased likelihood for any adverse outcome for women or their infants associated with having been randomised to a midwifery-led continuity model of care *Maternal satisfaction (10 studies)* Presented narratively due to a lack of consistency in measurement Satisfaction outcomes reported in the included studies included maternal satisfaction with information, advice, explanation, venue of delivery, preparation for labour and birth, as well as giving choice for pain relief and behaviour of the carer The majority of included studies reported a higher rate of maternal satisfaction in midwifery-led continuity models of care Costs (6 studies) Presented narratively due to a lack of consistency in measurement There was a trend towards a cost-saving effect for midwifery-led continuity care versus other care models
Talukdar et al. 2021 A scoping review of evidence comparing models of maternity care in Australia	Scoping review RCTs (n=9) Observational studies (n=3)	<u>Participants</u> Pregnant women (n=7151) RCTs included pregnant for less than 24 weeks	*Midwifery continuity care versus standard care (n=7) or private obstetric care (n=1))* Maternal outcomes(which were consistently reported)

Midwifery 99 (2021) 102973 https://doi.org/10.1016/j.midw.2021.102973	Dates of search not stated in paper	Observational studies included recent mothers or women more than 37 weeks of pregnancy Low risk status (n=5) Any risk status (n=7) <u>Interventions</u> Midwifery continuity care <u>Controls</u> Standard care Standard care and private obstetric care <u>Setting</u> Australia Note only one public hospital setting <u>Focus</u> To identify and synthesise the current available evidence for comparing maternity care models in Australia with a view to identifying the range of models compared, reported outcome and experience measures and the limitations of existing evidence for supporting quality decisions between the alternative models that are available <u>Outcomes</u> 1. Maternal clinical outcomes 2. Neonatal clinical outcomes 3. Maternal experience measures during pregnancy, birth and in the postpartum period <u>Appraisal tool</u> JBI critical appraisal tools <u>Appraisal rating</u> RCTs: High quality (n=9)	Higher rates of unassisted vaginal births (n=7) Lower rates of caesarean sections (n=7) Lower rates of inductions (n=4) Higher rates of spontaneous onset of labour (n=2) Lower rates of epidural analgesia for pain relief and episiotomies (n=7) Shorter hospital stays - returning home within 24 hours of birth (n=3) Lower postpartum blood less (n=1) *Neonatal outcomes* Likelihood of being admitted to NICU or SCN (n=5 less likely, n=2 no difference) Apgar score <7 at 5 minutes (n=6 no difference, n=1 less likely) Still birth (n=1 less likely) Higher rates of breastfeeding initiation (within 1 hour of birth) (n=1) *Women's experience* Women in midwifery-led care were more likely to have a known midwife during their labour (n=4) Women in midwifery continuity care experienced more continuity of care, increased self-control and satisfaction than women who received standard care (n=4)

		Observational studies: High quality (n=2) Medium quality (n=1) <u>Review appraisal score</u> 9 out of 11 in the JBI checklist for systematic reviews and research syntheses <u>Confidence in results of the review</u> -- Critically low	

Key: AOR: adjusted odds ratio; APGAR: score based on appearance, pulse, grimace, activity, and respiration; CI: confidence intervals; IUGR: intrauterine growth restriction; MD: mean difference; NICU: neonatal intensive care unit; OECD: Organization of Economic Co-operation and Development; PTB: pre-term birth; RCT: randomised controlled trial; RR: relative risk; SGA: small for gestational age

[a] Update of previous Cochrane review (Sandall et al 2015; Sandall et al 2013, Hatem et al 2008)

Table 4: Summary of included primary research evidence for question 2

Author/ year **Aim** **doi**	**Participant details** **Study design** **Setting**	**Intervention / control** **Outcomes** **Appraisal score** **Quality rating**	**Relevant findings**
Allen et al. 2019 To explore how women perceived the experience of having caseload midwifery compared with standard care during pregnancy regardless of her level of risk https://doi.org/10.1111/birt.12436	Participants Women at 6 weeks postpartum (n=1017) All risk levels Study design RCT Multicentre Setting Two tertiary hospitals Australia	Intervention Caseload midwifery (n=573) 'Caseload midwifery provided women with a primary midwife who was on-call and available 24/7' Control Standard care (n=444) 'Standard antenatal care was delivered by general practitioners, midwives, and/or obstetric registrars and consultants in community or hospital clinics' Outcome/s Self-reported perceptions and experiences of antenatal, intrapartum, and postnatal care midwifery care 12-item authors own questionnaire Appraisal score 7 out of 13 on the JBI checklist for RCTs Quality rating + Moderate	Perceptions and experiences of care reported by 692 women with known medical, obstetric, and/or social risk factors I was always asked whether I had any questions Caseload (n=397) versus standard (n=301) AOR 2.41, 95% CI 1.72 to 3.39 I was always kept informed about what was happening Caseload (n=385) versus standard (n=298) AOR 2.07, 95% CI 1.55 to 2.78 I was always given an active say in decisions about my care in pregnancy Caseload (n=387) versus standard (n=300) AOR 3.21, 95% CI 2.35 to 4.37 I always felt my worries, anxieties, or concerns about the pregnancy and my baby were taken seriously Caseload (n=384) versus standard (n=299) AOR 2.13, 95% CI 1.57 to 2.87 I was provided reassurance when I needed it Caseload (n=385) versus standard (n=299) AOR 2.32, 95% CI 1.71 to 3.14 My checkups often seemed rushed Caseload (n=387) versus standard (n=299) AOR 0.37, 95% CI 0.28 to 0.50 Care in pregnancy was provided in a competent way Caseload (n=382) versus standard (n=298)

			AOR 2.28, 95% CI 1.68 to 3.08 I was happy with the physical care I received in pregnancy Caseload (n=387) versus standard (n=297) AOR 2.19, 95% CI 1.62 to 2.96 I was happy with the emotional support I received in pregnancy Caseload (n=384) versus standard (n=301) AOR 2.52, 95% CI 1.87 to 3.39 Overall perception of care during pregnancy Caseload (n=386) versus standard (n=299) AOR 2.94, 95% CI 2.28 to 3.79 Women's perceptions of care during pregnancy among 1017 women responding to the 6-week survey I was always asked whether I had any questions Caseload (n=572) versus standard (n=441) AOR 2.33, 95% CI 1.74 to 3.11 I was always kept informed about what was happening Caseload (n=569) versus standard (n=438) AOR 2.30, 95% CI 1.80 to 2.93 I was always given an active say in decisions about my care in pregnancy Caseload (n=571) versus standard (n=439) AOR 2.93, 95% CI 2.27 to 3.77 I always felt my worries, anxieties, or concerns about the pregnancy and my baby were taken seriously Caseload (n=568) versus standard (n=439) AOR 1.94, 95% CI 1.51 to 2.48 I was provided reassurance when I needed it Caseload (n=569) versus standard (n=437)

			AOR 2.24, 95% CI 1.74 to 2.89 My checkups often seemed rushed Caseload (n=571) versus standard (n=439) AOR 0.37, 95% CI 0.30 to 0.47 Care in pregnancy was provided in a competent way Caseload (n=566) versus standard (n=437) AOR 2.26 95% CI 1.76 to 2.90 I was happy with the physical care I received in pregnancy Caseload (n=571) versus standard (n=435) AOR 2.25, 95% CI 1.75 to 2.90 I was happy with the emotional support I received in pregnancy Caseload (n=568) versus standard (n=440) AOR 2.74, 95% CI 2.14 to 3.50 Overall perception of care during pregnancy Caseload (n=569) versus standard (n=438) AOR 2.94, 95% CI 2.28 to 3.79
Attanasio et al. 2019 To compare the costs and outcomes of care for low-risk pregnancies with midwife-led care vs obstetrician-led care https://doi.org/10.1111/birt.12464	Participants Low risk women (n=2400 from LTM 3 survey 1 July 2011-30 June 2012) Estimated 2.6 million low risk hospital births per year in the US based on the LTM 3 Study design Decision analysis model Setting US hospital	Intervention Midwifery-led care Control Obstetrician-led care Primary Outcome/s Obstetric procedures, including: Epidural analgesia Labor induction Caesarean birth Episiotomy Preterm birth (Gestational lengths less than 37 completed weeks) Costs Appraisal score	Measured associations between midwife-led care and obstetric-led care Epidural AOR 0.68, 95% CI 0.40 to 1.14 Induction with definitive medical reason (vs no induction) RRR 1.87, 95% CI 0.91 to 3.87 Induction without definitive medical reason (vs no induction) RRR 0.71, 95% CI 0.38 to 1.35 Planned caesarean AOR 0.49, 95% CI 0.20 to 1.21 Spontaneous vaginal birth (vs caesarean) RRR 1.54, 95% CI 0.82 to 2.91 Assisted vaginal birth (vs caesarean)

		7 out of 11 on the JBI checklist for economic evaluations <u>Quality rating</u> Not rated	RRR 0.38, 95% CI 0.05 to 3.00 Episiotomy AOR 0.40, 95% CI 0.18 to 0.88 <u>Predicted outcomes for midwife-led care vs obstetrician-led care based on estimated 2.6 million low risk hospital births:</u> Mean number of preterm births (midwifery-led care vs obstetrician-led care) 167,259 (95% PI 129,409-214,502) vs 219,427 (95% PI (181,672-259,473) Mean averted pre-term birth per year by using midwifery-led care 51 550, 95% PI 17,566-81,217 Mean number of planned caesareans 257,014 (95% PI 103,204-529,369) vs 436,975 (95% PI 386,199-493,331) Mean number of epidural 1,607,355 (95% PI 1,287,747-1,899,061) vs 1,838,755 (95% PI 1,767,262-1,913,231) Mean number of episiotomy 195,795 (95% PI 82,553-381,967) vs 415,665 (95% PI 354,446-480,324) <u>Costs</u>: The 10,000 simulated scenarios comparing midwife-led care to obstetrician-led care indicated lower costs for midwife-led care The average difference in costs for births to low-risk women with midwife-led care was $2421 less than the cost of births to low-risk women cared for by obstetricians A ten-percentage point increase in the proportion of low-risk pregnancies with midwife-led care (i.e., from 8.9% to 18.9%) would generate $627 million in cost savings in the United States, annually, by

			means of lower rates of preterm birth and episiotomy An increase to 40% of pregnancies with midwife-led care would generate $1949 million in cost savings annually
Bernitz et al. 2016 To investigate possible differences in satisfaction with intrapartum care among low-risk women, randomized to a midwifery unit or to an obstetric unit within the same hospital https://doi.org/10.1186/s12884-016-0932-x	Participants Women at low risk at onset of labour (n=485) Study design RCT Single centre Setting Department of Obstetrics and Gyneacology at Østfold Hospital Trust Norway	Intervention Care on midwifery unit (n=184) Control Care on obstetric unit (n=301) Outcome/s Satisfaction with intrapartum care -Overall satisfaction with birth care - Satisfaction with intrapartum transfer from midwifery unit to obstetric unit - Effects of mode of delivery and epidural analgesia on patient satisfaction Labour and Delivery Satisfaction Index questionnaire Appraisal score 7 out of 13 on the JBI checklist for RCTs Quality rating ++ High	Overall satisfaction with birth care Those randomized to the midwifery unit had significant higher mean score (182.7) than those randomised to the obstetric unit (175.5) MD 7.2, CI 95% 2.6 to 11.8 p=0.002 Women who had an obstetrician involved, expressed significant lower overall satisfaction with intrapartum care (161.2), than those who did not (183.5) MD 22.3, CI 95% 17.1 to 27.4 Satisfaction with intrapartum transfer The mean score for overall satisfaction with intrapartum care was 162.5 for women who were transferred during labour or delivery compared to 190.9 for those who stayed in the midwifery unit throughout labour and delivery MD 28.4, CI 95 % 20.7 to 36.0 Effects of mode of delivery and epidural analgesia on patient satisfaction The mean score for intrapartum care for women with an operative delivery was 157.4 compared to women with a spontaneous vaginal delivery 183.0 MD 25.5, CI 95 % 19.0 to 32.1 The mean score for overall satisfaction with intrapartum care for women with an epidural was 161.5 compared to 182.2 for women without epidurals

			MD 20.7 CI 95 % 13.8 to 27.7
Callander et al. 2021 To examine the cost utility of a publicly funded Midwifery Group Practice caseload model of care compared to other models of care and demonstrate the feasibility of conducting such an analysis to inform service decision-making https://doi.org/10.1093/intqhc/mzab084	Participants Women of all risk levels at 27 weeks of gestation or less (n=157) Study design Cost-utility analysis Setting Gold Coast University Hospital, Australia	Intervention Midwifery Practice Group caseload model (One primary, named midwife funded by the public hospital who cares for a caseload of around 40 women per year works within a small team with other two or three midwives who provide support and backup, with collaboration of hospital doctors if required) (n=85) Control	Unadjusted total mean cost for mothers' and babies' health service use from study entry to 12 months post-partum Midwifery Practice Group caseload care: $27,618 Other models of care: $33,608 Adjusted total costs (adjusted for clinical and demographic differences between groups) Midwifery Practice Group caseload care: $23,884 (95% CI 18,219–31,310)

		Other models (Including GP shared care, Combined care, Public hospital maternity care and public hospital high-risk maternity care as classified according to the Maternity Care Classification System) (n=72) Primary Outcome/s Health-related quality of life Costs Appraisal score 9 out of 11 on the JBI checklist for economic evaluations Quality rating Not rated	Other models of care: $29,092 (95% CI 22,471–37,663) Total adjusted costs were 22% higher (cost ratio: 1.218, P = 0.04) for other models of maternity care than for Midwifery Practice Groups caseload model The Midwifery Practice Group caseload care cost $5208 (95% CI 4,252-6,353) less than other models of care QALY Midwifery Practice Group caseload care: 0.918 (95% CI 0.868–0.967) Other models of care: 0.908 (95% CI 0.860–0.956) No significant difference in QALY between the two groups (difference: 0.010, 95% CI: −0.038, 0.018)
Fernandez Turienzo et al. 2020 To assess feasibility, fidelity, and clinical outcomes of a model of midwifery continuity of care linked with a specialist obstetric clinic for women considered at increased risk. preterm birth https://doi.org/10.1371/journal.pmed.1003350	Participants Women at increased risk of preterm birth (n=334) Study design RCT (pilot) Single centre Setting Inner city maternity service UK (England)	Intervention Midwifery continuity of care (Pilot study Of midwifery Practice in Preterm birth Including women's Experiences [POPPIE] (n=169 Control Standard maternity care (n=165) Primary (composite) outcome Comprised the initiation and timing of any the following interventions for the prevention and/or management of potential preterm labour and birth; - antibiotics for suspected / confirmed urinary tract infections - transvaginal scan assessments of the cervix - fetal fibronectin assessments - cerclage insertion	Primary (composite) outcome The proportion of women with the primary composite outcome (initiation and timing of any of the interventions given to prevent and/or manage potential preterm labour and birth) was similar in the POPPIE group (83.3%) and standard group (84.7%); Risk ratio 0.98, 95% CI 0.90 to 1.08 Secondary maternal outcomes There were no differences in of the secondary maternal secondary outcomes Secondary neonatal outcomes Most neonatal outcomes did not differ between the groups Infants in the POPPIE group were significantly more likely to have - skin-to-skin contact after birth Risk ratio 1.24, 95% CI 1.08 to 1.43

		- progesterone administration - corticosteroid administration - magnesium sulphate administration - admission for observation in utero transfer - smoking cessation and domestic violence referrals. <u>Secondary outcome/s</u> - a range of other maternal and neonatal outcomes Secondary maternal outcomes included pregnancy complications (pre-eclampsia, obstetric cholestasis, gestational diabetes, PPROM, placenta abruption, polyhydramnios, oligohydramnios, chorioamnionitis, antepartum haemorrhage, pulmonary embolism, and maternal morbidity and mortality), spontaneous onset of labour, induction or augmentation of labour, regional analgesia (epidural/spinal), opiate analgesia, no intrapartum analgesia/anaesthesia, gestation at birth, spontaneous vaginal birth, assisted vaginal birth (forceps/vacuum), caesarean birth, vaginal breech, vaginal birth after caesarean section, perineal status after birth, blood loss, place of birth, intrapartum transfers, and admission to higher levels of care such as intensive care unit or high dependency unit Secondary neonatal outcomes included gestational ages (weeks) and birth weights (g) of infants, Apgar score at 5 mins less than or equal to 7, delayed cord clamping, skin-to-skin contact and duration, breastfeeding initiation immediately after birth and at hospital discharge, perinatal mortality, admission to special care nursery/neonatal intensive care unit principal indication for admission, mean length of neonatal hospital	- to have it for a longer time Risk ratio 28.57, 95% CI 21.36 to 35.77 - and to breastfeed immediately after birth and at hospital discharge Risk ratio 1.12, 95% CI 1.02 to 1.22 - to breastfeed immediately at hospital discharge Risk ratio 1.23, 955 CI 1.030 to 1.46 The number of serious adverse events was similar in both groups and unrelated to the intervention

		stays in each category of care (days), and transfer of infant to a tertiary centre Appraisal score 11 out of 13 on the JBI checklist for RCTs Quality rating ++ High	
Forster et al. 2016 To evaluate the effect of caseload midwifery on women's satisfaction with care across the maternity continuum https://doi.org/10.1186/s12884-016-0798-y	Participants Women with low obstetric risk at recruitment at two months postpartum (n=2,314) Study design RCT Setting Tertiary hospital Australia	Intervention Caseload midwifery (n=984/ 1121 (87.8% response rate)) Control Standard care (n=828/ 1126 (73.5% response rate) Primary outcome/s Satisfaction with care Authors own questionnaire Appraisal score 10 out of 13 on the JBI checklist for RCTs Quality rating ++ High	Compared with standard care, caseload care was associated with higher overall ratings of satisfaction with - antenatal care OR 3.35; 95 % CI 2.79 to 4.03) - intrapartum care OR 2.14; 95 % CI 1.78 to 2.57) - hospital postpartum care OR 1.56, 95 % CI to 1.32 to 1.85) - home-based postpartum care OR 3.19; 95 % CI 2.64 to 3.85
Homer et al. 2022 To determine whether midwifery continuity of care for women with a previous caesarean section increases the proportion of women who plan to attempt a vaginal birth in their current pregnancy http://dx.doi.org/10.1016/j.wombi.2021.05.010	Participants Low risk women with a previous history of one caesarean section (n=218) Study design RCT Setting Level 5 Maternity Unit attached to a district hospital Australia	Intervention CMP - continuity across the full spectrum — antenatal, intrapartum and postpartum) (n=108) Control MAC Program (antenatal continuity of care only) (n=110) Primary outcome/s The rate of attempted vaginal birth after caesarean section Secondary outcome/s	VBAC success rate No statistical difference between the groups (27.8% CMP group versus 32.7% MAC group having a vaginal birth) (p=0.5) The model of care did not significantly impact planned vaginal birth at 36 weeks (CMP 66.7% vs MAC 57.3%) or success rate (CMP 27.8% vs MAC 32.7%) Maternal and neonatal complications No significant differences

		- If the intervention, midwifery continuity of care demonstrates an increase in the number of women having a vaginal birth after caesarean section - Neonatal outcomes Respiratory distress, Admission to SCN, Composite adverse neonatal outcome (2500 g), preterm birth (<37 weeks), Apgar less than 7 at 5 min and admission to the SCN) - Maternal outcomes Postpartum haemorrhage (>500 ml) Composite adverse maternal outcome (included postpartum haemorrhage (>500 ml) Need for blood transfusion Third degree perineal tear and other complications (including anaesthetic complication, wound infection and/or breakdown, chest infection, uterine rupture) - Immediate skin to skin contact - Breastfeeding on discharge Authors own questionnaire <u>Appraisal score</u> 11 out of 13 on the JBI checklist for RCTs <u>Quality rating</u> ++ High	
McLachlan et al. 2016 To determine the effect of primary midwifery-led care ('caseload midwifery') on women's experiences of childbirth https://doi.org/10.1111/1471-0528.13713	<u>Participants</u> Women with low obstetric risk at recruitment (n=2314) <u>Study design</u> RCT <u>Setting</u> Tertiary care women's hospital, Australia	<u>Intervention</u> Midwifery caseload care (n=1156) <u>Control</u> Standard care (n=1158) <u>Primary outcome/s</u> Caesarean section rates <u>Secondary outcome/s</u> Women's experience of childbirth - Pain intensity	<u>Women's experience of childbirth</u> Logistic regression analyses showed that women in the caseload group scored more positively on the following aspects of the childbirth experience: Positive experience of childbirth overall AOR 1.50, 95% CI 1.22 to 1.84 Control in labour AOR 1.48, 95% CI 1.19 to 1.83 Coping physically AOR 1.33, 95% CI 1.11 to 1.64

		- Experience of pain in relation to expectations - Experience of pain overall - Anxiety during labour - Felt free to express feelings during labour - Experience of control during labour - Physical coping in relation to expectations - Emotional coping in relation to expectations - Feeling proud when looking back at labour and birth - Support by midwife - Support by doctor - Support by husband/partner <u>Appraisal score</u> 10 out of 13 on the JBI checklist for RCTs <u>Quality rating</u> ++ High	Coping emotionally AOR 1.33, 95% CI 1.10 to 1.61) Feeling proud of themselves AOR 1.65, 95% CI 1.31 to 2.10 Feeling free to express their feelings AOR 1.82, 95% CI 1.43 to2.28 Less likely to be very anxious AOR 0.78, 95% CI 0.64 to 0.98 More likely to have a positive experience of pain AOR 1.39, 95% CI 1.10 to 1.75). Women in the caseload group were less likely to have a very negative experience (OR 0.63, 95% CI 0.41, 0.93) No associations were found in relation to pain intensity or pain in relation to expectations

Key: AOR: adjusted odds ratio; CI: confidence intervals; CMP: Community Midwifery Program; GP: general practitioner; LTM 3: Listening to Mothers III; MAC: Midwifery Antenatal Care; MD: mean difference; OR: odds ratio; PI: Prediction interval; QALY: Quality adjusted life years; RCT: randomised controlled trial; RR: relative risk; RRR: relative risk reduction; SCN: special care nursery; VBAC: vaginal birth after caesarean section

Table 5: Summary of included primary research evidence for question 3

Author/ year **Aim** **doi**	**Participant details** **Study design** **Setting**	**Outcomes**	**Relevant findings**
Drake et al. 2020 To investigate the disparities between planned unavailability ("headroom") and actual staff unavailability https://doi.org/10.12968/bjon.2020.29.7.406	Participants Sample from e-rostering systems of 87 NHS Trusts 35 roster policies Study design Cross-sectional Multicentre Setting 87 NHS Trusts, UK	Outcome/s - Planned headroom and unavailability data from e-rostering - Recorded headroom and unavailability occurring over a 12-month period - Potential for over – or under-staffing Appraisal score 3 out of 5 in JBI checklist for analytical cross-sectional studies Quality rating ++ High	Key findings *Headroom and unavailability data from e-rostering systems:* Recorded unavailability varied from 16-34% Of the 76 Trusts that specified, headroom varied from 16-26%, with an average of 21.1% In Trusts where headroom exceeded unavailability (positive variability), this was indicative of over-staffing If unavailability exceeded headroom (negative variability), this was indicative of under-staffing. *Headroom components data from roster policies* % Headroom mean 22.1%, range 18% to 25%, 20/20 policies % Annual leave mean 14.3%; range 10% to 16%, 20/20 policies % Sickness mean 4.0%, 3% to 7%, 20/20 policies % Study leave mean 2.6%, range 1% to 5%, 18/20 polices % Parenting leave mean 2.3%, range 1.5% to 3%, 6/20 policies % Non-clinical work mean 1.8%, 1% to 3%, 9/20 polices

Table 6: Summary of included systematic review evidence for question 4

Author / year **Aim** **doi**	**Number of included studies** **Search dates** **Appraisal** **Confidence in results of the review**	**Included relevant studies** **(study design / quality appraisal)** **Relevant findings**
Ali et al. 2020 To describe the single-room maternity care model and evaluate its influence on patient, provider and system outcomes https://dx.doi.org/10.1002/nop2.586	Number of included studies Included studies (n=13) Search dates 1985 to August 2018 Appraisal scale For quantitative studies: Effective Public Health Practice Project Quality Assessment Tool For qualitative studies: Critical Appraisal Skills Programme Qualitative Checklist For mixed methods studies: both the quantitative and qualitative quality appraisal tools Review appraisal score 10 out of 11 on the JBI checklist for systematic reviews and research syntheses Confidence in results of the review ++ High	Relevant studies (n=11) Bergeron 2001 (USA, Mixed methods – weak quality) - Quantitative data - reduced costs, shorter maternal lengths of stay - Qualitative data - increased staff support to admitted patients, and increased patient satisfaction Drum 2011(NB Assessed a move FROM SRMC to TMC) (USA, Before-after, cross sectional comparative – weak quality) - Reported a 12% decrease in labour hours, which equalled to over $533,000 in saving - Patient satisfaction increased (improvement was shown to move from a mean score of 89.0 to 90.7, and improvement from the 85th percentile to the 89th percentile) - Mixed findings for staff satisfaction Gerrits et al. 2013 (the Netherlands, Retrospective cohort – weak quality) - A decrease in the number of hypoglycaemias (from 15.6% in 2005 to 2.5% in 2009) Harris et al. 2004 (Canada, Before-after, cross sectional comparative – weak quality) - Rates of intrapartum interventions and adverse outcomes were similar in both groups, with the exception of less frequent electronic foetal monitoring in the SRMC setting - Length of stay was significantly shorter in the SRMC group (55.1 ± 26.5 days vs. 61.0 ± 24.3 days; p<0 .00I) - Staff positions in the hospital were reduced from 206 to 193.7 - Direct costs for women of similar acuity (resource intensity weightings) were reduced by 24% ($I809 vs $2377) - The proportion of physicians preferring SRMC to the traditional setting increased from 45.8% at 6 months to 78.7% at 12 months after implementation of the SRMC model (p=0.003)

		Hickey 1994 (USA, Descriptive survey – weak quality) - 68% had a negative attitude towards SMRC after having practices in a traditional maternity care setting Janssen et al. 2000 (Canada, Before-after, cross sectional comparative – weak quality) - Study group women were more satisfied than comparison groups in all areas evaluated, including provision of information and support, physical environment, nursing care, patient education, assistance with infant feeding, respect for privacy, and preparation for discharge (all p<0.001) Janssen et al. 2001 (Canada, Before-after, cross sectional comparative – weak quality) - Overall job satisfaction increased from 6.5 to 8.4 on a scale of 1 to 10 (p=0.002) Janssen et al. 2006 (Canada, Cross sectional comparative – weak quality) - Mean scores were significantly higher (p<0.05) in the SRMC group (mean = 181.05, SD 15.26) than the traditional care group (mean = 164.25, SD 19.39) Olson and Smith 1992 (USA, Descriptive cross sectional – weak quality) - Patient satisfaction with SRMC and the nursing care they received (98%). Comments included quiet atmosphere, togetherness of family and privacy - Physician satisfaction - 95% of nurses surveyed preferred single room maternity care to traditional maternity care Rogner 1995 (USA, Qualitative – high quality) - Women experienced a high level of satisfaction with their labour and delivery nurses Williams and Mervis 1990 (USA, Retrospective cohort – strong quality) - No change in perinatal mortality rate
Bertuzzi et al. 2023) To assess the impact of single rooms versus multioccupancy accommodation on inpatient healthcare outcomes and processes. doi:10.1136/bmjopen-2022-068932	Number of included studies Included studies (n=145) Single room maternity care (n=3) Search dates Up to February 2022 Appraisal scale Observational studies: Downs and Black checklist	Relevant studies (n=3) Harris et al. 2004 (Before-after, cross sectional comparative- appraisal score 74% - moderate quality) Janssen et al. 2000 (Cross sectional comparative - appraisal score 56% - moderate quality) Olson and Smith 1992 (Descriptive cross sectional - appraisal score 52% - moderate quality)

	Review appraisal score Not conducted as relevant studies included form the review by Ali et al. 2020 Confidence in results of the review Not conducted as relevant studies included form the review by Ali et al. 2020	
Voigt et al. 2018 What is the effect of SBRs in low-acuity healthcare settings on the outcomes of infections, patient falls, medication errors/usage, LOS, costs, patient satisfaction (including issues of sleep, patient comfort/well-being, dignity, and well-being), staff preferences, and operational efficiencies? https://dx.doi.org/10.1177/1937586717702597	Number of included studies Included studies (n=49) Single room maternity care (n=2) Search dates 1980 to September 2016 Appraisal scale GRADE CEBM Review appraisal score Not conducted as relevant studies included form the review by Ali et al. 2020 Confidence in results of the review Not conducted as relevant studies included form the review by Ali et al. 2020	Relevant studies (n=2) Harris et al. 2004 Before-after, cross sectional comparative CEBM grading – 2b / GRADE C Janssen et al. 2000 (Cross sectional comparative - CEBM grading – 3b / GRADE C

Key: CEBM: Center for Evidence Guidelines Levels of Evidence; GRADE: Grading of Recommendations, Assessment, Development, and Evaluation; ICU: intensive care unit, LOS: length of stay; SBR: single bed rooms, SRMC: Single room maternity care, TMC: traditional maternity care

Table 7: Summary of included primary research evidence for question 4

Author/ year, Country **Aim** **Doi**	**Participant details** **Study design** **Setting**	**Outcomes of interest**	**Relevant findings**
Ali et al. 2019 Canada To describe the single-room maternity care model and evaluate its influence on patient, provider and system outcomes https://dx.doi.org/10.1002/nop2.586	Participants 12 healthcare providers (9 RNs, 2 physicians, and 1 healthcare aide) Study design Qualitative study Focused ethnographic study (Face-to-face semi-structured interviews and participant observations) Setting 1 SRMC	Outcomes of interest Description of the unit Unit culture and impact on practice Appraisal score 6 out of 8 on the JBI checklist for qualitative studies Quality rating Not rated	Staffing levels Each patient care area had various levels of staffing Triage – 2 RNs / 4 patients Labour and delivery – 1 RN /1 patient Postpartum – 1 RN / 4 patients Staffing schedules Staff systematically rotated through different work settings Value seemed to be placed on having necessary resources for patient care that matched the task Support staff Multiple support staff were noted on the unit Service workers - Seemed to optimize the nurses' scope of practice Presence of the support staff appeared to be one of the factors that influenced unit culture
Hall et al. 2019 Canada To compare healthcare providers' satisfaction and collaboration between SRM and TMC models and to explore how each model of care shaped providers' practice https://dx.doi.org/10.1097/JPN.0000000000000413	Participants 84 SRMC providers (76% RNs, 10% allied health, 8% physicians, 4% LPN/healthcare aide, 1% other 42 TMC providers (76% RNs, 0% allied health, 7% physicians, 10% LPN/healthcare aide, 7% other) Study design Mixed-methods study (Questionnaires and interviews with healthcare providers) Setting 2 Hospitals (1 SRMC, 1 TMC)	Outcomes of interest Job satisfaction Appraisal score 6 out of 8 in JBI checklist for analytical cross-sectional studies and 6 out of 8 on the JBI checklist for qualitative studies Quality rating Not rated	Quantitative data - No significance difference (p=0.24) was found in job satisfaction scores between SRMC (mean=4.7) and TMC (mean=4.6) Qualitative data - While quantitative differences were not observed in job satisfaction between SRM and TMC providers, the qualitative findings suggest that providers were satisfied for different reasons - Single-room maternity providers were satisfied in providing a full spectrum of maternity care, whereas traditional maternity providers enjoyed specializing in labour/delivery or postpartum care

Hall et al. 2023 Canada Single room maternity care versus traditional maternity care: a cross-sectional study examining differences in mothers' perceptions of readiness for discharge and satisfaction and health outcomes https://doi.org/10.1177/08445621231165233	Participants 506 mothers (292 SRMC, 214 TMC) Study design Descriptive study Setting 2 Hospitals (1 SRMC, 1 TMC)	Outcomes of interest Maternal satisfaction Newborn and mother length of stay Appraisal score 8 out of 8 in JBI checklist for analytical cross-sectional studies and 6 out of 8 on the JBI checklist for qualitative studies Quality rating Not rated	*Length of stay* Although newborn and mother length of stay were significantly reduced in SRMC compared to TMC for univariate tests, mother length of stay was not significantly different when adjusting for other variables *Maternal satisfaction* Mothers were significantly more satisfied ($p<0.001$) with care provided in the SRMC hospital (mean=9.10, SD=0.62) compared to the TMC hospital (mean=6.76, SD=1.47)

Key: LPN: licensed practical nurse, RN: registered nurses: SRMC: Single room maternity care, TMC: traditional maternity care

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8. RAPID SCOPING REVIEW METHODS

Protocol

The protocol for this rapid scoping is publicity available on Open Science Framework https://osf.io/5dmza/

Eligibility criteria

The PCC framework was used to inform the eligibility criteria: Population, Concept and Context (Peters et al. 2020).

PCC	Inclusion criteria	Exclusion criteria
Population	Midwives Nurse midwives Maternity support workers / care assistants Obstetricians Allied health professionals Other support staff	Students Birth companions
Concept	Question 1 Skill mix in relation to outcomes - 1a: Staffing levels - 1b:Task shifting and maternity support assistants - 1c: Obstetric consultant presence Maternal and neonatal outcomes Events in labour Mode of birth Patient satisfaction or experience Cost-effectiveness Question 2 Deployment Models - Midwifery-led - Obstetric- led Maternal and neonatal outcomes Events in labour Mode of birth Patient satisfaction or experience Cost-effectiveness Question 3 Headroom provision Staffing ratios Workforce planning Maternal and neonatal outcomes Question 4 Single rooms in relation to staffing levels	Methods for determining midwifery staffing requirements (including Birthrate plus tool, computer simulation models) Healthcare workforce satisfaction and retention Other healthcare workforce outcomes (i.e. confidence, team working)

	Maternal and neonatal outcomes Patient satisfaction or experience Cost-effectiveness	
Context	Worldwide including LMICs Where registered midwife role exists	
Study design	Question 1 – Scoping reviews, systematic reviews, umbrella reviews, experimental studies and observational studies, randomised controlled trials Question 2 - Scoping reviews, systematic reviews, Umbrella reviews and randomised controlled trials Question 3 – Any Question 4 – Any	Qualitative studies Qualitative studies Quasi-experimental and observational study designs
Geographical considerations	Question 1 – Worldwide Question 2 – High income countries Question 3 – Worldwide Question 4 – Worldwide	Low and middle income countries
Date restrictions	The search will be limited to updating previous review[16] material from 2016 to June 2023 with the following caveats Question 1: Primary studies published since the review conducted by Turner et al. 2021 Question 2: Primary studies published since the review conducted by Reid et al. 2017 English language	
Other Study Considerations		
Outcomes of interest will include Safe staffing midwifery indicators as published by the previous review, available at https://www.england.nhs.uk/wp-content/uploads/2021/05/safe-staffing-maternity-apendices.pdf		

Literature search

Comprehensive searches were conducted across six databases for English language publications and the search strategies are provided in Appendix 1:

- On the Ovid Platform: Medline, Embase, OVID Emcare, HMIC
- On the Ebsco Platform: CINAHL
- SCOPUS

[16] Sandall et al. 2017. Evidence review – maternity safe staffing improvement resource. https://www.england.nhs.uk/wp-content/uploads/2021/05/safe-staffing-maternity-evidence-review.pdf

The websites of key third sector and government organisations relevant to the topic area were also searched.

- National Audit Office
- National Quality Board
- National Institute for Health and Care Excellence
- Royal Colleges of Midwives
- Royal College of Obstetricians and Gynaecologists
- Kings Fund
- NHS England
- Welsh Government
- Scottish Government
- Department of Health, Northern Ireland

An initial search of MEDLINE was undertaken (May 2023) that informed the rapid scoping review. The keywords used within the title of a publication were midwi* or maternity or obstetric* and skill mix or staffing or workforce or model* or ratio*.

This informed the development of the final search strategy that was tailored for each information source for each question. The reference list of all included publications were screened and forward citation tracking was conducted for additional studies.

Reference management
All citations retrieved from the database searches were imported or entered manually into EndNote™ (Thomson Reuters, CA, USA) and duplicates removed. At the end of this process the citations that remained were imported to Rayyan™ and any further duplicates removed.

Study selection process
One reviewer screened all the citations using the information provided in the title and abstract using Rayyan™, and a second reviewer screened 10% of the citations; any disagreements were resolved by discussion. For citations that appeared to meet the inclusion criteria, or in cases in which a definite decision cannot be made based on the title and/or abstract alone, the full texts of all citations were retrieved. The full texts were screened for inclusion by one reviewer using a purposefully developed screening tool and all decisions were checked by a second reviewer, and any disagreements were resolved by discussion. The flow of citations through each stage of the review process is presented based on the principles of PRISMA-ScR (Tricco et al. 2018).

Data extraction
All demographic and outcome data was extracted directly into tables by one reviewer and checked by another. The data extracted included specific details about the populations, study methods and outcomes of significance to the review questions. A template for the data extraction process was developed and piloted on manuscripts for each of the included study designs. Additionally, for question 4 where available, we used the data as presented in the review by Ali et al. 2020 and only went back to the primary research studies if further details were needed.

Assessment of methodological quality
The methodological quality of all the research studies for questions 1 to 3 were assessed by one reviewer (and judgements verified by a second reviewer). Overall critical appraisal scores are presented in Appendix 4.

The critical appraisal tools that were used were the JBI critical appraisal checklist for systematic reviews and research syntheses (Aromataris et al. 2015); JBI critical appraisal checklist for randomised controlled trials (Tufanaru et al. 2020); JBI checklist for checklist for analytical cross sectional studies (Moola et al. 2020) and the JBI critical appraisal checklist for economic evaluations (Gomersall et al. 2015). Using these checklists when a study meets a criterion for inclusion a score of one was given. Where a particular point for inclusion was regarded as "unclear" it was given a score of zero. Where a particular point for inclusion was regarded as "not applicable" this point was taken off the total score.

For question 4, for the 11 primary research studies that were included in the review by Ali et al. 2020, we utilised the review authors quality appraisal ratings. This review used the terms strong, moderate and weak in defining the overall quality of each research study. For consistency within this report we used the terms high, moderate and low. For the remaining two studies we used the appropriate JBI Checklist for Qualitative Research (Lockwood et al. 2015) and the JBI checklist for checklist for analytical cross sectional studies (Moola et al. 2020).

For the RCTs the approach described in an earlier review into safe midwifery staffing in maternity settings (Bazian, 2015) to provide an overall quality assessment was assigned as follows:

- High quality [++]: All or most of the checklist criteria have been fulfilled, and where they have not been fulfilled the conclusions are very unlikely to alter.
- Moderate quality [+]: Some of the checklist criteria have been fulfilled, and where they have not been fulfilled, or are not adequately described, the conclusions are unlikely to alter.
- Low quality [-]: Few or no checklist criteria have been fulfilled and the conclusions are likely or very likely to alter.

Cohort studies were appraised using the Scottish Intercollegiate Guidelines Network (SIGN), Methodology Checklist 3; Cohort Studies (Scottish Intercollegiate Guidelines Network.2019). This is a 14-item checklist ('yes', 'no', 'can't say', 'does not apply'). For retrospective cohort studies five items do not apply to this type of study design (Statement 1.3, 1,4, 1.5, 1.6, 1.12). Additionally, when there is only one group, statement 1.8 (the assessment of outcome is made blind to exposure status) does not apply and when measures used are completely objective, statement 1.11 (evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable) does not apply. The final assessment of quality is based on an adaptation[17] from the SIGN Checklist (Scottish Intercollegiate Guidelines Network. 2019).

- High quality [++]: Majority of criteria met. Little or no risk of bias. Results unlikely to be changed by further research.
- Moderate quality [+]: Most criteria met. Flaws in the study with an associated risk of bias. Conclusions may change in the light of further studies.
- Low quality [-]: Either most criteria not met, or significant flaws relating to key aspects of study design. Conclusions likely to change in the light of further studies.

[17] The checklist uses the term acceptable quality and this has been replaced with the term moderate quality and Q1.13 The main potential confounders are identified and taken into account in the design and analysis and Q1.14 Have confidence intervals been provided were considered to be critical domains.

The guidance states that as retrospective designs are generally regarded as a weaker design and as such they should not receive a rating higher than “+”.

Overall confidence in the results of reviews
Alternative appraisal tools that can be used for assessing the quality of SRs, evidence maps and overviews of reviews include the AMSTAR-2 2 (Shea et al. 2017). While in this rapid review, the JBI critical appraisal checklist for systematic reviews and research syntheses (Aromataris et al. 2015) was selected due to its ability to be completed more swiftly than AMSTAR-2, five of the JBI quality checklist questions could be matched to the domains deemed critical in the AMSTAR-2 which were considered relevant to this review.

As a result, the JBI domains considered critical after the mapping include the following:
Q3: Was the search strategy appropriate?
Q4: Were the sources and resources used to search for studies adequate?
Q5: Were the criteria for appraising studies appropriate?
Q8: Were the methods used to combine studies appropriate?
Q9: Was the likelihood of publication bias assessed?

- High quality [++]: No or one non-critical weakness. The systematic review provides an accurate and comprehensive summary of the results of the available studies that address the question of interest.
- Moderate quality [+]: More than one non-critical weakness[18] the systematic review has more than one weakness but no critical flaws. It may provide an accurate summary of the results of the available studies that were included in the review.
- Low quality [-]: One critical flaw with or without non-critical weaknesses. The review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest.
- Critically low [- -]: More than one critical flaw with or without non-critical weaknesses. The review has more than one critical flaw and should not be relied on to provide an accurate and comprehensive summary of the available studies.

Synthesis
The data was reported narratively as a series of thematic summaries across each research question and sub categorised by the outcomes of interest (Thomas et al. 2017).

[18] Multiple non-critical weaknesses may diminish confidence in the review and it may be appropriate to move the overall appraisal down from moderate to low confidence

9. APPENDICES

8.1. Appendix 1: Search strategies

Search strategies for Question 1a: skill-mix

Medline (Ovid) 20th June 2023

Search Number	Search	Results
1	ratio* adj5 (midwi* or matern*).tw	4,840
2	((skill-mix or skillmix) adj5 (midwi* or matern*)).tw	8
3	((workload* or workforce or manpower) adj5 (midwi* or matern*)).tw	466
4	((safety or safe staffing) adj5 (midwi* or matern*)).tw	1,197
5	((staffing or understaffing) adj5 (midwi* or matern*)).tw	99
6	OR 1-5	6,549
7	Exp "Personnel Staffing and Scheduling"/	45,914
8	Exp Workforce/	80,883
9	7 OR 8	120,560
10	Exp Nurse Midwives/	7,543
11	Exp Midwifery/	21,252
12	Exp Maternal Health Services/	57,810
13	Exp Delivery, Obstetric/	91,080
14	Exp Obstetrics/	24,573
15	Exp Obstetric Nursing/	3,064
16	Midwi*.tw	28,889
17	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	63,350
18	OR 10-17	229,917
19	9 AND 18	3,234
20	6 OR 19	9,560
21	Limit 20 to (English Language and yr="2020–current")	**1,761**

EMBASE (Ovid) 20th June 2023

Search Number	Search	Results
1	ratio* adj5 (midwi* or matern*).tw	6,291
2	((skill-mix or skillmix) adj5 (midwi* or matern*)).tw	11
3	((workload* or workforce or manpower) adj5 (midwi* or matern*)).tw	608
4	((safety or safe staffing) adj5 (midwi* or matern*)).tw	1,745
5	((staffing or understaffing) adj5 (midwi* or matern*)).tw	127
6	OR 1-5	8,693
7	Exp personnel shortage/	4,048
8	Exp skill mix/	522
9	Exp workload/	55,494
10	OR 7-9	59,634
11	Exp midwife/	37,634
12	Exp maternal health service/	2,851
13	Exp prenatal care/	184,214
14	Exp perinatal care/	71,702
15	Exp postnatal care/	144,488
16	Exp obstetric delivery/	205,660
17	Exp obstetrical nursing/	2,879
18	Exp obstetrics/	48,926

19	Midwi*.tw	34,189
20	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	82,712
21	OR 11-20	631,552
22	10 AND 21	1,763
23	6 OR 22	10,280
24	Limit 23 to (English Language and yr="2020–current")	**2,479**

Ovid EMCARE 20th June 2023

Search Number	Search	Results
1	ratio* adj5 (midwi* or matern*).tw	2,176
2	((skill-mix or skillmix) adj5 (midwi* or matern*)).tw	6
3	((workload* or workforce or manpower) adj5 (midwi* or matern*)).tw	430
4	((safety or safe staffing) adj5 (midwi* or matern*)).tw	796
5	((staffing or understaffing) adj5 (midwi* or matern*)).tw	77
6	OR 1-5	3,433
7	Exp personnel shortage	2,736
8	Exp skill mix/	822
9	Exp workload/	20,061
10	Exp workforce/	8,068
11	OR 7-10	30,923
12	Exp midwife	15,923
13	Exp maternal health service/	472
14	Exp prenatal care/	38,090
15	Exp perinatal care/	20,822
16	Exp postnatal care/	36,419
17	Exp obstetric delivery/	40,360
18	Exp obstetrics/	9,518
19	Exp obstetrical nursing/	494
20	Midwi*.tw	19,150
21	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	28,473
22	OR 13-21	147,153
23	11 AND 22	1,145
24	6 OR 23	4,390
25	Limit 24 to (English Language and yr="2020–current")	**1,265**

HMIC (Ovid) 20th June 2023

Search Number	Search	Results
1	ratio* adj5 (midwi* or matern*).tw	77
2	((skill-mix or skillmix) adj5 (midwi* or matern*)).tw	4
3	((workload* or workforce or manpower) adj5 (midwi* or matern*)).tw	108
4	((safety or safe staffing) adj5 (midwi* or matern*)).tw	62
5	((staffing or understaffing) adj5 (midwi* or matern*)).tw	39
6	OR 1-5	271
7	Exp skill mix/	626
8	Exp workforce/	5,360
9	Exp workload/	1,477
10	Exp workload management/	39
11	Exp staffing/	2,035

12	Exp staff ratios/	129
13	OR 7-12	8,912
14	Exp midwives/	2,328
15	Exp midwifery services	542
16	Exp midwifery/	670
17	Exp obstetrics/	349
18	Midwi*.tw	4,623
19	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	2,360
20	OR 14-19	7,153
21	13 AND 20	339
22	6 OR 21	539
23	Limit 22 to (English Language and yr="2020–current")	**40**

CINAHL (EBSCO) 20th June 2023

Search Number	Search	Results
S1	TI ratio* N5 (midwi* or matern*) OR AB ratio* adj5 (midwi* or matern*)	2,050
S2	TI ((skill-mix or skillmix) N5 (midwi* or matern*)) OR AB ((skill-mix or skillmix) adj5 (midwi* or matern*))	12
S3	TI ((workload* or workforce or manpower) N5 (midwi* or matern*) OR AB ((workload* or workforce or manpower) N5 (midwi* or matern*)	645
S4	TI ((safety or safe staffing) N5 (midwi* or matern*)) OR AB ((safety or safe staffing) N5 (midwi* or matern*))	892
S5	TI ((staffing or understaffing) N5 (midwi* or matern*)) OR AB ((staffing or understaffing) N5 (midwi* or matern*))	207
S6	OR S1-S5	3,711
S7	(MH "Personnel Staffing and Scheduling+")	34,151
S8	(MH "Workload")	18,126
S9	S7 OR S8	49,215
S10	(MH "Midwifery+")	22,400
S11	(MH "Midwifery Service+")	2,096
S12	(MH "Maternal Health Services+")	36,530
S13	TI midwi* OR AB midwi*	38,657
S14	TI ((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N2 (care or service* or period)) OR AB ((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N2 (care or service* or period))	32,202
S15	OR S10-S14	95,268
S16	S9 AND S15	1,730
S17	S6 OR S16 (Limited to English Language and 01012020 - 31072023	**1,240**

Scopus 20th June 2023

Search Number	Search	Results
1	TITLE-ABS-KEY ratio* W/5 (midwi* or matern*)	6,501
2	TITLE-ABS-KEY ((skill-mix or skillmix) W/5 (midwi* or matern*)).tw	9
3	TITLE-ABS-KEY ((workload* or workforce or manpower) W/5 (midwi* or matern*)).tw	637

4	TITLE-ABS-KEY ((safety or “safe staffing”) W/5 (midwi* or matern*))	1,615
5	TITLE-ABS-KEY ((staffing or understaffing) W/5 (midwi* or matern*))	132
6	0R 1-5	8,805
7	6 Limited to English Language and Publication Year 2020-2023	**1,590**

Search strategies for Question 1b: task-shifting and maternity support assistants

Medline (Ovid) 26th June 2023

Search Number	Search	Results
1	(task-shift* or taskshift*).tw.	1,381
2	(extend* adj3 role*).tw.	2,742
3	1 OR 2	4,122
4	midwi*.tw.	28,910
5	((matern* or neonatal) adj3 (support* or assistant* or nurs* or care)).tw.	48,752
6	4 OR 5	75,080
7	3 AND 6	134
8	limit 7 to (english language and yr="2016 -Current")	**62**

EMBASE (Ovid) 26th June 2023

Search Number	Search	Results
1	(task-shift* or taskshift*).tw.	1,740
2	(extend* adj3 role*).tw.	3,579
3	1 OR 2	5,318
4	midwi*.tw.	32,914
5	((matern* or neonatal) adj3 (support* or assistant* or nurs* or care)).tw.	63,504
6	4 OR 5	93,140
7	3 AND 6	169
8	limit 7 to (english language and yr="2016 -Current")	**80**

Ovid EMCARE 26th June 2023

Search Number	Search	Results
1	(task-shift* or taskshift*).tw.	881
2	(extend* adj3 role*).tw.	1,138
3	1 OR 2	2,018
4	midwi*.tw.	19,150
5	((matern* or neonatal) adj3 (support* or assistant* or nurs* or care)).tw.	29,864
6	4 OR 5	46,727
7	3 AND 6	113
8	limit 7 to (english language and yr="2016 -Current")	**55**

HMIC (Ovid) 26th June 2023

Search Number	Search	Results
1	(task-shift* or taskshift*).tw.	22

2	(extend* adj3 role*).tw.	330
3	1 OR 2	352
4	midwi*.tw.	4,623
5	((matern* or neonatal) adj3 (support* or assistant* or nurs* or care)).tw.	1,368
6	4 OR 5	5,630
7	3 AND 6	25
8	limit 7 to (english language and yr="2016 -Current")	**0**

CINAHL (EBSCO) 26th June 2023

Search Number	Search	Results
S1	TI (task-shift* or taskshift*) OR AB (task-shift* or taskshift*)	693
S2	TI (extend* N3 role*) OR AB (extend* N3 role*)	1,253
S3	S1 OR S2	1,944
S4	TI midwi* OR AB midwi*	38,677
S5	TI ((matern* or neonatal) N3 (support* or assistant* or nurs* or care) OR AB (matern* or neonatal) N3 (support* or assistant* or nurs* or care))	32,081
S6	S4 OR S5	67,811
S7	S3 AND S6 Limited to English Language and Published dates 20160101 - 20230731	**52**

Scopus 26th June 2023

Search Number	Search	Results
1	TITLE-ABS-KEY (task-shift* or taskshift*)	1,802
2	TITLE-ABS-KEY (extend* W/3 role*)	6,582
3	1 OR 2	8,382
4	TITLE-ABS-KEY midwi*	54,119
5	TITLE-ABS-KEY ((matern* or neonatal) W/3 (support* or assistant* or nurs* or care))	101,048
6	4 OR 5	149,179
7	3 AND 6	226
8	limit 7 to (english language and yr=2016-2023)	**114**

Search strategies for Question 1c: Obstetric consultant presence

Medline (Ovid) 25th July 2023

Search Number	Search	Results
1	exp Consultants/	7,100
2	Obstetricians/	54
3	consultant* or obstet* or staff senior*).ti.	46,923
4	1 or 2 or 3	51,392
5	(cover* or presence or out of hours or off-hours or evening* or weekend* or 24 hour* or 24-hour or 24*).ti.	16,0571
6	4 and 5	229
7	exp Hospitals, Maternity/	3,182
8	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	60,460

9	exp midwifery/	21,301
10	7 or 8 or 9	80,246
11	6 and 10	32
12	limit 11 to (english language and yr="2017 - current")	6

EMBASE (Ovid) 25th July 2023

Search Number	Search	Results
1	exp Consultants/	16,0280
2	Obstetricians/	9567
3	consultant* or obstet* or staff senior*).ti.	48,393
4	1 or 2 or 3	21,1371
5	(cover* or presence or out of hours or off-hours or evening* or weekend* or 24 hour* or 24-hour or 24*).ti.	19,1415
6	4 and 5	1246
7	exp Hospitals, Maternity/	140,4436
8	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	75,958
9	exp midwifery/	35,654
10	7 or 8 or 9	149,2816
11	**11** 6 and 10	352
12	limit 11 to (english language and yr="2017 - current")	164

Ovid EMCARE 25th July 2023

Search Number	Search	Results
1	exp Consultants/	50,968
2	Obstetricians/	2129
3	consultant* or obstet* or staff senior*).ti.	15,939
4	1 or 2 or 3	66,917
5	(cover* or presence or out of hours or off-hours or evening* or weekend* or 24 hour* or 24-hour or 24*).ti.	41,720
6	4 and 5	478
7	exp Hospitals, Maternity/	383,999
8	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	35,367
9	exp midwifery/	16.048
10	7 or 8 or 9	42,4741
11	**11** 6 and 10	114
12	limit 11 to (english language and yr="2017 - current")	34

HMIC (Ovid) 25th July 2023

Search Number	Search	Results
1	exp Consultants/	2,241
2	Obstetricians/	102
3	consultant* or obstet* or staff senior*).ti.	1594
4	1 or 2 or 3	2958
5	(cover* or presence or out of hours or off-hours or evening* or weekend* or 24 hour* or 24-hour or 24*).ti.	2005

6	4 and 5	31
7	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	3065
8	exp midwifery/	671
9	7 or 8	3640
10	6 and 9	4
11	limit 10 to (english language and yr="2017 - current")	3

CINAHL (EBSCO) 25th July 2023

Search Number	Search	Results
S1	exp midwifery/	8.131
S2	(MM "Obstetricians")	72
S3	TI (consultant* or obstet* or staff senior*)	20,434
S4	S1 OR S2 OR S3	26,489
S5	TI (cover* or presence or "out of hours" or off-hours or evening* or weekend* or "24 hour*" or 24-hour or 24*)	50,548
S6	S4 AND S5	474
S7	(TI ((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N3 (ward* or unit* or centre* or center* or suite* or care or service*))) OR (AB ((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N3 (ward* or unit* or centre* or center* or suite* or care or service*)))	36,556
S8	S7 OR S8	55,789
S9	S4 AND S6 AND S9	21
S10	S4 AND S6 AND S9 (English 2017)	10

Search strategies for Question 2: Deployment models

Medline (Ovid) 14th June 2023

Search Number	Search	Results
1	Exp Nurse Midwives/	7,542
2	Exp Midwifery/	21,247
3	Exp Maternal Health Services/	57,793
4	Exp Delivery, Obstetric/	91,060
5	Exp Obstetrics/	24,570
6	Exp Obstetric Nursing/	3,064
7	Midwi*.tw	28,853
8	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	63,264
9	OR 1-8	229,775
10	Exp “Continuity of Patient Care”/	288,930
11	((midwi* or matern* or medical* or obstetric* or consultant* or physician*) adj (led or manag*)).tw	29,188
12	Deployment model*.tw	52
13	((continuity* or caseload* or shared* or model* or team*) adj3 (care or midwi* or matern*)).tw	71,567
14	OR 10-13	380,533
15	9 AND 14	8,153
16	Limit 15 to (English language and yr=”2016-current”)	**3,451**

EMBASE (Ovid) 14th June 2023

Search Number	Search	Results
1	Exp Nurse Midwife/	7,269
2	Exp midwife/	37,611
3	Exp maternal health service/	2,847
4	Exp prenatal care	184,047
5	Exp perinatal care	71,604
6	Exp postnatal care	144,342
7	Exp obstetric delivery/	205,370
8	Exp obstetrical nursing/	2,879
9	Exp obstetrics/	48,899
10	Midwi*.tw	34,150
11	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	82,592
12	OR 1-11	630,892
13	((midwi* or matern* or medical* or obstetric* or consultant* or physician*) adj (led or manag*)).tw	47,056
14	Deployment model*.tw	62
15	((continuity* or caseload* or shared* or model* or team*) adj3 (care or midwi* or matern*)).tw	106,517
16	OR 13-15	152,451
17	12 AND 16	11,369
18	Limit 17 to (English language and yr=”2016-current”)	**5,702**

Ovid EMCARE 14th June 2023

Search Number	Search	Results
1	Exp midwife/	15,906
2	Exp maternal health service/	470
3	Exp prenatal care/	38,060
4	Exp perinatal care/	20,804
5	Exp postnatal care/	36,398
6	Exp obstetric delivery/	40,334
7	Exp obstetrics/	9,504
8	Exp obstetrical nursing/	493
9	Midwi*.tw	19,120
10	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	32,021
11	OR 1-10	150,712
12	((midwi* or matern* or medical* or obstetric* or consultant* or physician*) adj (led or manag*)).tw	11,656
13	Deployment model*.tw	17
14	((continuity* or caseload* or shared* or model* or team*) adj3 (care or midwi* or matern*)).tw	49,181
15	OR 12-14	60,302
16	11 AND 15	4,834
17	Limit 16 to (English language and yr=”2016-current”)	**2,340**

HMIC (Ovid) 14th June 2023

Search Number	Search	Results
1	Exp Midwives/	2,328
2	Exp Midwifery Services/	542
3	Exp Midwifery/	670
4	Exp Obstetrics	349
5	Midwi*.tw	4,623
6	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw	2,360
7	OR 1-6	7,153
8	Exp "Continuity of Patient Care"/	535
9	((midwi* or matern* or medical* or obstetric* or consultant* or physician*) adj (led or manag*)).tw	638
10	Deployment model*.tw	0
11	((continuity* or caseload* or shared* or model* or team*) adj3 (care or midwi* or matern*)).tw	6,644
12	OR 8-11	7,412
13	7 AND 12	594
14	Limit 13 to (English language and yr="2016-current")	**39**

CINAHL (EBSCO) 14th June 2023

Search Number	Search	Results
1	(MH "Midwifery+")	22,384
2	(MH "Maternal Health Services+")	36,497
3	(MH "Certified Nurse Midwives")	2,377
4	(MH "Obstetrics")	6,910
5	(MH "Delivery, Obstetric"+)	16,610
6	TI midwi* or AB midwi*	39,178
7	TI ((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N2 (care or service* or period) or AB (matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N2 (care or service* or period))	32,215
8	OR 1-8	113,232
9	(MH "Continuity of Patient Care+")	21,412
10	TI ((midwi* or matern* or medical* or obstetric* or consultant* or physician*) N1 (led or manag*) or AB (midwi* or matern* or medical* or obstetric* or consultant* or physician*) N1 (led or manag*))	15,891
11	TI "deployment model*" or AB "deployment model*"	26
12	TI ((continuity* or caseload* or shared* or model* or team*) N3 (care* or midwi* or matern*) or AB (continuity* or caseload* or shared* or model* or team*) N3 (care* or midwi* or matern*))	58,428
13	OR 9-12	89,832
14	8 AND 13 (20160101 – 20230631; English Language)	**3,300**

Scopus 14th June 2023

Search Number	Search	Results
1	TITLE-ABS-KEY (midwi*)	54,061
2	TITLE-ABS-KEY ((matern* OR intrapartum OR postnatal OR antenatal OR prenatal OR perinatal OR childbirth) W/2 (care OR service* OR period)	188,076
3	1 OR 2	228,343
4	TITLE-ABS-KEY ((midwi* or matern* or medical* or obstetric* or consultant* or physician*) W/1 (led or manag*)	66,171
5	TITLE-ABS-KEY ("deployment model*")	1,617
6	TITLE-ABS-KEY (continuity* or caseload* or shared* or model* or team*) W/3 (care* or midwi* or matern*))	171,614
7	4 OR 5 OR 6	237,117
8	3 AND 7	9,996
9	8 Limited to English Language and Publication years 2016-2023	**4274**

Search strategies for Question 3a: Headroom (midwifery)

Medline (Ovid) 27th June 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	8,931
2	"hours per patient day".tw.	146
3	1 OR 2	9,074
4	exp Nurse Midwives/	7,543
5	exp Midwifery/	21,263
6	exp Maternal Health Services/	57,852
7	exp Delivery, Obstetric/	91,141
8	exp Obstetrics/	24,586
9	exp Obstetric Nursing/	3,064
10	midwi*.tw	28,912
11	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw.	63,419
12	OR 4-11	230,080
13	3 AND 12239	239
14	Limit 13 to (English language and yr="2016 – current")	**100**

EMBASE (Ovid) 27th June 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	11,070
2	"hours per patient day".tw.	173
3	1 OR 2	11,239
4	exp Midwife/	37,654
5	exp Maternal Health Services/	2,862

6	exp Prenatal care/	184,431
7	exp Perinatal care/	71,795
8	exp Postnatal care/	144,641
9	exp Obstetric delivery/	205,961
10	exp Obstetrical nursing	2,882
11	exp Obstetrics/	48,925
12	midwi*.tw.	34,233
13	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw.	82,819
14	OR 4-13	632,277
15	3 AND 14	477
16	Limit 15 to (English language and yr=”2016 – current”)	**212**

Ovid EMCARE 27th June 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	4,626
2	“hours per patient day”.tw.	132
3	1 OR 2	4,755
4	exp midwife/	15,936
5	exp maternal health service/	473
6	exp prenatal care/	38,105
7	exp perinatal care/	20,839
8	exp postnatal care/	36,429
9	exp obstetric delivery/	40,367
10	exp obstetrics/	9,522
11	exp obstetrical nursing/	493
12	midwi*.tw.	19,184
13	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw.	32,183
14	OR 4-13	151,014
15	3 and 14	212
16	limit 15 to (english language and yr="2016 -Current")	**105**

HMIC (Ovid) 27th June 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	906
2	“hours per patient day”.tw.	21
3	1 OR 2	925
4	exp Midwives/	2,330
5	exp Midwifery services/	542
6	exp Midwifery/	671
7	exp Obstetrics/	349
8	midwi*.tw.	4,627

9	((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw.	2,361
10	OR 4-9	7,158
11	3 AND 10	31
12	limit 11 to (yr="2016 -Current" and english)	**1**

CINAHL (EBSCO) 27th June 2023

Search Number	Search	Results
1	TI (headroom or "planned unavailability" or roster* or e-roster* or eroster* or uplift* or "annual leave" or "sickness leave" or "study leave" or "planned absence" or "staff* absence*" or "sick* absence*" or "maternity leave" or "paternity leave") OR AB (headroom or "planned unavailability" or roster* or e-roster* or eroster* or uplift* or "annual leave" or "sickness leave" or "study leave" or "planned absence" or "staff* absence*" or "sick* absence*" or "maternity leave" or "paternity leave")	4,561
2	TI "hours per patient day" OR AB "hours per patient day"	169
3	1 OR 2	4,726
4	(MH "Midwifery+")	22,407
5	(MH "Maternal Health Services+")	36,570
6	(MH "Certified Nurse Midwives")	2,377
7	(MH "Obstetrics")	6,917
8	(MH "Delivery, Obstetric+")	16,634
9	(MH "Midwifery Service+")	2,096
10	TI midwi* OR AB midwi*	38,677
11	TI ((matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N2 (care or service* or period) OR AB (matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj2 (care or service* or period)).tw.	32,237
12	OR 4-11	113,332
13	3 AND 12 (limited to English Language and 20160101-20230731	**122**

Scopus 27th June 2023

Search Number	Search	Results
1	TITLE-ABS-KEY (headroom or "planned unavailability" or roster* or e-roster* or eroster* or uplift* or "annual leave" or "sickness leave" or "study leave" or "planned absence" or "staff* absence*" or "sick* absence*" or "maternity leave" or "paternity leave")	74,945
2	TITLE-ABS-KEY "hours per patient day"	179
3	1 OR 2	75,121
4	TITLE-ABS-KEY (midwi*)	54,119
5	TITLE-ABS-KEY (matern* or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) W/2 (care or service* or period)	188,164
6	4 OR 5	228,441
7	3 AND 6	368
8	7 Limited to English Language 2016-2023	**169**

Search strategies for Question 3b: Headroom (nursing)

Medline (Ovid) 12th July 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	8,967
2	"hours per patient day".tw.	146
3	1 or 2	9,110
4	exp Nursing Staff/	69,853
5	nurs*.tw.	521,317
6	4 or 5	546,093
7	3 and 6	811
8	limit 7 to (english language and yr="2016 -Current")	**287**

EMBASE (Ovid) 12th July 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	10,619
2	"hours per patient day".tw.	171
3	1 or 2	10,786
4	exp nursing staff/	75,675
5	nurs*.tw.	607,254
6	4 or 5	631,700
7	3 and 6	1,012
8	limit 7 to (english language and yr="2016 -Current")	**401**

Ovid EMCARE 12th July 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	4,642
2	"hours per patient day".tw.	132
3	1 or 2	4,771
4	exp nursing staff/	26,247
5	nurs*.tw.	319,079
6	4 or 5	327,274
7	3 and 6	605
8	limit 7 to (english language and yr="2016 -Current")	**248**

HMIC (Ovid) 12th July 2023

Search Number	Search	Results
1	(headroom or planned unavailability or roster* or e-roster* or eroster* or uplift* or annual leave or sickness leave or study leave or planned absence or staff* absence* or sick* absence* or maternity leave or paternity leave).tw.	906
2	"hours per patient day".tw.	21
3	1 or 2	925
4	exp Nurses/	21,360
5	nurs*.tw.	40,357
6	4 or 5	45,663
7	3 and 6	212
8	limit 7 to (yr="2016 - 2023" and english)	**21**

CINAHL (EBSCO): 12th July 2023

Search Number	Search	Results
S1	TI (headroom or "planned unavailability" or roster* or e-roster* or eroster* or uplift* or "annual leave" or "sickness leave" or "study leave" or "planned absence*" or "staff* absence*" or "sick* absence*" or "maternity leave" or "paternity leave") OR AB (headroom or "planned unavailability" or roster* or e-roster* or eroster* or uplift* or "annual leave" or "sickness leave" or "study leave" or "planned absence*" or "staff* absence*" or "sick* absence*" or "maternity leave" or "paternity leave")	4583
S2	TI "hours per patient day" OR AB "hours per patient day"	173
S3	S1 or S2	4753
S4	(MH "Staff Nurses")	8,156
S5	TI nurs* OR AB nurs*	618,153
S6	S4 or S5	620,345
S7	S3 and S6	878
S8	limit S7 to (english language and yr="2016 -Current")	**331**

Search strategies for question 4: single bedroomed wards

Medline (OVID)13th April 2024

Search Number	Searches	Hits
1	exp Hospitals, Maternity/	3,207
2	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	63,169
3	exp midwifery/	21,625
4	1 or 2 or 3	83,172
5	((Private* or single*) adj3 (room* or ward*)).mp.	2,800
6	exp delivery room/	1,793
7	5 or 6	4,581
8	4 and 7	702
9	limit 8 to yr="2016 -Current"	**154**

Embase (Ovid) 13th April 2024

Search Number	Searches	Hits
1	exp maternity ward/	4,743
2	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	79,578
3	exp midwife/	36,683
4	((Private* or single*) adj3 (room* or ward*)).mp.	3,790
5	exp delivery room/	4,448
6	1 or 2 or 3	111,387
7	4 or 5	8,217
8	6 and 7	1,277
9	limit 8 to yr="2016 -Current"	**535**

Ovid Emcare 13th April 2024

Search Number	Searches	Hits
1	exp maternity ward/	1754
2	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).tw.	37,467
3	midwife/	15,770
4	1 or 2 or 3	50,341
5	((Private* or single*) adj3 (room* or ward*)).mp.	1418
6	exp delivery room/	1376
7	5 or 6	2787
8	4 and 7	433
9	limit 8 to yr="2016 -Current"	**172**

HMIC (OVID) 13th April 2024

Search Number	Searches	Hits
1	exp Maternity units/	232
2	exp Midwifery/	673
3	((matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) adj3 (ward* or unit* or centre* or center* or suite* or care or service*)).af.	4,823
4	1 or 2 or 3	5,365
5	((Private* or single*) adj3 (room* or ward*)).af.	234
6	exp Delivery rooms/	8
7	5 or 6	242
8	4 and 7	11
9	limit 8 to yr="2016 -Current"	**1**

CINAHL (EBSCO) 14th April 2024

Search Number	Query	Hits
S1	(MH "Maternal Health Services+")	38,113
S2	AB (matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N3 (ward* or unit* or centre* or center* or suite* or care or service*) OR TI (matern* or labor or labour or intrapartum or postnatal or antenatal or prenatal or perinatal or childbirth) N3 (ward* or unit* or centre* or center* or suite* or care or service*)	36,759
S3	(MH "Midwifery+")	22,700
S4	S1 OR S2 OR S3	78,331
S5	TI (Private* or single*) N3 (room* or ward*) OR AB (Private* or single*) N3 (room* or ward*)	1,327
S6	(MH "Delivery Rooms+")	2,380
S7	S5 OR S6	3,689
S8	S4 AND S7	1,238
S9	S4 AND S7 Limiters - Publication Date: 20160101-20241231	**450**

Scopus 14th April 2024

Search Number	Searches	Hits
1	TITLE-ABS-KEY ((matern* OR labor OR labour OR intrapartum OR postnatal OR antenatal OR prenatal OR perinatal OR childbirth) W/3 (ward* OR unit* OR centre* OR center* OR suite* OR care OR service*))	162,006
2	TITLE-ABS-KEY ((private* OR single*) W/3 (room* OR ward*))	9,641
3	(TITLE-ABS-KEY ((private* OR single*) W/3 (room* OR ward*))) AND (TITLE-ABS-KEY ((matern* OR labor OR labour OR intrapartum OR postnatal OR antenatal OR prenatal OR perinatal OR childbirth) W/3 (ward* OR unit* OR centre* OR center* OR suite* OR care OR service*)))	138
4	(TITLE-ABS-KEY ((private* OR single*) W/3 (room* OR ward*))) AND (TITLE-ABS-KEY ((matern* OR labor OR labour OR intrapartum OR postnatal OR antenatal OR prenatal OR perinatal OR childbirth) W/3 (ward* OR unit* OR centre* OR center* OR suite* OR care OR service*))) AND PUBYEAR > 2015 AND PUBYEAR < 2025	**63**

8.2. Appendix 2: Final search numbers

Database	Results						
	Q1a	**Q1b**	**Q1c**	**Q2**	**Q3a**	**Q3b**	**Q4**
Medline	1,761	62	6	3451	100	287	154
EMBASE	2,479	80	164	5702	212	407	535
Ovid EMCARE	1,265	55	34	2340	105	248	172
HMIC	40	0	3	39	1	21	1
CINAHL	1,240	52	10	3300	122	331	450
Scopus	1,590	114	NS	4274	169	NS	63
Total	**8,375**	**363**	**207**	**19,106**	**709**	**681**	**1375**
Duplicates	4,536	224	153	9967	354	169	318
Title and abstract screening	3,990	139	154	9139	355	512	1057
Full text screening	16	16	9	19	0	2	13
Included citations	**4**	**2**	**4**	**14**	**0**	**1**	**5**
Supplemental searches	0	0	1	1	4	NS	NS
Back chaining	0	0	0	0	0	0	0
Forward citation tracking	0	0	0	1	0	0	1
Total number of included studies	**3**	**0**	**3**[19]	**8**	**0**	**1**	**3**
Total number of included reviews	**1**	**2**	**1**	**6**[20]	**0**	**0**	**3**
Total number of organisational reports	**0**	**0**	**0**	**0**	**4**	**0**	**0**

Key: NS: Not searched

[1919] One study was across two publications
[20] One review was across two publications

8.3. Appendix 3: Studies excluded on full text screening

1. Anonymous 2019: Healthcare providers' perceptions of single-room versus traditional maternity models: a concurrent mixed-methods study.
   Reason for exclusion: Not a research paper

2. Dani et al. 2020: Midwife-to-newborn ratio and neonatal outcome in healthy term infants.
   Reason for exclusion: Included in scoping review by Turner et al. 2021.

3. Facchini 2022: Low staffing in the maternity ward: Keep calm and call the surgeon
   Reason for exclusion: Modelling study.

4. Floyd and Brunk 2016: Utilizing task shifting to increase access to maternal and infant health interventions: a case study of Midwives for Haiti.
   Reason for exclusion: Description of midwives for Haiti program that uses task shifting to educated skilled birth attendants.

5. Gu et al. 2020: Midwives' views and experiences of providing midwifery care in the task shifting context: a meta-ethnography approach.
   Reason for exclusion: Wrong outcomes - midwives' views and experiences of providing midwifery care in the task shifting context.

6. Hansen et al. 2022. The effect on the birth experience of women and partners of giving birth in a "birth environment room": A secondary analysis of a randomised controlled trial.
   Reason for exclusion: Wrong intervention – Birth environment room

7. Hosler et al. 2018: Combining task shifting and community-based care to improve maternal health: Practical approaches and patient perceptions.
   Reason for exclusion: Wrong outcomes - patient perceptions of task shifting for maternal health in mobile an community settings in Haiti.

8. Housseine et al. 2017: Task-shifting of foetal heart rate monitoring during labour in low-resource settings: Perceptions of skilled birth attendants, mothers and policymakers
   Reason for exclusion: Conference abstract of a qualitative study

9. Javernick et al. 2021. Low-intervention birth suites within a community hospital: an innovative approach to perinatal services.
   Reason for exclusion: Wrong intervention – Low-intervention birth suites

10. Matthews et al. 2022: Midwifery workforce challenges - staffing and skill mix in Victorian hospitals in 2021.
    Reason for exclusion: Conference abstract of a cross sectional study exploring staffing challenges.

11. Makhfudli et al. 2020: Staffing characteristics and their associations with the severe maternal outcomes at Indonesian tertiary hospitals.
    Reason for exclusion: Included in scoping review by Turner et al. 2022.

12. Michalak et al. 2022: Task shifting for maternal and neonatal care in low-resource settings: A mixed-methods evaluation of a midwifery training program in rural Papua New Guinea.

13. Mijovic et al. 2016: What does the literature tell us about health workers' experiences of task-shifting projects in sub-Saharan Africa? A systematic, qualitative review.
    Reason for exclusion: A systematic review that summarises factors affecting the implementation of task shifting for health workers in sub-Saharan Africa.
    Reason for exclusion: To evaluate a midwifery training program for nurses and community health workers.

14. Nielsen and Overgaard 2020. Healing architecture and Snoezelen in delivery room design: a qualitative study of women's birth experiences and patient-centeredness of care.
    Reason for exclusion: Wrong intervention – alternative delivery room.

15. Nyende 2020: Maternal healthcare service transformation: Exploring opportunities for IT use in task shifting.
    Reason for exclusion: Conference abstract.

16. Pallangyo et al. 2020: Task shifting to attain Sustainable Development Goals and Universal Health Coverage: What are the consequences to the nursing and midwifery profession?
    Reason for exclusion: Editorial.

17. Perdok et al. 2016. Opinions of maternity care professionals and other stakeholders about integration of maternity care: a qualitative study in the Netherlands.
    Reason for exclusion: Wrong outcomes - exploration of participants' views and opinions about integrated care in the light of their experience in maternity care.

18. Prapawichar et al. 2020: Maternal and health service predictors of postpartum hemorrhage across 14 district, general and regional hospitals in Thailand.
    Reason for exclusion: Included in scoping review by Turner et al. 2022.

19. Rao et al. 2019: Where there is no nurse: an observational study of large-scale mentoring of auxiliary nurses to improve quality of care during childbirth at primary health centres in India.
    Reason for exclusion: Outcomes are based on hypothetical scenarios:

20. Reid et al. 2018: 'Just an extra pair of hands'?: A qualitative study of obstetric service users' and professionals' views towards 24/7 consultant presence on a single UK tertiary maternity unit.
    Reason for exclusion: Wrong outcomes - obstetric service users' and professionals' views.

21. Rottenstreich et al. 2021: Midwife annual delivery workload and maternal and neonatal adverse outcomes, is there an association?
    Reason for exclusion: Not about skill-mix – midwife annual delivery workload.

22. Simpson et al. 2023: Hospital characteristics associated with nurse staffing during labor and birth: Inequities for the most vulnerable maternity patients.
    Reason for exclusion: Not about skill-mix - nurse staffing in maternity units and adherence to guidelines.

23. Stelwagen et al. 2021. Parents' experiences with a model of integrated maternity and neonatal care designed to empower parents.
    Reason for exclusion: Wrong intervention – neonatal care.

24. Stelwagen et al. 2020. Integration of maternity and neonatal care to empower parents.
    Reason for exclusion: Wrong intervention – neonatal care

25. Taylor et al. 2018: Task shifting Midwifery Support Workers as the second health worker at a home birth in the UK: A qualitative study.
    Reason for exclusion: Explores the implementation of a new home birth care model where births to low risk women are attended by one midwife and one Midwifery Support Worker.

26. Than et al. 2018: The potential of task shifting selected maternal interventions to auxiliary midwives in Myanmar: a mixed-method study.
    Reason for exclusion: Wrong outcomes - an examination of the role of auxiliary midwives Myanmar and the introduction of new tasks.

27. Than et al. 2017: Prevention of postpartum haemorrhage by community-based auxiliary midwives in hard-to-reach areas of Myanmar: a qualitative inquiry into acceptability and feasibility of task shifting.
    Reason for exclusion: Wrong outcomes: Community and provider perspectives on the roles of auxiliary midwives and community-level provision of oral misoprostol by auxiliary midwives.

28. Turner et al. 2021: What is the relationship between midwifery staffing and outcomes?
    Reason for exclusion: Summary article in Nursing Times of scoping review published in Midwifery.

29. Turner et al. 2022: Are poor experiences on postnatal wards linked to staffing levels?
    for exclusion: Summary article in the Nursing Times of scoping review published in Women & Birth.

30. Vanderlaan 2023: Midwifery workforce density moderates the association between independent practice and pregnancy outcomes.
    Reason for exclusion: Wrong outcomes – midwifery density.

31. Wangler et al. 2023. Influence of the birthing room design on midwives' job satisfaction - A cross-sectional online survey embedded in the 'Be-Up' study.
    Reason for exclusion: Wrong intervention – birthing room only.

32. Wangmo et al. 2016: Auxiliary midwives in hard to reach rural areas of Myanmar: Filling MCH gaps.
    Reason for exclusion: Evaluation of training program for new auxiliary midwives

33. Wilkinson et al. 2021: Does consultant presence at trials of operative vaginal delivery increase success?
    Reason for exclusion: Conference abstract.

34. Wilson B. (2019). Identifying optimal labor and delivery unit nurse staffing
    Reason for exclusion: Wrong intervention – Not single room maternity care

35. Henderson et al. 2017: Resident consultant obstetrician presence on the labour ward versus other models of consultant cover: a systematic review of intrapartum outcomes
    Reason for exclusion: Duplicate publication of Knight et al. 2015

36. Prior et al. 2017: Resident consultant cover may become part of 21st century maternity care, but it is not a panacea.
    Reason for exclusion: Commentary.

37. Shawer et al. 2018: What is the impact of 24-7 consultant presence on serious untoward incidents?

Reason for exclusion: Conference abstract.

38. Pedrana et al. 2019: Presence of doctors and obstetrician/gynecologists for patients with maternal complications in hospitals in six provinces of Indonesia.
    Reason for exclusion: Description of doctors' and specialist physicians' availability to manage obstetric complications.

39. Pfniss et al. 2019. Birth during off-hours: An evaluation of obstetric interventions depending on time of birth, attending staff's level of education and unit volume.
    Reason for exclusion: Conference abstract.

40. Bradford et al. 2022 : Midwifery continuity of care: A scoping review of where, how, by whom and for whom?
    Reason for exclusion: A scoping review of where, how, by whom and for whom are midwifery continuity of care models implemented?

41. Homer et al. 2016: Models of maternity care: evidence for midwifery continuity of care.
    Reason for exclusion: Narrative review.

42. Lettink et al. 2020: CCT: continuous care trial - a randomized controlled trial of the provision of continuous care during labor by maternity care assistants in the Netherlands.
    Reason for exclusion: Study protocol

43. McRae et al. 2017. Is model of care associated with infant birth outcomes among vulnerable women? A scoping review of midwifery-led versus physician-led care
    Reason for exclusion: Corrigendum

44. Sandall et al. 2023. Updated Cochrane review on continuity of midwife care to inform scale up.
    Reason for exclusion: Conference abstract.

45. Tuominen et al. 2020: Comparing the two techniques for nursing staff rescheduling to streamline nurse managers' daily work in Finland.
    Reason for exclusion: Nit related to maternal or neonatal outcomes

8.4: Appendix 4: Critical appraisal scores

JBI critical appraisal checklist for systematic reviews and research syntheses scores

Study	JBI Appraisal items											Score	Confidence in the findings
	1	2	3	4	5	6	7	8	9	10	11		
Ali et al. 2020	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10	++ High
Donnellan-Fernandez et al. 2018	Y	Y	Y	Y	U	U	U	Y	N	Y	Y	7	-- Critically low
Fikre et al. 2023	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11	++ High
Kilpatrick 2016	Y	Y	U	Y	Y	U	U	Y	N	Y	Y	7	-- Critically low
McRae et al. 2016a	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10	+ High
Raams et al. 2018	Y	Y	Y	Y	Y	N	N	N	U	N	Y	6	-- Critically low
Reid et al. 2017	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	10	++ High
Sandall et al. 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11	++ High
Talukdar et al. 2021	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	9	-- Critically low
Turner et al. 2021	Y	Y	Y	Y	N	N	N	N	N	Y	Y	6	-- Critically low
Wekesah et al. 2016	N	Y	U	Y	Y	N	N	N	U	Y	N/A	4	-- Critically low

Key: Y= Yes; N= No; U= Unclear; N/A=not applicable

1. Is the review question clearly and explicitly stated?
2. Were the inclusion criteria appropriate for the review question?
3. Was the search strategy appropriate?
4. Were the sources and resources used to search for studies adequate?
5. Were the criteria for appraising studies appropriate?
6. Was critical appraisal conducted by two or more reviewers independently?
7. Were there methods to minimize errors in data extraction?
8. Were the methods used to combine studies appropriate?
9. Was the likelihood of publication bias assessed?
10. Were recommendations for policy and/or practice supported by the reported data?
11. Were the specific directives for new research appropriate?

JBI critical appraisal checklist for randomised controlled trials

Study	JBI Appraisal items													Score	Quality rating
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13		
Allen et al. 2019	Y	Y	Y	N	N	U	Y	N	N	Y	Y	Y	Y	8	+ Moderate
Bernitz et al. 2016	Y	Y	Y	N	N	Y	Y	U	Y	Y	Y	Y	Y	10	++ High
Fernandez Turienzo et al. 2020	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	11	++ High
Forster et al. 2016	Y	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	10	++ High
Homer et al. 2022	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	11	++ High
McLachlan et al. 2016	Y	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	10	++ High

Key: Y= Yes; N= No; U= Unclear; N/A=not applicable

1. Was true randomization used for assignment of participants to treatment groups?
2. Was allocation to treatment groups concealed?
3. Were treatment groups similar at the baseline?
4. Were participants blind to treatment assignment?
5. Were those delivering treatment blind to treatment assignment?
6. Were outcomes assessors blind to treatment assignment?
7. Were treatment groups treated identically other than the intervention of interest?
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?
9. Were participants analysed in the groups to which they were randomized?
10. Were outcomes measured in the same way for treatment groups?
11. Were outcomes measured in a reliable way
12. Was appropriate statistical analysis used?
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

JBI critical appraisal checklist for descriptive surveys

Study	JBI Appraisal items								Score
	1	2	3	4	5	6	7	8	
Turner et al. 2022a	Y	Y	Y	Y	Y	Y	Y	Y	8
Turner et al. 2022b	Y	Y	Y	Y	Y	Y	Y	Y	8
Drake et al. 2020	N	Y	Y	N/A	N/A	N/A	Y	N	3
Hall et al. 2019	Y	Y	Y	Y	N	N	Y	Y	6
Hall et al. 2023	Y	Y	Y	Y	Y	Y	Y	Y	6

Key: Y= Yes; N= No; U= Unclear; N/A=not applicable

1. Were the criteria for inclusion in the sample clearly defined?
2. Were the study subjects and the setting described in detail?
3. Was the exposure measured in a valid and reliable way?
4. Were objective, standard criteria used for measurement of the condition?
5. Were confounding factors identified?
6. Were strategies to deal with confounding factors stated?
7. Were the outcomes measured in a valid and reliable way?
8. Was appropriate statistical analysis used?

JBI critical appraisal checklist for qualitative studies

Citation	1	2	3	4	5	6	7	8	9	10	Score
Ali et al. 2019	Y	Y	Y	Y	Y	N	N	Y	Y	Y	8
Hall et al. 2019	Y	Y	Y	Y	Y	N	N	Y	Y	Y	8

Key: Y= Yes; N= No; U= Unclear; N/A=not applicable

1. Is there congruity between the stated philosophical perspective and the research methodology?
2. Is there congruity between the research methodology and the research question or objectives?
3. Is there congruity between the research methodology and the methods used to collect data?
4. Is there congruity between the research methodology and the representation and analysis of data?
5. Is there congruity between the research methodology and the interpretation of results?
6. Is there a statement locating the researcher culturally or theoretically?
7. Is the influence of the researcher on the research, and vice- versa, addressed?
8. Are participants, and their voices, adequately represented?
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

SIGN methodology checklist 3 for cohort studies (prospective)

Study	SIGN checklist items														Quality rating
	Q1.1	Q1.2	Q1.3	Q1.4	Q1.5	Q1.6	Q1.7	Q1.8	Q1.9	Q1.10	Q1.11	Q1.12	Q1.13	Q1.14	
Reif et al. 2017 Pfniss et al. 2023	Y	Y	Y	Y	N/A	N/A	Y	N	N	Y	Y	CS	Y	Y	+ Moderate

Key: Y=Yes, N=No; N/A=not applicable, CS=can't say

1.1. The study addresses an appropriate and clearly focused question
1.2. The two groups being studied are selected from source populations that are comparable in all respects other than the factor under investigation
1.3: The study indicates how many of the people asked to take part did so, in each of the groups being studied.
1.4: The likelihood that some eligible subjects might have the outcome at the time of enrolment is assessed and taken into account in the analysis
1.5: What percentage of individuals or clusters recruited into each arm of the study dropped out before the study was completed.
1.6: Comparison is made between full participants and those lost to follow up, by exposure status.
1.7: The outcomes are clearly defined.
1.8: The assessment of outcome is made blind to exposure status. If the study is retrospective this may not be applicable.
1.9. Where blinding was not possible, there is some recognition that knowledge of exposure status could have influenced the assessment of outcome
1.10. The method of assessment of exposure is reliable
1.11 Evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable
1.12 Exposure level or prognostic factor is assessed more than once.
1.13. The main potential confounders are identified and taken into account in the design and analysis
1.14. Have confidence intervals been provided

High quality (++): Majority of criteria met. Little or no risk of bias. Results unlikely to be changed by further research.
Moderate quality (+): Most criteria met. Some flaws in the study with an associated risk of bias, Conclusions may change in the light of further studies.
Low quality (0): Either most criteria not met, or significant flaws relating to key aspects of study design. Conclusions likely to change in the light of further studies.

SIGN methodology checklist 3 for cohort studies (retrospective)

Study	SIGN checklist items								Quality rating
	Q1.1	Q1.2	Q1.7	Q1.9	Q1.10	Q1.11	Q1.13	Q1.14	
Carlson et al. 2020	Y	Y	Y	N	Y	Y	Y	Y	+ Moderate
Morad et al. 2021	Y	Y	Y	N	Y	Y	Y	Y	+Moderate
Shawer et al. 2019	Y	Y	Y	CS	Y	Y	CS	N	- Low

Key: Y=Yes, N=No; N/A=not applicable, CS=Can't say

1.1. The study addresses an appropriate and clearly focused question
1.2. The two groups being studied are selected from source populations that are comparable in all respects other than the factor under investigation
1.7. The outcomes are clearly defined
1.9. Where blinding was not possible, there is some recognition that knowledge of exposure status could have influenced the assessment of outcome
1.10. The method of assessment of exposure is reliable
1.11. Evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable
1.13. The main potential confounders are identified and taken into account in the design and analysis
1.14. Have confidence intervals been provided

High quality (++): Majority of criteria met. Little or no risk of bias. Results unlikely to be changed by further research.
Moderate quality (+): Most criteria met. Some flaws in the study with an associated risk of bias, Conclusions may change in the light of further studies.
Low quality (0): Either most criteria not met, or significant flaws relating to key aspects of study design. Conclusions likely to change in the light of further studies.

JBI critical appraisal checklist for economic evaluations

Study	JBI Appraisal items											Score
	1	2	3	4	5	6	7	8	9	10	11	
Attanasio et al. 2019	Y	Y	Y	N	N	N	U	Y	Y	Y	Y	7
Callander et al. 2021	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	9

Key: Y= Yes; N= No; U= Unclear; N/A=not applicable

1. Is there a well-defined question?
2. Is there comprehensive description of alternatives?
3. Are all important and relevant costs and outcomes for each alternative identified?
4. Has clinical effectiveness been established?
5. Are costs and outcomes measured accurately?
6. Are costs and outcomes valued credibly?
7. Are costs and outcomes adjusted for differential timing?
8. Is there an incremental analysis of costs and consequences?
9. Were sensitivity analyses conducted to investigate uncertainty in estimates of cost or consequences?
10. Do study results include all issues of concern to users?
11. Are the results generalizable to the setting of interest in the review?