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Birth environments for women with complex pregnancies: A mixed-methods systematic review

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ABSTRACT

Background: Birth environments can help support women through labour and birth. Home-like rooms which encourage active birthing are embraced in midwifery-led settings. However, this is often not reflected in obstetric settings for women with more complex pregnancies.
Aim: To investigate the impact of the birth environment for women with complex pregnancies.
Methods: This was a mixed-methods systematic review, incorporating qualitative and quantitative research. A literature search was implemented across three databases (Medline, CINAHL, Embase) from the year 2000 to June 2021. Studies were eligible if they were based in an Organisation for Economic Cooperation and Development country and reported on birth environments for women with complex pregnancies. Papers were screened and quality appraised by two researchers independently.
Findings: 30,345 records were returned, with 15 articles meeting inclusion criteria. Studies were based in Australia, the UK, and the USA. Participants included women and health professionals. Five main themes arose: Quality of care and experience; Supportive spaces for women; Supportive spaces for midwives; Control of the space; Design issues.
Discussion: Women and midwives found the birth environment important in supporting, or failing to support, a positive birth experience. Obstetric environments are complex spaces requiring balance between space for women to mobilise and access birthing aids, with the need for medical teams to have easy access to the woman and equipment in emergencies.
Conclusion: Further research is needed investigating different users' needs from the environment and how safety features can be balanced with comfort to provide high-quality care and positive experiences for women.

Introduction

The policy for maternity care in England, the UK National Health Service (NHS) Better Births National Maternity Review, describes quality maternity services as safe, clinically effective and providing a good experience [1]. For women with straightforward (low-risk) pregnancies this high-quality care may be provided in midwifery-led settings, such as birth centres (which can either stand alone or as a separate space within a hospital). Midwifery-led settings are associated with lower rates of medical interventions during labour and birth without increasing risk to mothers or babies [2,3]. Numbers of births in midwifery-led settings in England have trebled since 2010 to 14% of all births in 2018[4], and many women state a preference for midwifery units[5]. However, this still leaves the vast majority (86%) of births in England taking place in obstetric-led units [4], with higher rates in countries such as the USA and Australia (98.4% and 93.6% respectively) [6,7]. Obstetric-led units are located within hospitals and have a more medical focus compared to midwifery-led units. Women who give birth in obstetric-led units include those with complicated pregnancies (higher risk) that may require medical care (up to 62% of births) [8], but it also includes women at low risk of complications who have either chosen obstetric settings, had limited choice of birthplace, or who have been transferred during labour. Birthing options that respect women's values are essential components to optimise the quality of care, alongside any necessary clinical interventions, but are not consistently provided worldwide [9].

Midwifery-led units (which can be located alongside obstetric units or freestanding) place considerable importance on environmental design. Compared to obstetric-led units, they are generally designed to be more home-like environments, with supportive facilities to promote a

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physiological birth with minimal clinical intervention. Typically a midwifery-led unit may include facilities in the room such as birthing pools, double beds, mood lighting, birthing aids (e.g. stool, ball, mats), domestic furniture; all designed for a homely, relaxing feel more akin to a hotel room than a hospital room [10]. The benefits of a home-like environment have been discussed since the 1970 s, placing less importance on the hospital bed and concealing medical equipment [11]. The design of conventional hospital (obstetric-led unit) labour rooms is similar to the design of other hospital rooms, the bed being a central feature with visible medical equipment for ease of access [3]. Hospital birthing rooms have been described by women as clinical and stark, and in such spaces, women take on the role of a patient and interact with the environment in a passive way [12]. More domestic birth environments enable women to claim ownership of the space[12] and are thought to assist the progress of labour by helping women to feel calm and preventing an adrenaline response to an unfamiliar environment [13]. Adrenaline disrupts the production of oxytocin during labour causing labour to slow down or stop, and reduces blood flow to the placenta potentially leading to fetal distress [13]. The overall effect can be increased medical intervention during labour and childbirth [13].

The design of midwifery-led units can be more focussed on supporting and empowering the woman than on clinical functionality for emergency situations. The design of obstetric units is more complicated and needs to create a balance between the quality of the environment as a supportive factor to women, and the safety of an environment designed for clinical intervention. Optimising safety and promoting a calming, protective space requires a thorough consideration of the needs of women, their families, maternity care providers and interactions between them.

The aim of this mixed-methods systematic review was to investigate the impact of birth environments with a specific focus on women with complex pregnancies. This included exploring the experiences, views and evaluations of women and healthcare professionals. This work informed new guidance for the intrapartum care of all women in all settings [14,15].

Methods

A mixed-methods systematic review was undertaken using a segregated results-based convergent synthesis design [16–18]. Segregated designs require individual syntheses of quantitative and qualitative evidence to be conducted prior to the final mixed-method synthesis. The review protocol was registered on the PROSPERO database: CRD42018090013. The review is reported according to PRISMA reporting guidance [19].

Search strategy

A comprehensive search strategy was developed by an information specialist (JE) for Medline, Embase and CINAHL databases using information from scoping searches to refine search terms. The literature search was undertaken in January 2018 and updated in June 2021. An example (Medline) search strategy is included as supplementary material. Papers were included in the review if they met the following criteria: (i) published in English, (ii) based in an Organisation for Economic Cooperation and Development (OECD) country, (iii) reporting quantitative or qualitative primary research (iv), published January 2000 to June 2021, (v) reporting experiences, views and evaluations of birth settings for women with complicated pregnancies. Papers which only reported views, evaluations and experiences of low-risk (straightforward) pregnancies, low-risk birth settings (home, midwifery-led unit), operating theatre and recovery rooms, unplanned or transfer environments were excluded.

Duplicates were removed and one researcher (KE) screened the titles and abstracts for relevance. Full-text papers of the remaining citations were then retrieved and independently assessed against the inclusion and exclusion criteria by two researchers (GS, KE), with a third researcher (HS) moderating any ambiguity or disagreements. Data was extracted using a pre-piloted form and was completed independently by two researchers (GS, KE).

Quality assessment

The quality of studies included in the review was evaluated by two researchers (GS, KE) using Joanna Briggs Institute levels of evidence[20] and appropriate established critical appraisal tools depending on study design [21–24]. Following this, studies were categorised as low, medium or high quality. Although no studies were excluded on the basis of quality, the quality assessment was undertaken to enable a critical consideration of the strengths and limitations of the evidence [16].

Data analysis and synthesis

For qualitative data, QSR NVivo software was used to assist two researchers to independently dual-code and analyse data into key themes and sub-themes following a thematic synthesis approach (GS, KE) [25]. There was insufficient data to complete a planned meta-analysis, therefore a narrative description of the quantitative findings was produced. The qualitative and quantitative themes were discussed with the review team. Themes were compared, contrasted and, where possible, integrated to create a final set of synthesised findings (Fig. 1) [26; 27].

Findings

We screened 30,345 studies by title and abstract (studies were screened by hand) and 36 articles were selected for full-text review, 2 were not retrieved (Fig. 2). A table of excluded studies is included in the supplementary material. Fifteen studies were included: Eight qualitative [28–35], 5 mixed methods [36–40], and 2 quantitative[41,42].

Study characteristics

The study characteristics are detailed in Table 1. Studies were conducted between 2003 and 2020 in Australia (n = 7) [28–33], the United Kingdom (n = 5)[33,36–39] and USA (n = 4) [34,35,40–42]. The majority of papers were assessed as being of high or medium quality (Table 1), but some were rated as low quality due to methodological and reporting concerns. Study participants included both women and clinicians (predominantly midwives). Studies investigated the impact of the birth environment on midwives and midwifery practice [28–33,36–38]; the impact of the birth environment on women's experiences [33,34,36, 37,39]; and the design of birthing rooms [34,35,40–42]. The qualitative and quantitative findings are presented together in five main synthesised themes.

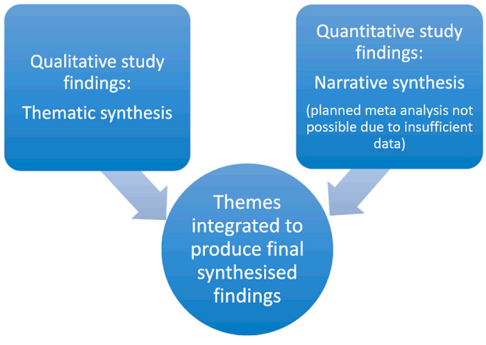

Fig. 1. Qualitative and quantitative data synthesis.

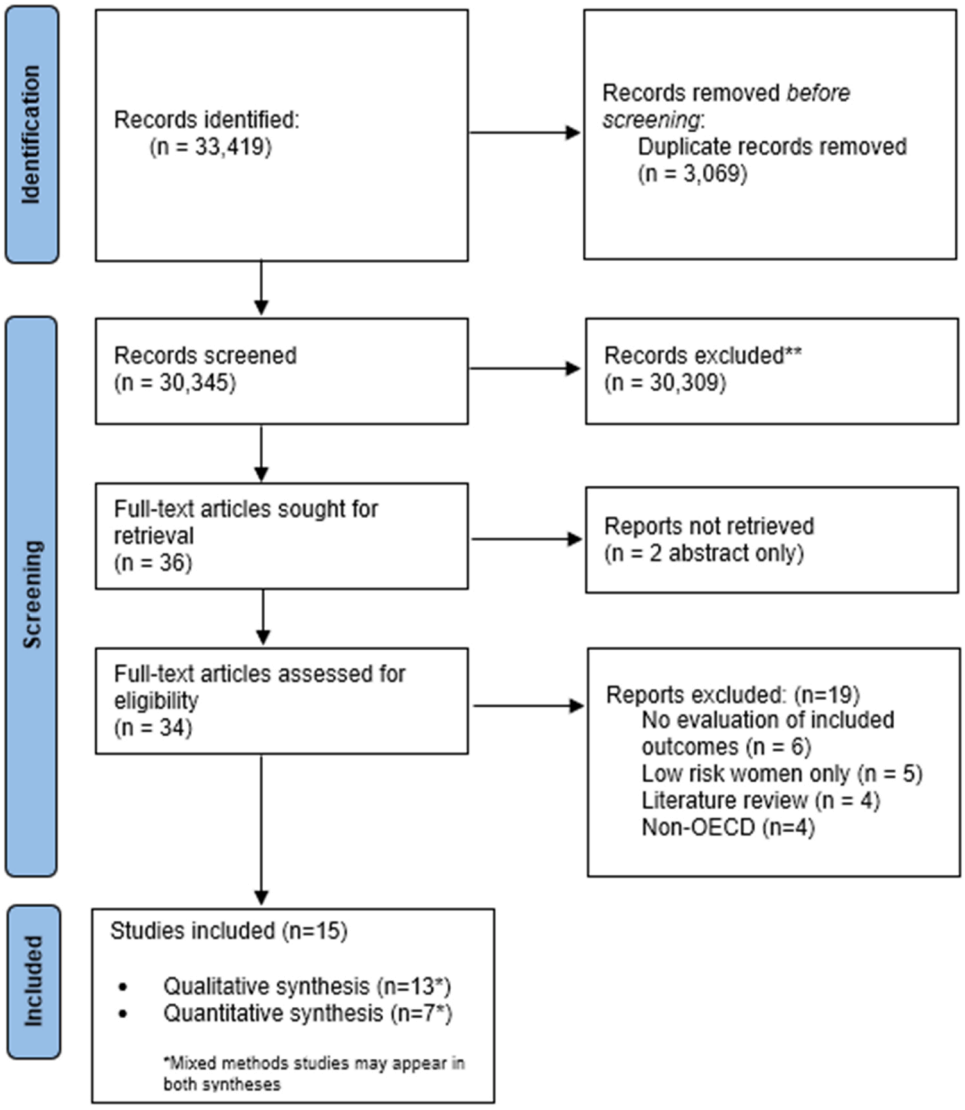

Fig. 2. PRISMA Flow Diagram– Birth environments for complex pregnancies.

Theme 1: quality of care and experience

Eight studies reported findings about the relationship between the environment and the quality of care and experience [28–30,33,35–37,39]. Midwives' dissatisfaction with birthing room layouts was described, such as the need to move the bed from the centre of the room to create space for active birthing [29]. Midwives' discomfort with the layout sometimes resulted in them spending time adapting the environment or layout rather than welcoming the woman into the room. Lack of provision in the birthing space for the midwife to write notes or sit was also reported to affect midwives' ability to be continuously present in the room [28,35]. The proximity of the room to other areas, e.g. central nursing station, could also contribute to the ability of staff to respond quickly to care needs [35].

Both women and midwives valued the flexibility and space of rooms as an important factor for optimising the birth experience and quality of care [29,30,39]. Unwelcoming environments were described as making women feel less relaxed which could impact on their progress in labour [30,33]. A room with a more homely ambience enhanced women's sense of freedom to move around and enabled midwives to practice in a flexible and spontaneous way. In spaces that were too small, midwives felt constrained and unable to use their skills to support women in different labour positions [29]. An association was also reported between women's comfort and the likelihood of a straightforward birth and the authors state that although this does not prove cause and effect, it is likely that staff helping women to find comfortable positions is a facilitative factor for a straightforward birth [37]. Staff-perceived quality of care was significantly correlated with positive opinions about the ward layout, comfort in the work environment, and perceived space for women [36]. Similarly 94% of women felt that the physical environment affected how easy or difficult it was to give birth [39].

Theme 2: supportive spaces for women

One of the key themes reported in nine studies was need for environments to be supportive spaces for women [28,29,31,33,34,36,39,41,42]. Midwives and women stressed the importance of having access to birthing aids to support labour and promote a physiological birth, however these were sometimes difficult to access or locate [28,39]. Numerous aspects were identified to make birth environments more acceptable for women including comfortable furniture for women and partners, cleanliness, privacy, en-suite bathrooms and control over who entered the room [36,39]. Women also felt they could relax when they were able to stay in one room for their whole hospital stay [39]. Some women felt a double bed could help support them to get into different positions whilst also enabling their partner to rest [36,39]. Women and

Table 1
Characteristics of included studies (n = 15).

Author (Year)	Aim of study	Design and methods	Sample and settings / country	Quality assessment
Hammond et al. (2014a) [28]	To explore the perspective of midwives to discover how the design of hospital birth rooms impacts on their work.	Qualitative ethnography: video reflexive interviews.	Sample: n = 8 midwives Setting: Tertiary hospitals, Sydney, Australia.	High
Hammond et al. (2014b) [29]	To explore the relationship between birth environment and the practice of midwifery.	Qualitative critical realist: interviews.	Sample: n = 16 midwives Setting: Large hospital in Australia.	Medium to high
Hammond et al. (2017) [30]	To explore the design characteristics of hospital birth rooms that support midwives and their practice.	Qualitative critical realist: photo elicitation interviews.	Sample: n = 16 midwives Setting: Large hospital in Australia.	High
Seibold et al. (2010) [31]	To explore midwives' perceptions of birth space and clinical risk management and their impact on practice in different facilities.	Qualitative: exploratory descriptive, using focus groups.	Sample: n = 18 midwives Setting: Metropolitan hospital in Australia.	Medium to high
Townsend et al. (2016) [32]	To describe midwives' perceptions of the birth bed.	Qualitative: Interviews	Sample: n = 14 midwives Setting: Maternity unit in Australia.	High
Davis et al. (2016) [33]	To explore the way that birthplace impacts on midwives in Australia and the United Kingdom.	Qualitative: Focus Groups	Sample: n = 12 midwives. Setting: UK and Australia.	High
Lyndon et al. (2018) [34]	To explore women's birth experiences to understand their perspectives on patient safety.	Qualitative: Interviews	Sample: n = 17 women Setting: Community recruitment, USA	High
Plough et al. (2018) [35]	To explore key mechanisms of how facility design affects clinicians in providing childbirth care.	Qualitative: Interviews and Delphi	Sample and setting: managers at 12 birth centres and hospitals in the USA.	Medium
Symon et al. (2008a) [36]	To discover which design features contribute most and least to satisfaction levels among service users and providers.	Mixed methods: Survey and focus groups.	Sample: Survey; n = 559 women and n = 227 midwives. Focus groups; n = 7 women, n = 5 staff. Setting: 9 maternity units, UK.	Medium to low
Symon et al. (2008b) [37]	To investigate the issues of comfort in and control over the interior environment, from the perspectives of both mothers and midwives.	Mixed methods: Survey and focus groups.	Sample: Survey; n = 559 women and n = 227 midwives. Focus groups; n = 7 women, n = 5 staff. Setting: 9 maternity units, UK.	Medium to low
Symon et al. (2008c) [38]	To examine the perceptions and experiences of those using and working in different types of unit.	Mixed methods: Survey and focus groups.	Sample: Survey of midwives (n = 227). Focus groups (n = 5 staff). Setting: 9 maternity units, UK.	Medium to low
Newburn and Singh (2003) [39]	To explore what aspects of room design mattered to women, and whether the physical environment affected their experience of labour.	Mixed methods: Survey - multiple choice and open ended questions.	Sample: n = 1944 women Setting: Community recruitment, UK.	Medium
Sherman et al. (2020) [40]	To implement design thinking to understand how design of labour and delivery units impact safety.	Mixed methods: Observation, measurements, and interviews	Sample: ~30 clinicians. Setting: 10 Labour and Delivery units in the USA.	Medium
Shin et al. (2004) [41]	To investigate how interior design elements in birth environments can foster a home-like feeling desired by women and their families.	Quantitative: Survey – 7 point Likert scale rating of birth room designs.	Sample: n = 35 women Setting: Community recruitment, USA.	Medium
Austin et al. (2018) [42]	To quantify space and design of labour and delivery units.	Quantitative: Evaluating physical space and equipment	Setting: USA Labour and Delivery units.	Medium

their partners also liked access to refreshments and distractions to pass the time [39]. There were mixed opinions on having a clock in the room due to some people wanting to have a sense of time, and others feeling like they did not want to know how long they had been there [39].

The importance of homeliness and ambience in birth environments was frequently discussed in the studies. A particular focus was for the environment to be aesthetically pleasing and not feeling like a clinical space, although some women in the studies found medical equipment reassuring [28,29,31,33,34,36,39]. This also included environment factors such as having natural light, ambient lighting, fresh air, and controlling the temperature [28,33,37]. Women had concerns about not wanting to hear others in labour and feeling uncomfortable about being overheard themselves [33,39]. Also noises from medical equipment (e.g.

fetal monitoring) were frightening to some women [34]. Similarly, design elements affecting privacy and contact with people outside the room affected women's feelings of homeliness [41], control [33,41], and safety[34] and may also interrupt the flow of hormones necessary for effective labour progress [33]. Women tended to dislike any type of interior window or lack of transition space into the room [41]. Women rated room designs as less home-like if they felt they would be immediately visible to those entering the room, even if there was a physical barrier such as a half-height wall [41]. Rooms with visual as well as physical barriers (e.g. full-height partition wall) were rated as more homely as long as the transition space was not so large that it impacted on room size [41].

The importance of women having enough space to mobilise and try different birthing positions was described in several studies [28–31,36,39]. The ability to walk around was highly important to 89% of women, but only 61% of those in hospital units felt able to [39]. Women also felt that compared to any other single factor, having freedom and space to move around was most important to encourage the type of birth they wanted [39]. A lack of flexibility in the space, including inadequate storage for birthing aids and personal possessions, was reported as making the rooms cluttered and difficult to work with [30,36,39]. Labour rooms varied dramatically in size and layout, both within and between units, some rooms were found to be more than double the size of others [42]. One study suggested that room size may not be as important as the design and flexibility of the room [36]. Equipment and furniture varied in different rooms and units [42]. Birthing aids such as floor mats, extra pillows, or bean bags were easily accessible to only a third of women who gave birth in hospital compared to 9 out of 10 women who birthed at home [39]. Some women with complex needs could also not be able to use mobility aids due to the restrictions of some monitoring equipment [39].

Birthing pools were highly valued by midwives and women to promote physiological birth [28,39], but some design features limited women's independence getting in and out of the pool [28]. There were particular problems with the high sides of the pool and steep steps making it difficult for women to get in and out without support [28]. Women felt they were less likely to have access to birthing pools in hospital compared to midwife-led units [39].

Theme 3: supportive spaces for midwives

Nine studies reported findings relating to how supportive the birth environment was for midwives [28–33,36–38]. Similarly to women, midwives often did not have enough space, flexibility of layout, or provisions to support their role [28–31]. Midwives described adapting the room for the woman and thus restricting their own space required to complete their tasks [28,29]. The main factors described were lack of storage for birthing aids, the woman's personal possessions and medical equipment, and the bed dominating the middle of the room [28,32]. Flexibility in the room was valued by midwives, the room had to function well for active birthing but also for medical emergencies and complex care [28,30,31]. Fold-down seating was suggested as a way to provide a place for the midwife whilst maintaining the flexibility of the space [28].

Working conditions were frequently raised as impacting midwives physically and through workplace stress [28,29,37]. Midwives needed to get into a variety of positions to assist births which can be uncomfortable or not well supported by the physical environment [28]. Factors such as ambience, thermal comfort, and cluttered conditions in birthing rooms contributed to workplace stress [29,33]. Room temperature could often be too warm for women and midwives, however the temperature requirements of newborns must be considered [37]. Midwives preferred natural and ambient lighting, feeling that harsh lighting contributed to a difficult working environment [37]. One study reported a weak correlation between the midwives' overall job satisfaction and midwives' perceptions of whether noise levels were a problem ($rs=-0.162$; $p < 0.05$) [37].

Positive perceptions of room layout and comfortable work environments were found to have a weak but significant correlation with midwives' job satisfaction [36]. Two-thirds of midwives agreed that the clinical area was spacious enough for them to perform their duties, but less than half agreed that computer equipment for entering clinical records was located in the right place [38]. Midwives also reported that being in a hospital setting and culture changed the way they worked, for example the need to 'look busy' meant that they felt less comfortable spending time just being with the woman than they did in home or birth centre settings [33].

Theme 4: control of the space

Seven studies reported that it was sometimes unclear who controlled the space in birth environments, mostly concerning the different, and sometimes conflicting, priorities of women, midwives and doctors [29,31–34,37,39]. Women often did not have control and privacy in the birth environment, particularly in hospital settings [33,34,39]. Fathers' and partners' needs were also often overlooked, giving women more concerns during labour and potentially devaluing the father's or partners' role [39]. Studies describe midwives trying to make the space the woman's by adjusting the room, but sometimes feeling conflicted in the hospital setting [29,31–33]. Some midwives feared reprimand from senior colleagues for altering the position of the bed and were reluctant to take control of the room layout [32].

There were different opinions on who should have control of temperature given the different needs of women, midwives and babies. Whereas few mothers knew if they were able to control the environmental temperature, most midwives indicated that they definitely could not control the temperature and were unable to adjust the flow of air within their working environment [37].

Theme 5: design issues

Seven studies highlighted design issues that could help improve the birth environment for women, staff, and birth partners [28,30,34–36,40,41]. These included the layout and space of the birth room, as well as the furniture, equipment, and workspace provision [28,30,40]. The main focus was that the spaces needed to be flexible to change according to requirements; the usability of the space was reported to be more important than the size of room [28,30]. One study also discussed the importance of flexible space in the whole unit to ensure spaces were adaptable for birthing as a contingency/overflow during peak times [35]. There were incidences reported where the design of equipment or facilities impacted on the way midwives could complete their tasks, in some cases resulting in risky workarounds [28]. Neonatal resuscitation equipment also needs to be considered in the design to ensure that it is easily accessible when needed, does not block other equipment, and has space for multiple clinicians to perform complex neonatal resuscitation [40].

Lack of storage was highlighted as limiting the functionality of the space for both women and midwives [28,30,36]. Midwives felt there should be better designed storage that was more easily accessible for women and midwives [28,36]. Some women found lack of storage distressing as they worried people may trip over their bags [36]. Reorganisation of storage and accessibility of clinical equipment to be more human-centred was noted as a factor which may improve staff workflow [40].

Shin et al. and Sherman et al. produced design and human factors recommendations for birth environments [40,41]. This included providing comfortable, spacious, light spaces to enable the woman and her family to have private, supportive areas within labour wards [41]. Privacy was important for sensitive discussions with women without being overheard, and also for clinicians to have private space to discuss cases [40]. Labour rooms should have transition spaces to enable women

to feel less exposed and have time to prepare for visitors [41]. Natural light was important to women but windows should not result in women feeling over-exposed [34], blinds or curtains can help enhance women's feelings of homeliness and control of the room [41].

Discussion

Current guidance recommends that women with straightforward pregnancies are offered a choice of birth setting (e.g. home, midwifery-led unit, obstetric-led unit) [1]. However, for women with more complex pregnancies with medical conditions or in situations where there is increased risk for the woman or baby during labour, an obstetric-led unit is recommended [43]. Obstetric units tend to have an emphasis on safety and facilitating the use of interventions, in contrast to environments that are explicitly designed to complement birth physiology and enhance the quality of care such as midwifery-led units. We believe this to be the first systematic review of birth environments which focusses beyond women with straightforward pregnancies and midwife-led settings.

The synthesised findings highlight that the flexibility, space and comfort of the environment may help facilitate staff to assist women with comfortable positions and ultimately straightforward birth. This is in line with other research which shows that more comfortable environments (midwifery-led units) are associated with decreased use of analgesia and clinical intervention during labour, as well as increased likelihood of spontaneous vaginal birth, breastfeeding at six-to-eight weeks and very positive views of care [3]. Birthing pools and aids (such as floor mats, or bean bags) were highly valued by women to support birthing, as was the ability to mobilise. However, many women may not have access to these, particularly in obstetric-led settings or if they are restricted by widely used continuous electronic fetal monitoring equipment and/or oxytocin infusions. The introduction of remote telemetry (wireless monitoring), which is recommended to be offered to all women requiring continuous fetal monitoring [43], offers women more freedom to mobilise and birth rooms need to adapt to these technological changes. This is a good example of where the safety and quality of care can be equally facilitated by appropriate technological solutions.

Having a comfortable and homely space was another major theme in this review. Fannin describes these home-like settings within the hospital unit as a 'hybrid space' highlighting the conflicting priorities of safety, control and family [11]. Adjustable lighting can help a space feel more relaxing whilst also facilitating the lighting required for medical assessments. Alcoves, such as window seats, can provide flexible spaces and make the room feel more homely. Comfortable and adaptable furniture could help support women and their partners through long labours. Storage for both personal possessions and equipment could help to prevent rooms becoming too cluttered, promoting flexibility. Well-designed rooms may feel more spacious than larger rooms. Women have reported feeling disappointed when they are transferred from a midwifery-led unit to a hospital labour ward, having to adjust from a more relaxed and homely environment to one which felt clinical and confining [44]. A modified 'ambient' labour room pilot trial also seemed to prompt positive reactions in women with straightforward pregnancies and reduce the amount of time spent in bed [45].

Women preferred a private space where they could control who enters the room and be out of sight of other people. This is in line with previous research reporting that modern hospital birth spaces provide high levels of surveillance of the birthing woman, which serve to reassure the maternity care providers, but can result in women feeling stressed and reduce women's sense of control [13]. This may also be a particular issue for obstetric-led settings as women who gave birth in midwifery-led birth centres reported greater feelings of dignity, confidentiality and social considerations compared to those receiving obstetric-led care in hospital [46]. Transition spaces (e.g. partition wall) in doorways may help to achieve this. Large openable exterior windows were preferred by women to help provide natural light and ventilation, but full-length windows may make women feel exposed. Women also preferred rooms to be insulated from noise and particularly did not want to be overheard or hear other women giving birth.

In birth environments there are different, and sometimes conflicting, priorities of women, partners, midwives and doctors. The systems in which midwives practice can create tensions between the provision of woman-centred midwifery philosophy of care and negotiating the dominant medicalised model of care [44]. This conflict has come through strongly in our review findings, particularly with regard to the bed dominating the room (and often placed in the centre therefore limiting flexible space). It is sometimes unclear who has control of the space, and the review suggests that midwives may fear reprimand for adapting the room. While spaces need to be supportive for women, they need to work well for medical emergencies; lack of storage, space, layout, and clutter poses a risk in emergency situations. The review shows that room design may affect the care given by midwives, particularly if they need to spend time adapting the room or leaving the room to write notes. Workplace conditions can be challenging for midwives, with a lack of control over environmental factors, including noise. Clearly, working in an uncomfortable environment has implications for health and wellbeing, and may affect staff performance potentially influencing safety of care [47,48]. Midwives also reported needing to get into positions to assist births which were uncomfortable or not well supported by the physical environment, improved design is recommended to ameliorate this [49].

With innovative design, many of the environmental changes to birth rooms can be made to improve the birthing experience of all women, irrespective of risk status [50]. The Birth Unit Design Spatial Evaluation Tool provides a theoretical framework identifying four domains for the optimal birth environment: the Fear Cascade, Facility, Support and Aesthetics [51]. However, the spatial design of labour and delivery units varies greatly and best practices for unit design are undefined [42]. Creating a gold standard for labour rooms and units requires both an analysis of the physical space, clinical outcomes and maternal level of care. A human factors approach may provide an appropriate framework to investigate this, given the complexity of factors and users involved [52]. Human factors led design standards may be useful for units that are being newly constructed, remodelled, or retrofitted. All users of the space (including women, families, clinicians and facilities staff) should be actively involved in the design process to maximize safety, efficiency, and experience of care.

Limitations

Screening by title was completed by one researcher, however this was based on topic relevance rather than the specific inclusion criteria (completed by two researchers), so it is unlikely that relevant papers were excluded due to this. The review was limited to OECD countries to enable greater comparability between health systems and socio-economic contexts, particularly as this review informed new guidance for intrapartum care. However, this review will remain relevant to the many countries that have similar maternity systems to the UK. The studies exploring women's views were less rich than those exploring midwives' views, as they were based mainly on survey data, therefore this may affect the findings. Although most of the included papers were rated as high or medium quality, some were rated as low quality due to methodological and reporting concerns. In addition to this, we were unable to identify any 'gold standard' randomised controlled trials which assessed birth environments for women with complex pregnancies, however, there are some ongoing trials [53,54]. As this systematic review was focussed on women with complex pregnancies, papers were excluded if they focussed solely on women with straightforward pregnancies or associated settings. However, the included papers may have had a mix of low- and high-risk women or settings and in some cases data could not be differentiated between these during analysis.

Conclusions

Women, their families, midwives, and doctors have different requirements from birth environments and these must all be considered. Environments for women with complex pregnancies need to be multifunctional so that they have the space to both support women to use birthing aids and mobilise, but also have the facilities for medical emergencies. This can be achieved through innovative design of equipment, furniture, and storage solutions. A sense of privacy and control in the space is important, particularly for women, but also to help midwives feel comfortable to support women as they would like to. There is a need for more high-quality research investigating birth environments for women with complex pregnancies and those supporting them, particularly in terms of: (i) in-depth qualitative data of women's experiences, and (ii) the design requirements for different users of the space.

Statement of significance

Problem

Women with complex pregnancies have less choice over birthplace. Birthing rooms are often designed to facilitate medical emergencies rather than physiological birth processes.

What is already known

Birth environments can influence women's outcomes and experience. Women prefer rooms that are homely and relaxing, aiding birth physiology. These types of birth rooms are commonly based in midwifery led settings and are not available to all women.

What this paper adds

Designing to provide flexibility in the space will accommodate women's needs and other room users. Balancing the provision of a supportive environment with suitability for medical emergencies is vital.

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Conflicts of interest

None.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.wombi.2022.04.008.

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