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DEVELOPING THE BIRTH UNIT DESIGN SPATIAL EVALUATION TOOL (BUDSET) IN AUSTRALIA – PAPER 1

INTRODUCTION

When looking at the homes in which we live in and the buildings we access for work or play, it is apparent that society has largely considered the spaces we inhabit merely as containers to accommodate our bodies or at best as an expression of our bodies. More recently there has been an acknowledgement of the profound way that the design and aesthetics of the spaces we inhabit impacts on our physicality, behaviour and wellbeing (de Botton, 2006; Dilani, 2004; Ulrich et al., 2008). Ulrich's original study (1984) showed that patients with a view of nature from their window had a shorter hospital stay and required fewer analgesics than those facing a brick wall. This work has inspired new thinking about design and health in many fields (Devlin, 2003) including maternity care. Several studies and writers have considered the impact of spaces built for women giving birth in hospital settings and how these environments may impact on maternal and infant outcomes (Davis & Walker, 2009b; Foureur, 2007; Lepori, 2008; Lock & Gibb, 2003; Newburn & Singh, 2005; Symon, 2008a; Walsh & Downe, 2004). This study builds on this growing body of knowledge by developing a set of design principles and an assessment tool to measure the optimality of different birth settings.

Background

Birth in hospital is a relatively recent phenomenon. The move to hospital coincided with the medicalisation of childbirth. THIS IS THE PULL-OUT QUOTE: Hospital spaces for childbirth now function as a technology of biomedicine with childbirth seen as a medical condition. According to the architect Lepori (1994) "…the organisation of the entire setting is a function of the patterns of movement that occur during medical intervention" (p.4). Davis and Walker (2009a) regard the hospital birth room as a place that "…informs the woman, her supporters and carers that she is vulnerable and endangered and this is what she becomes: A woman at

risk of peril and death rather than a woman in rapture to birth and life." So the labouring woman and those around her become fearful and watch, waiting for the first sign that things have gone awry (Hood, Fenwick, & Butt, 2008).

Labour and birth are influenced by complex neuro-chemical responses to the emotional states of fear and anxiety that govern physiology. One well supported hypothesis (the Fear Cascade) suggests that fear will stimulate the woman's body to produce excessive amounts of catecholamines that interfere with oxytocin production leading to the slowing of labour (uterine inertia) (Foureur, 2007). Catecholamines, particularly adrenaline, produced in the 'fight, flight or freeze' response to fear may contribute to diminished oxygen flow to the unborn baby, resulting in fetal distress (Teixeira, Fisk, & Glover, 1999). Uterine inertia and fetal distress are the two main reasons for intervention in childbirth. This led us to question whether the hospital birth space could be a contributing factor in the Fear Cascade.

A means of measuring the qualities of the birth space or environment is required to explore these issues. A search of the literature identified a number of empirical studies and theoretical ideas about birth environments but no appropriate measuring instrument. One key study surveyed 2000 women through the National Childbirth Trust and two magazines - Practical Parenting and New Generation in the United Kingdom (Newburn & Singh, 2005). Women were asked about their experience of the birth environment in the last 5 years. Ninety percent believed that the physical surroundings affected how easy or difficult it was to give birth and listed specific elements they felt were essential during labour. These included having a clean room with ensuite, comfortable furniture for themselves and their companions, room to move around and an ability to control heat and light and who came into the room. Another study by Lepori, based on observations of women giving birth at home, recommended that architects return to the fundamental principles of design by considering the behaviours of women in spontaneous, uninhibited labour (Lepori, 2008).

Maternity units throughout the developed world undergo refurbishment or rebuilding on a regular basis. New maternity units are built each year. Every location has a set of design principles and local building codes, occupational health and safety and infection control guidelines and budgetary constraints. THIS IS THE PULL-OUT QUOTE. It is our observation that the principles and guidelines in many countries have failed to consider the many new developments in neuroscience and architecture and are unaware of changes in birthing

services that are now required to be much more responsive to the needs and desires of childbearing women. New insights to establish a new set of holistic design principles needed to be considered for optimising the environments for childbirth.

The aim of this study was to develop a set of design principles (which include specific characteristics), incorporate these into a measurement tool and determine whether this tool could measure the optimality of different birth settings. The tool is known as the Birth Unit Design Spatial Evaluation Tool (BUDSET). This is the first stage of a larger study that aims to assess whether optimal design influences outcomes for mothers and babies.

METHODS

The process to develop the BUDSET included a review of literature, interviews with key informants and the use of an expert panel.

Literature review

Initially, a search was undertaken of the design and health literature to identify relevant research. The question addressed in the literature review was 'what are the ideal design elements to support optimal childbirth?'

We searched for evidence about the physiological mechanisms that support normal childbirth, the views of women and care providers of the desirable elements of maternity care settings and the quality of architectural space and usage, in particular, in hospital-based settings (e.g Newburn, 2006; Newburn & Singh, 2005; Symon, 2008a, 2008b, 2008c). We were interested in reviewing literature that explored the relationship between health facility planning and the unconscious effects of space on human physiological responses – principally, stress reduction (e.g. Gullone, 2000; Shur Blichuk, 2002). This was important as stress reduction is a critical element in supportive or salutogenic (health-giving) space design and an essential component of supporting normal childbirth (Lepori, 2008; Trevathan, 1994).

We reviewed literature that described how women gave birth at home and in homely birthing centres (e.g. Boulton, Chapple, & Saunders, 2003; Walsh, 2006a, 2006b, 2006c). Studies of women giving birth at home and in birth centres show that in these environments women respond to labour in dynamic and disinhibited ways. Homebirth and birth centres provide a

unique opportunity to understand what women will choose to do when unencumbered by a medicalised environment (Walsh & Downe, 2004; Dahlen, Barclay & Homer, 2008)).

The theory of *Birth Territory*, co-developed by one of our team in a recent book (Fahy, Foureur, Hastie, 2008b) was reviewed and utilised. This theory recognises the physical territory of the birth space over which jurisdiction or power is claimed for the woman and builds on work of philosophers including Foucault (cited in Fahy, 2008a; Foucault, 1980) the Supportive Design Theory of Ulrich (1997) and the work of nursing scholars, such as Watson (1999).

In addition, relevant government documents and reports were also accessed and reviewed. For example, the Royal College of Midwives in the United Kingdom addressed issues of design in their Campaign for Normal Birth in 2007 (Royal College of Midwives, 2007). Our state government Health Facility Guidelines were also reviewed to highlight the issues in relation to regulations and guidelines (NSW Health, 2005, 2007).

Interviews with key informants

A series of interviews, in groups and one-to-one, were conducted with the key informants. The key informants were 10 midwife clinicians and researchers who had attended women at both home and hospital births, and three architects or students of architecture who were involved in the design of health settings including maternity units.

As explained earlier, we knew that homebirth midwives have a deep understanding of the important elements in non-medicalised childbirth and so it was important to collect their reflections (Foureur, 2007). Understanding how women behaved in a homebirth setting provided an important means to articulate design principles that would support optimal childbirth.

The midwife key informants were initially asked to describe the journey that women take either at home or in hospital once they commence labour. They were encouraged to recount experiences that illustrated how women used space and what the important elements of the space were, for women, families and care providers. The architectural key informants were asked to reflect on the process of design, especially in maternity settings, and to explore ways in which this could be optimised. This process also drew on personal and professional

experiences and design examples from elsewhere, both in Australia and internationally. Key informants were encouraged to bring illustrations or photographs of design elements that had been utilised with effect elsewhere.

Expert panel

The research team were the expert panel which brought together experts from midwifery and architecture. The expert panel met regularly over a two-year period as the project progressed and the BUDSET was developed.

The midwives in the research team brought many years of clinical practice to the expert panel. Over time, we had watched how midwives work when they know the women they attend and know what they want and need in labour. These midwives, including ourselves, always altered the environment when entering the birth room. This included turning down the brighter lights, moving the bed away from being centre stage, bringing in soft and yielding bean bags, cushions and extra pillows, putting on music that the woman has chosen, burning essential oils to provide a relaxing fragrance, inviting the woman to bring a favourite picture or flower or object from nature and drawing a bath so that water immersion is available. Since these activities were always a feature of their care it seemed the space had not considered the needs of the labouring and birthing woman in the initial design and so the midwives adapted the space. Equally, we had observed that at homebirths there was none of this activity as the woman had already ensured her own comfort over the many months of her pregnancy and the time that she had occupied the space and made it her home. We recognised that many elements found at home are comforting and become essential requirements to relieve stress in the environment. In our experience, many hospital birth rooms are set up to increase a woman's anxiety and stress at the very time that she needs to be most relaxed to ensure labour and birth can progress optimally. This expert knowledge and experience was used throughout the study to build on what was seen in the literature and data from interviews.

The expert panel used the Pattern Language format developed by Alexander (1977) to synthesise the literature and data from the key informants. Alexander provided a formula that identified a design problem (an observable problem requiring a solution), the underlying assumption about this problem (a testable hypothesis) and the solution (the suggested way of solving the problem). The formula produces a series of ‘patterns’ that can be linked into a

design solution – these are recognised as universal objectives for the design. These are described in more depth in an earlier paper (Forbes, Homer, Foureur, & Leap, 2008).

The patterns were further developed by the expert panel into design principles and characteristics that could be assessed in the BUDSET. Using a thematic analysis, these were grouped into a series of four domains. Through this process, the design principles could be described and contained within each domain.

The development process was iterative. As evidence was found in the literature review, this was tested out with key informants and then synthesised by the exert panel. Preliminary feedback after presentations given to clinicians also shaped the process. This process of analysis and synthesis developed the design principles. THIS IS THE PULL-OUT QUOTE. The design principles are built around a sequence of patterns which mirror the progressive flow that a woman takes through the birth unit during the course of entering the space, giving birth and leaving. In total, 18 design principles were identified and subsequently used in the BUDSET.

FINDINGS

The design principles are expressed in four domains in the BUDSET. Each domain contains 3-8 measurable characteristics (Table 1). The scoring system measures whether the design characteristics are present or not and the total score for each domain and the overall facility gives a weighted score that compares to the ideal and between facilities.

The four domains measure:

1. Characteristics affecting the **Fear Cascade**
2. **Facility** characteristics
3. The **Aesthetic** aspects of the unit
4. The essential **Support** elements for women and families

<Insert Table 1 here>

The findings describe the design principles and characteristics within each domain. The essential aspects of the design principles are described within each domain. The text under

each characteristic highlights important issues within that characteristic based on the development process. The full 'pattern' will be provided at a later time when the BUD Design Guideline is completed for publication.

Domain 1: Fear Cascade

Characteristics in the *Fear Cascade* domain include space (arrival area, outside area, reception area and the birthing room), sense of domesticity, privacy, noise control and universal precautions.

Space: The arrival to the Birth Unit

The entrance to the maternity unit must be easily identified and there should be a dedicated entry area in a general hospital facility. Entry through the emergency department is inappropriate. Easy way-finding and a welcoming environment reduces anxiety.

Long corridors can be frightening and cause anxiety for first time arrivals, especially those who are not sure how far it might be and if there is help nearby. This fear is exacerbated at night when the lights are low and no-one is around. Corridors without windows or evidence that other people and staff are nearby can also cause anxiety and interrupt the progress of the woman's labour.

Like a home, the unit must have a public arrival area and lounging space to sit, watch television or talk. The unit, like a home, has bedrooms, in this case for birthing, and support rooms such as toilets, storage and supply areas. These spaces should be arranged by a hierarchy of activity.

Space: Outside

An important element of health facility design is the connection with nature and to have patients, family and the public move easily out into gardens and courtyards.

Often if the labour slows and women have had a rush of adrenaline due to a fear response, their moving to another environment, especially a garden or outdoor setting can reduce fear and restore the production of oxytocin [the hormone responsible for initiating labour] in support of strong contractions.

Space: The Reception

The reception area should not look like an office with desks and a reception counter. Staff desks and reception counters form intimidating barriers to families arriving. Therefore, the reception area should be as 'low key' as possible and not have high counters which signal a barrier between staff and families. Waiting spaces should have comfortable chairs and a low table. The area should look attractive with flowers, pictures and symbols of beauty evident. The space should be child-friendly with toys and a play space for siblings.

Space: The Birthing Room

The woman's personal space for birthing should not be immediately accessible from the public area. The inner room is a place for the process of labour and birth and should not be for continued post-partum rooming-in. The activity around labour and birth differs to that which occurs in the post-partum period. The atmosphere and priorities are often different. Our experience suggests having these spaces together is undesirable.

The birthing room should have different spaces which allow the woman to retreat, use the bath or toilet but maintain privacy when she chooses. The process and pain of labour and birth induces various responses and women try to withdraw, to find places where they can be undisturbed, preoccupied with their feelings and focus on the changes taking place as the birth progresses.

An examination of beds leads to the following performance specification. The bed must not be the focus of the room. Too often the room has been sized with a bed in mind and little else. It is preferred if the bed can be pushed out of the way, for example behind the door, and the balance of the room left for activities to suit the individual woman during labour and birth. Increased use of partner-friendly double beds has not been accompanied by the necessary increase in space to enable women to give birth off the bed and this must be considered.

Most women do not use the bed when alternatives are offered. This is especially true if sufficient space is available and women are supported to remain off the bed. Instinctively woman show a preference to give birth on the floor, on hands and knees or in a squatting position. When comfortable places to stand and lean on are available, women will use them. The forward learning stance facilitates internal rotation of the baby in the pelvis, making

ready for birth. Women also have shown a desire to be able to labour and/or give birth in various places within a room including the bath or near the toilet.

Sense of domesticity

Birthing units should be homelike and small or grouped into ‘villages’. It should be possible to become familiar with the unit very quickly. A small table and chairs in the birth room placed near the window provides utility and a domestic feel.

The need for medical gases and suction are fundamental even if the focus of care is for low risk uncomplicated births. Oxygen, suction and nitrous oxide should be stored behind cupboards and a service panel exposed by pulling open doors or dropping a table down. Women want the assurance of this technology but do not want to see it.

Many women complain that rooms are designed around clinical procedures and the simple things, which make the space homelike, familiar and accessible, are missed. There must be a cupboard to provide adequate space for the woman’s belongings. This should be designed for easy access, for quick unpacking and repacking, as women may not be there for long. It should also be secure with a key if women have to leave the area (e.g. for transfer to an operating theatre in case of an operative birth).

Privacy

The birthing woman should control the room. She should see who is entering. The entry door should screen the room as it opens and there should be a further screen or curtain to maintain privacy inside the room. Women do not want to be feel unsafe or on display. The configuration of the room should provide cues that immediately suggest barriers to intrusion so women can relax.

Noise control

The acoustics of the room are important. Soundproofing is required so that the room is quiet on the inside and women feel comfortable to make a noise during labour without being overheard. Soundproofing of the room also means that women in adjacent rooms are not distracted or worried by the noise of other women in labour. Sound absorption with acoustic wall materials or panels also adds to the control of reverberant noise.

Universal Precautions

Universal precautions are needed for infection control considerations and include the provision of clinical hand basins in each birth room. These should be kept separate from domestic basins for use by labouring women. Clinical basins require gloves, soap dispensers and sharp disposal containers. These features, while accessible, must not be the focus of the room as they produce a clinical environment. It is preferable if the basin is screened like the gas outlets, or can be near the entrance and behind a curtain.

Domain 2: Facility

The characteristics of the *Facility* domain include physical support, a birthing bath and ensuite bathroom facilities.

Physical Support

The features for support include a mantelpiece for the woman to lean on. Women often feel more comfortable standing or leaning while standing. This mantelpiece should preferably be of wood so that the texture and the appearance are domestic and have a natural feel. Equipment, such as floor mattresses, exercise balls, pulling ropes and other supports for labour and birth, should be available but kept out of the room and brought in as required. Places where women can lie, sit or kneel, such as material-covered seating or built in benches, are other ways that the space can provide support.

Birthing Bath

Access to a pool or large bath is important to help women cope with pain in labour and to facilitate birth. The ability to lie in the water, hold onto a supporter, kneel, move about or sit up, all assist in the birthing process. The bath must be deep enough for a woman to be on her hands and knees with her bottom submerged. Most commercial baths are not deep enough and mean that she must recline (lie on her back) to labour or give birth. A supine position has been shown to be counter-productive to the physiology of giving birth. Spa baths are not recommended for infection control reasons.

Ensuite bathroom

In addition to the bath, which becomes more of a feature of the birth room, there should be a bathroom with toilet, hand basin and shower for normal ablution functions. Ready access to

an ensuite toilet enables women to maintain privacy. For this reason women should not have to cross a corridor or share a facility.

Domain 3: Aesthetics

The characteristics of the *Aesthetics* domain include light, colour, texture, indoor environment and femininity.

Light

Lighting is critically important. In the first instance, natural light should be available and used. Natural light supports the biorhythms of the body and knowing whether it is day or night is an important orientation. Light effects mood and stimulates people physiologically as well as psychologically.

All light must be considered in its affect on mood. Changing the light levels and locations can create opportunities to soften light and create a more restive mood versus a stronger light to assist with an active mood. Since the woman may be in the space for 12 or more hours, the light should be dimmable and not located directly overhead. Centrally located overhead theatre lights, which are typically found in many birth rooms, are likely to increase anxiety in women. Creative use of grouped up and down lights also provide an opportunity to change the environment and also increase or decrease the light intensity without using dimmers.

Colour

Careful selection of colours is important to support mood, by either stimulating with brighter colours or providing restful psychological responses with warm tones that are more subdued in colour. Small amounts of strong colour will provide stimulating vignettes but generally rooms must have less white and cream in exchange for stronger pastel colours. The object in labour is to decrease stimulation of the neocortex and to maintain the woman in a right brain thinking state (Lepori, et al., 2008) – so the best colours are those that do not stimulate.

Texture

Traditionally clinical assumptions have driven the use of materials in birthing rooms so that surfaces are washable, sterilisable and smooth. This has provided a very clinical appearance. Recent experience with hospital quality carpets, or timber-look vinyl, natural timber joinery,

shelves and rails to lean on, plus the use of domestic looking curtains and bedcovers made of sterilisable materials, all have enabled the introduction of texture to make the room familiar and therefore less stress inducing.

Women in labour are more likely to seek soft and yielding textural objects that can mould about their body to provide comfort. Naturally occurring fibres are preferred since hard edged man-made textures stimulate left brain activity which is likely to result in increased catecholamine production resulting in the initiation of the Fear Cascade.

Indoor Environment

The room should have an atmosphere of cleanliness and order and contain feminine symbols of beauty, wholeness and harmony.

Views of nature enhance stress reduction via the Biophilia Hypothesis (Wilson, 1984) and therefore reduce the likelihood of the Fear Cascade being initiated. Nature 'views' can include naturally occurring views through windows or the inclusion of natural objects such as water in the form of fountains, pools, aquariums; green indoor plants, river stones, shells, or paintings or projected images of nature or natural objects. There must also be room for the woman to move as she wishes without hindrance.

As discussed previously, the environment should not be dominated by the bed as the central focus. If the first object the woman sees on entering the room is the bed then she interprets this as a powerful message – to get on it – and there she stays for the rest of her labour, immobilised. Immobility and feeling under constant surveillance stimulates left brain activity (Lepori, et al., 2008), results in increased anxiety and the initiation of the Fear Cascade.

The smell of the birth room is another feature that needs to be considered. The sense of smell is one of the most primitive and most powerful sources of information we obtain from the environment, sometimes consciously but often unconsciously. Antiseptic smells easily stimulate a fear response so need to be avoided or masked by more pleasing and relaxing odours that can be provided via electronic oil burners containing essential oils.

The consideration of the design of indoor environments is essential to establish comfort zones. Women in labour need changes of temperature and will feel cold or hot at different

times. The ability to individually control this becomes essential. The design requirements include the same principles employed in Environmentally Sustainable Design such as ability to have natural ventilation, to ensure cross ventilation, screen windows from sun penetration, reduce heat gain and glare as the sun moves over windows.

Femininity

Curved walls should be used where practical to help provide a softer environment, reminiscent of 'caves' with protected spaces where a woman can feel safe and focus on the changing aspects of the labour and birth. Such a cave like space enhances the woman's sense of privacy and of not being under constant surveillance. Curved and rounded objects reflect the feminine archetype of the earth mother – labouring women respond unconsciously to this archetype with a subsequent reduction in stress. Pictures and soft feminine images on walls with roundness (e.g. a fruit still life, pregnant woman) are believed to be calming and reduce stress.

Domain 4: Support

The characteristics for the *Support* domain include food and drink for women, accommodation and access to refreshments for companions and birth attendants. These characteristics are often not thought of as part of design, rather they fit into the realm of care provided. However, if the provision of tea and coffee making facilities, are not included in the architectural design then the service cannot exist.

Food and drink for women

Women may be in labour for hours and in the early hours of the morning when usual food supplies are not available. Unless there is a risk of anaesthesia, women should maintain their hydration and avoid exhaustion by having food. Therefore snacks, tea and coffee making facilities and access to food and a toilet for the support people must be available so they do not have to leave the area.

Accommodation for companions and birth attendants

Historically companions and partners were not expected to be involved in birthing but this has changed with greater encouragement of supporters being present. Labour and birth can be a long process and women benefit from the support provided by their companions.

Companions therefore need to be able to meet their own energy demands by having access to food and drink. Women in labour may require privacy at various times or companions may need to withdraw from the intensity of the birthing room to rest and be refreshed. The birth facility needs to provide appropriate facilities for birth companions.

There needs to be a 'family room' on the unit where supporters can retreat, get food, if only from a coin machine and rest during a long labour. A clearly visible separate public toilet and shower must be provided. Provision for a pull out bed or convertible lounge for a partner should be provided in the birthing room.

DISCUSSION

This study has developed a set of design principles which are articulated as characteristics and domains within an instrument called the BUDSET. The BUDSET was designed to be able to assess whether birth spaces were optimally designed and potentially to help inform future designs. This was the first stage of an ongoing project which ultimately aims to determine whether birth outcomes can be altered by improving the optimality of the design of birth units.

Our basic premise was that optimising the birth space would reduce stress and thereby improve experiences and outcomes for childbearing women. The notion that space contributes to stress is not new. Changing the health environment to reduce stress and improve outcomes has been hypothesized to improve the experience, improve the use of technology and reduce cost (Shur Blichuk, 2002). Our work build on this and subsequent work into evidence-based design.

The BUDEST was developed using a qualitative approach drawing on a review of the literature, interviews with key informants and the use of an expert panel. Validity and reliability has not been undertaken as yet – this is the next phase of this ongoing project. We are currently interviewing women, either who are pregnant or who have recently given birth, and their caregivers to undertake a content validity of BUDSET. Paper 2 in this Journal describes how the BUDSET has been used in eight maternity units in New South Wales, Australia.

THIS IS THE PULL-OUT QUOTE. The identification of the principles and characteristics which led to the development of BUDSET and the future review of built facilities will help provide documented evidence for use in the design of better birthing units. The literature supports the notion that physical environments provide both positive and negative effects on birthing outcomes. Women prefer quite specific types of places in which to give birth. If we can ensure the essential elements of these designs are provided in every case, we will have reduced anxiety, increased support and increased patient safety (McCarthy, 2004). We might also expect to see reductions in the Fear Cascade that creates the demand for interventions that could have negative consequences for both mothers and babies.

Some of the characteristics are not conventionally considered in design, for example, food and beverage during labor, family presence and food for family members. Studies have found that involving the patient's family may contribute to patient safety (Anjali & Rashid, 2007) and so they need to be accommodated. We have included them in the BUDSET as, without the built facilities, they are unable to provided as part of the system of care.

CONCLUSION

THIS IS THE PULL-OUT QUOTE. Designing facilities to meet the needs of birthing women, their supporters, the staff who care for them and the funders of such enterprises is a challenging undertaking. In the developed world, huge budgets are allocated annually to new buildings and renovation of existing health facilities and their birth units. Optimal birth unit design should facilitate physiological birth while at the same time provide additional access to technology for those women and babies who require it. Currently most units are focused on making the technology overtly available for all women and immediately accessible for all staff. This may increase anxiety for some women resulting in the initiation of the Fear Cascade and a requirement for the very technology that has been provided. From the study it is also clear that even where staff in many of these units understand what should be done to improve the birthing experience of women, the physical environment does not support this.

The BUDSET provides a checklist of design elements to consider when refurbishing or planning new birth units that are focussed on supporting physiological birth. Existing units

may also benefit from applying the BUDSET to determine which domains may require attention to increase physiological birth support.

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