Abstract

Objective: This study examined the influence of neonatal nursery design on interactions between nurses and mothers of infants in the nursery. **Design and Methods:** We used a natural quasi-experimental design, using semi-structured interviews and a structured measure of mothers' and nurses' perceptions of nursing care, to compare mothers (N=26 and N=40) and nurses (N=22 and N=29) in an open-bay (OB) nursery and a single family room (SFR) nursery. Thematic analysis was used to generate key themes from the interviews. **Results:** Mothers and nurses in both nursery designs talked about *Valuing interactions*; the importance of interactions between mothers and nurses. Mothers and nurses described SFRs as providing a space, *My/their room*, which enhanced mothers' sense of control and connection with the infant. SFRs were also associated with *Changing the norms of interactions* with nurses and other mothers, which created challenges in the desired quantity and quality of interactions for mothers and nurses. Nurses in the SFR nursery also reported *Enhanced interactions*, including improved confidentiality and personalized communication. Mothers in the OB nursery reported more supportive mothering actions from nurses than mothers in the SFR nursery. Both mothers and nurses in the OB nursery also talked about *Our nursery community*, which captured the value of having other nurses and mothers in the rooms. **Conclusion:** Mothers and nurses perceived that the SFR nursery enhanced privacy and maternal closeness for mothers compared to the OB nursery. However, the SFR nursery design presented challenges to some interactions of value to nurses and mothers.

Keywords: Nursery design, mother interactions, preterm birth

The influence of neonatal nursery design on mothers' interactions in the nursery

Preterm birth (<37 weeks gestation) accounts for between five to 18% of all births worldwide (Howson, Kinney, & Lawn, 2012) and approximately 7.4 % of births in Australia (Li, McNally, Hilder, & Sullivan, 2011), with 6.2% being born with low birth weight (LBW <2500grams) (Li, Zeki, Hilder, & Sullivan, 2013). Preterm infants suffer greater risks of physical and developmental challenges than full term infants and often require admission to Special Care Nurseries (SCNs) (Roberts, Bellinger, & McCormick, 2007). The admission of an infant to the SCN affects the social and psychological adjustment of mothers (Miles, Holditch-Davis, Schwartz, & Scher, 2007; Sheeran, Jones, & Rowe, 2013), and challenges have been identified to maternal confidence, role, and coping in the nursery environment, during the transition when the infant is discharged home, and even longer term (Fenwick, Barclay & Schmied, 2008; Hess, Teti & Hussey-Gardner, 2004). Mothers have described the separation from their infant as the most stressful part of having a preterm baby (Lindberg & Ohrling, 2008), and they struggle to 'mother' in the hospital setting (Fenwick et al., 2008), including establishing breastfeeding. In turn, the infant's ability to develop secure attachment is affected, which may be associated with poorer child development (Eshel, Daelmans, Cabral de Mello, & Martines, 2006; Lee, Holditch-Davis, & Miles 2007).

There is extensive research showing the importance of supportive relationships, underpinned by effective communication, for improving maternal wellbeing, and enhancing mother-infant closeness and maternal efficacy for parents of preterm infants (Brett, Staniszewska, Newburn, Jones, & Taylor, 2011; Cleveland, 2008; Reis, Rempel, Scott, Brady-Fryer, & Van Aerde, 2010). In the neonatal nursery environment interactions with nurses are particularly important for mothers of preterm infants, as nurses are the predominant providers of health care in the nursery, and thus tend to spend the most time with both infants and mothers (Miles, 2003; Reis et al., 2010). Supportive interactions with

nurses may reduce stress in mothers and increase their maternal efficacy (Jones, Taylor, Watson, Dordic, & Fenwick, 2015). Moreover, where mothers are appropriately encouraged to assume responsibility for the care of their infant, this assists in the transition to motherhood (Fenwick, Barclay, & Schmied, 2001a; Gavey, 2007), including forming an attachment with their infant (Kowlaski, Leef, Mackley, Spear, & Paul, 2006).

We know much about the qualities of effective interactions between mothers and nurses in neonatal nurseries. A number of studies have identified that mothers and fathers value clear and consistent information from nurses (Jones, Woodhouse, & Rowe, 2007; Jones et al., 2015; Kowlaski et al., 2006; Reid, Bramwell, Booth & Weindling, 2007). This information includes parenting education that, in turn, provides parents with the opportunity to practice new skills through guided participation (Cleveland, 2008; Jones et al, 2015). Effective communication also involves emotional support from nurses (Jones et al., 2015; Reid et al., 2007), and nurses using a supportive interpersonal style that demonstrates kindness, empathy, friendliness, and respect (Jones et al, 2015), and includes informal “chatting” (Fenwick, Barclay, & Schmeid, 2001b; Jones et al., 2007).

The recognition of the importance of family and the need to facilitate close parent-infant interaction, in particular infant-maternal attachment, has led to key changes in neonatal nurseries over time: one ontological- the adoption of family-centred care (FCC), and the other architectural- new designs for nurseries. Both potentially influence mothers’ interactions in neonatal nurseries. Over the last twenty years there has been a substantial body of work advocating for the adoption of a FCC approach (see, for example, Gooding, Cooper, Blaine, Franck, Howse & Berns, 2011; Griffin, 2006). Family-centred care means putting the family at the centre of care in an approach which is a collaborative partnership between health professionals and family. Parents are considered best placed to care for infants, and FCC values the unique contribution parents and/or families make to the infant’s health and

wellbeing (Griffin, 2006; Newton, 2000). There remains evidence however that many neonatal intensive care units struggle to enact these principles (Gooding, et al., 2011; Griffin, 2006), particularly making this a collaborative partnership (Jones et al., 2015), and FCC may not particularly focus on infant-maternal attachment.

A further major change, that may change the nature of FCC and affect interactions for mothers in neonatal nurseries, is the change in nursery designs. The design of the neonatal nursery environments has been moving away from multi-patient open bay (OB) wards, to single family room (SFR) floor plans or pods. Research to date has found SFRs benefit both parents (mothers and fathers) and infants in neonatal nurseries. Lester, Hawes, Abar, Sullivan, Miller, Bigsby, et al (2014) reported improved medical and neurobehavioral outcomes for infants cared for in SFRs compared to OB. Parents also report that SFRs provide increased privacy, space, and comfort, decreased noise and increased control over lighting, and hence a decrease in overstimulation for their infant (Carlson, Walsh, Wergin, Schwarzkopf, & Ecklund, 2006; Carter, Carter & Bennett, 2008; Cone, Short, & Gutcher, 2010; Stevens, Helseth, Thompson, Pottala, Khan, & Munson, 2012). Moreover, recent research has found that the SFR was associated with increased visitation and breastfeeding by mothers, both at discharge and four months post-discharge (Jones, Jones & Feary, in press). Hogan, Jones and Saul (2016) also reported that seeing the benefits for parents of SFRs was perceived by nurses as improving their job satisfaction and sense of personal accomplishment, despite SFRs also being associated with increased workload and isolation.

Concerns have however been raised about the impact of SFRs on parents' interactions in the nursery. Ortenstrand (2014) suggested that parents may have fewer interactions with nurses in SFRs, with potential implications for infants (behavioral, cognitive, and language development). There has been little research examining the impact of SFRs on parents' interactions in the nursery, particularly mother-nurse interactions, and the findings have been

inconclusive. Domanico, Davis, Coleman, and Davis (2010) surveyed staff regarding their perceptions of care in OB and SFR nurseries, and found nurses thought an OB nursery aided their ability to support parents and coworker interactions more than the SFR design. In contrast, for parents there were almost no differences in their perceptions of interactions with nurses across the two nursery designs, but there was a lower mean for the item about interacting with other parents in the OB nursery. Harris, Shepley, White, and Kohlberg (2006) also reported that the OB nursery design afforded parents with greater social interaction and incidental communication with other parents, but the SFR provided more privacy for interactions. However, it is not clear what method was used to gather this data, except that it included a survey of staff. Overall, there has been limited research focusing specifically on mothers, despite mothers being the primary caregiver for infants in the nursery. Thus, to date, there has been no detailed study of how the SFR design impacts (or not) the quantity or quality of interactions that mothers have with staff or other parents. The aim of the current study was to examine how neonatal nursery design influences interactions between mothers and nurses. We focused on mother-nurse interactions as previous research has identified nurses as the most important and most frequent source of support for mothers. We examined the perceptions of both mothers and nurses in an OB nursery compared to a nursery with SFRs.

We considered it important to examine the views of both mothers and nurses as previous research has found differences in their perceptions of their interactions and their roles. For example, Jones et al. (2015) found nurses had a narrower focus than parents in describing information provision, with nurses focusing on breastfeeding and the infant's condition, and nurses were also less aware of the difficulties parents experienced in initiating interactions with nurses and negotiating the power relations. Nurses were also less aware of their role in socializing parents into the nursery and normalizing parents' situation.

Moreover, while parents value informal chatting, nurses value their professional role as educators and guardians of the infant, often at the expense of parental involvement (Fenwick et al., 2001a; Lupton & Fenwick, 2001). Rowe, Gardner, and Gardner (2005) also found parents identified and positioned themselves somewhat differently to professionals in the nursery.

As a secondary question, we also examined how mothers and nurses talked about mothers' interactions with other staff or parents in the nursery. While nurses are the key support person for mothers during their infant's hospitalization, a small number of studies have found mothers value formal and informal supportive relationships with other mothers (Hurst, 2006; Pearson & Anderson, 2001; Sheeran, et al., 2013).

Method

Study setting and design. In 2013 in South-East Queensland, Australia a hospital was relocated two kilometres to a new facility, where the special care nursery (SCN) and NICU changed from an OB nursery to SFR design, enabling this prospective study. It used a natural quasi-experimental design to compare the influence of the two nursery designs on mothers' relationships and interactions in the nursery, while controlling for geographical hospital region. There were no systematic differences between the two hospitals in general procedures and policies, nor the ratio of care (babies to nurses), acuity of infants, or demographic characteristics of parents. Two sources of data were collected: semi-structured interviews to elicit detailed descriptions of mothers' interactions and relationships with staff and other parents, and a survey measure of perceptions of nurse-parent interactions. This study formed part of a larger project on the effects of SFRs on parents and nurses that examined a range of outcomes for both parents and nurses, including family functioning and behaviour, nurse behaviour and attitudes, and delivery of family centred care.

OB nursery. The original hospital had a level three SCN with capacity for 20 special care infants and two NICU infants. The SCN was made up of two smaller rooms (6x4.5m) each caring for four infants, a NICU room and an isolation room both caring for two infants, and a larger area caring for ten infants. The two smaller rooms had a nursing station located next to the opening. All rooms had one wall with a glass window and cardiovascular monitoring was not universal, thus infants due to transition home from hospital were rarely monitored. There were two reclining chairs in the largest area but all other rooms only had regular armchairs. There were no screens provided for privacy in any of the rooms. There were no lockers or showering facilities available, and the family room, which had a couch and a television, was located outside the nursery on the same level of the hospital. Mothers were permitted to visit 24 hours a day.

SFR Nursery. The new SFR nursery is a level three nursery with capacity for 28 SCN infants and 16 NICU infants (the majority of NICU beds were not in use when the study was conducted). Each SFR in the SCN is 17-19m², enclosed by three floor-to-ceiling walls. The fourth wall is a glass sliding door with a curtain for privacy. Each SFR contains a bed or isolette for the infant, medical equipment, infant bath, and a fridge for the storage of expressed breast milk. Cardiovascular monitoring is available on a computer screen within each SFR and at nursing stations. All infants in the SFR are monitored until discharge. Each SFR also has customizable lighting, storage space, power points for charging devices, and a day bed with an additional curtain for privacy. All mothers with infants in the nursery have access to a Ronald McDonald family room that is staffed by volunteers and has showering facilities, a lounge space, television, computers, and kitchen facilities.

Participants

Participants were mothers of preterm infants admitted to the SCN and nurses working in the nursery.

Mothers. Participants from the OB nursery and SFR nursery were recruited for the larger project consecutively between August 2012–August 2013 and December 2013–June 2014, respectively. Eligible participants were women >18 years who were medically stable and who had an infant in the nursery for over 72 hours. Mothers were excluded if they were experiencing significant social issues, e.g., IV drug use, and if their infants had severe respiratory distress and were not expected to live, or had a suspected or confirmed congenital anomaly. Mothers were given the option to complete a survey, participate in an interview, or both.

Nurses. All nurses were Registered midwives or Registered nurses with a range of experience. Nurses were eligible to participate if they were full-time or part-time employees working in the SCN. Nurses were given the option to complete a survey, participate in an interview, or both. Staff turnover and participant attrition resulted in nurses who participated pre-move or post-move only, as well as ten nurses who participated at both times, thus the data for nurses is both cross-sectional and longitudinal.

Procedure

Prior to data collection ethical approval was obtained from the hospital's Human Research Ethics Committees (HREC 11/QGC/164) and Griffith University Human Research Ethics Committee. The same procedure was used in both nurseries. In-service information sessions for nurses were conducted in each neonatal nursery, where they were also asked to provide mothers with brochures about the project. Project material for both mothers and nurses, including brochures and information sheets, were left in key areas of each unit. Nurses were recruited individually during shifts.

All mothers who met the inclusion criteria were approached initially by nurses with an information brochure about the project. Members of the research team visited at a later time to determine if the mother was interested in participating. Mothers subsequently signed a

consent form if willing to participate. Mothers had an infant in the nursery for a minimum of 72 hours (Mean length of stay = 12.74 days), but were interviewed as close to their infant's discharge as feasible.

Recruitment of mothers was conducted over a five month period and recruitment of nurses was conducted over a three month period in each hospital. Overall, forty five percent of eligible mothers agreed to be approached to participate in the study and of these 77% completed a survey. Sixty one percent of eligible nurses completed the survey. Interviews were conducted with mothers and nurses until data saturation was reached.

There were separate semi-structured interview protocols for mothers and nurses that addressed the aims of the broader research project, however both contained questions about mothers' interactions with people in the nursery. Mothers were asked about their experiences in the nursery, including descriptions about who was helpful or difficult. Nurses were asked about how they and other staff were engaging in family centred care, and as a part of this they were probed about how the design had affected mothers' interactions with people in the nursery. All interviews were conducted by psychologists (registered or in-training), who have been trained in clinical and research interviewing, with oversight by a Registered nurse. Individual interviews were conducted in close proximity to the nursery (e.g., in the family room or a quiet area in the café) or within the SCN when confidentiality could be maintained (i.e., a room at back of nursery). Interviews lasted between 20-50 minutes and were audio-recorded.

Mothers' and nurses' perceptions of nurse-parent interactions were measured using the four subscales of the Special Care Nursery: Mothers' Evaluation Tool (SCN: MET) (Fenwick, Kristjanson, Monoterossa & Zuiderduyn, 2003). The SCN: MET is a 30-item tool, which is used to assess mothers' and nurses' perceptions of nursing care (Fenwick et al., 2003). Facilitative nurse behavior was evaluated using the following three sub-scales;

supportive mothering actions (“how often did nurses encourage you to hold and cuddle your baby” and “how often do you as a nurse encourage parents to feed their baby”), facilitative nurse actions (“how often did nurses encourage you to change your baby” and “how often do you as a nurse adequately explain things to mothers”) and facilitative nurse interactions (“how often did nurses listen to your concerns” and “how often do you as a nurse talk to them in an open and honest way”). Cronbach’s alpha coefficients for these sub-scales are .83, .88 and .79 respectively (Fenwick et al., 2003). Inhibitive nursing behavior was measured by items such as “how often did nurses ignore or minimize your concerns” and “how often do you as a nurse not explain what is happening”. Cronbach’s alpha coefficient for inhibitive nursing behavior is .88 (Fenwick et al., 2003). This scale has been used in SCNs in Australian hospitals and has been shown to be a reliable and valid measure of parent and nurse perceptions of nursing behavior (Fenwick, Barclay, & Schmeid, 2008). Mothers and nurses in the current study rated their perceptions of nursing behavior on a seven point Likert scale (1 = not at all and 7 = all of the time).

Analysis

Quantitative data were analyzed using SPSS22. Interviews were professionally transcribed and the accuracy of the transcription checked by the interviewers. Thematic analysis was used to generate the key themes from the participants’ narratives, using Braun and Clarke’s (2006) guidelines and checklist. Interviews from SFR and OB nurseries were analyzed separately. Themes were generated inductively rather than imposed apriori or deductively. This process commenced with sentence by sentence coding for all references to interactions with people in the nursery. Like codes or concepts were then clustered together to form tentative themes. Two of the authors initially coded the interviews to identify themes, with each interview analyzed in its entirety before moving to the next interview. The first

author then recoded the interviews to verify the themes. Regular discussions took place with the co-authors to ensure consistency with regard to coding procedures.

We used Yardley's (2000) guidelines to ensure credibility of the findings. Sensitivity to context was addressed via the researchers' prolonged engagement with the participants and time spent in the nurseries. To ensure rigor we ensured our interview participants were theoretically diverse and our analysis included prevalence, but also the depth and breadth of each theme, including divergence, convergence, representativeness, and variability. Finally, we used multiple coders, with auditing by a different co-author.

Results

Participant characteristics

Mothers. Twenty six mothers in the OB nursery and 40 mothers in the SFR nursery participated in the survey. Twelve and 11 mothers respectively from the two nurseries participated in an interview. Two of the mothers interviewed in the SFR nursery had previously had a preterm infant in the OB nursery.

Nurses. Twenty two nurses in the OB nursery and 29 nurses in the SFR nursery participated in the survey. Seventeen and 10 nurses respectively from the two nurseries participated in an interview.

Tables 1 and 2 contain descriptive information about the participants. There were no significant differences between nurseries in the demographics of either mothers or nurses. There also were no differences for either the survey or the interview in the findings for nurses who participated at both time points and those who only participated at one time point.

INSERT TABLES 1 AND 2 ABOUT HERE

Our analyses compared mothers in the OB nursery with mothers in the SFR nursery, and nurses in the OB nursery with nurses in the SFR nursery for both the survey and the interview

data. In this way we were able to examine the consistency in our findings for the two sets of data.

Survey findings

A series of t-tests were conducted separately for mothers and nurses comparing participants in OB and SFR nurseries' ratings of each of the 4 sub-scales of the SCN:MET. The only significant difference was that mothers in the OB nursery reported that they experienced more supportive mothering actions from nurses than did mothers in the SFR nursery, $t(71) = 2.11, p < .05, d = .49, CI [1.08, .03]$. Mothers perceived that nurses in the OB nursery were encouraging them more to engage in care tasks such as feeding, cuddling, and bathing their baby compared to nurses in the SFR nursery. Means are presented in Table 3, and were high for both mothers and nurses for all facilitative nursing sub-scales and low for the inhibitory nursing behavior sub-scale, although the means suggest that nurses were more positive in their ratings than mothers.

INSERT TABLE 3 ABOUT HERE

Interview findings

The analysis of mothers' and nurses' interviews identified one contextual theme, "My/their room" which encapsulated how SFRs provided mothers with a place like home, which enhanced their sense of control, presence and connection to their infant. Our analysis identified one theme common to both nurseries, *Valuing interaction*. The analysis of mother and nurses interviews in the OB nursery also identified one theme that encapsulated interactions in the OB nursery, *Our nursery community*. Two themes were identified in the SFR nursery. The first was mentioned by both mothers and nurses, *Changing the norms of interaction*. The second was only mentioned by nurses, *Enhanced communication*.

My/their room. Consistent with previous research (Carlson et al, 2006; Carter, et al., 2008; Cone et al., 2010; Stevens et al., 2012) both mothers and nurses described how SFRs

296 provided greater privacy compared to the OB nursery. In contrast, mothers in the OB nursery
 297 spoke frequently about being on display.

298 *Even just having the curtains that you can draw so that as people walk past, um, you*
 299 *know, you still have that privacy, you know, if nurses need to come into the room then,*
 300 *you know, you've still got that available to you (SFR Mother 2)*

301 *It can be a little bit embarrassing when um, when other mothers' visitors come onto the*
 302 *ward.... I mean, I sorta got a hard time, a little bit, when their husbands come in and*
 303 *you're on the breast pump (OB Mother 1)*

304 Mothers in SFR's talked more about having "ownership" and control over the physical space,
 305 the care of their infants, and contact with other people, with SFRs providing a space more
 306 like home. Mothers and nurses described how single rooms allowed parents to personalize
 307 the space to suit their needs.

308 *some mothers actually bring in their own sheets and pillows from home and really*
 309 *make it their own space...I think that's really important, and that is a constant*
 310 *reminder now that they are part of the care. It's just an inclusive environment. (SFR*
 311 *Nurse 4)*

312 The increased ability for mothers (and others) to stay overnight, was also highlighted by
 313 nurses as a clear advantage of SFRs.

314 Both mothers and nurses described SFRs as facilitating more connection between
 315 mothers and their infants, enabling mothers to mother.

316 *the fact that he has his own room and we have our own space and I have my own time*
 317 *to bond with him, even though he's in the hospital still, I feel like we're just not at home*
 318 *but closest as we could get to it, .. I just really like it here, I really love it and it's*
 319 *amazing (SFR Mother 1)*

320 *Because we've got the individual rooms, I think that (SFRs) helps facilitate that rather*
 321 *than someone hovering, or us sorta going "Oh, are we doing this right? ... because*
 322 *they're you know, I guess a little bit physically removed, it allows us to go, "Okay, well*
 323 *we need to take care of this, this is what needs to happen next" and... and we become*
 324 *more independent in, um.. in doing that, rather than sorta saying "Oh okay she's the*
 325 *responsibility of the hospital or the nursing staff" (SFR Mother 2)*

326 *So instead of it being our baby, it's her baby (SFR Nurse 1)*

327 Nurses commented that families appeared more comfortable in the nursery throughout
 328 their infant's admission. Nurses also described how the privacy of the SFR enabled mothers
 329 to be primary caregiver, to "know more and do more".

330 *The fact that parents are there and helping more and they're able to stay more and they*
 331 *feel more independent, they feel like they're doing their thing, it's actually better. You*
 332 *can see them growing, learning and getting more confident and I find that satisfying*
 333 *(SFR Nurse 6)*

334 Mothers were observed to be spending more time with their infants, which meant that
 335 they had the opportunity to attend rounds, be more involved in their baby's care and decision-
 336 making, and be more informed of their baby's health. These factors helped build mothers'
 337 confidence, with nurses describing parents as more prepared at discharge. Single rooms
 338 were also perceived by nurses to facilitate breastfeeding, and skin-to-skin bonding time with
 339 mothers and fathers.

340 *Mums and dads are very much in the loop with what is happening with their baby.*
 341 *(SFR Nurse 2)*

342 *The fact that the mums can stay or even just have somewhere to relax means that they*
 343 *can be in more, which means they have the opportunity to be more involved and be here*
 344 *for the rounds. They can do more skin-to-skin. They can do more breastfeeding. (SFR*
 345 *Nurse 3)*

346 Overall, then, *my/their room* describes how mothers had a place like home, that allowed
 347 increased presence and increased connection to the infant

348 While SFRs enhanced the connection between mothers and their infants, both
 349 mothers and nurses described how SFRs also changed the connection between mothers and
 350 nurses, and mothers and other parents. Mothers' and nurses' descriptions did however differ
 351 in some ways when describing nurse-mother interactions. Our analysis identified one theme
 352 common to both nurseries, *Valuing interaction*. The analysis of mother and nurses interviews
 353 in the OB nursery also identified one theme that encapsulated interactions in the OB nursery,
 354 *Our nursery community*. Two themes were identified in the SFR nursery. The first was

mentioned by both mothers and nurses, *Changing the norms of interaction*. The second was only mentioned by nurses, *Enhanced communication*.

Valuing interaction. Overall, both mothers and nurses in OB and SFR nurseries talked about the importance of interactions between nurses and parents. Consistent with previous research, mothers valued nurses providing information and enabling parenting, especially when done with an appropriate interpersonal style.

They're sources of wisdom and helpfulness. They're here to assist whenever I need anything, even emotional support. You don't feel like you're just a number or another patient (OB Mother 5)

The nurses have been a fantastic, you know, resource and support, and lots of information and very open to, you know, giving advice and receiving feedback, and all of that... I mean, I've seen them probably more than I expected to, and they've always asked if I've had any questions, and happy to repeat things, and explain them, and very approachable. So that's been really good. (SFR mother 1)

Nurses similarly acknowledged the importance of providing mothers with information and emotional support in both the OB and SFR environments.

Keeping the parents involved as much as possible, erm, just making sure that they understand everything that's going on. Making them feel welcome and, like, I like to make sure that the parents still have ownership over their babies. (OB Nurse 12)

Mothers did also make some references to the value of interactions with other staff such as doctors and lactation consultants, but this was infrequent, reinforcing the central role of nursing staff.

While mothers in both OB and SFR nurseries provided some examples of negative interactions with nurses, this was more prevalent in the narratives from mothers in the SFR. Consistent with previous research (Guillaume et al., 2013; Jones et al., 2015) the key areas that mothers spoke about were inconsistent information or a lack of information, and poor interpersonal skills.

Its more so just because you get told... like, you get told one thing by one nurses and then at changeover you get told another thing, and not all nurses are exactly communicating with the parents, as well as communicating properly with each other (SFR Mother 3)

386 **Our nursery community.** This theme was only identified in interviews with mothers
 387 and nurses in the OB nursery. Mothers in the OB nursery talked about the value of having
 388 other nurses and mothers in the rooms. Mothers in the OB nursery valued having multiple
 389 nursing staff in one room, where they could both observe how the different nurses interacted
 390 with infants and the information they shared with parents, as well as seeing nurses working
 391 together as a team.

392 *But um, whereas I mean we were so open in the room, the three of us, um, we didn't*
 393 *mind you know asking questions and then one of the mothers, other mothers, might say*
 394 *"Oh yeah, I had that question as well. I'm glad you asked that" (OB Mother 2)*

395 *I've benefitted from being exposed. People come and go "Try this, do this, do that"...*
 396 *If the nurse you have has her hands full with something all the other nurses come*
 397 *running so it's a really good team environment (OB Mother 6)*

398 Mothers also appreciated the opportunity to observe nurses caring for other infants, which,
 399 unsurprisingly, was not evident in mothers in SFRs' descriptions. In contrast, nurses did not
 400 talk about the value of mothers interacting with multiple nurses.

401 *Yeah things like when they were wrapping, I looked different ways that they were doing*
 402 *it. If I liked it I might say to the nurse oh can you just show me now what you just did*
 403 *(OB Mother 2)*

404 Mothers in the OB nursery also valued highly interactions with other mothers. Such
 405 contact was described as providing opportunities to chat; to interact with people who
 406 understood their experience.

407 *No one else, you know...we're the only ones that sort of know what we go through,*
 408 *and although it's very different for every person, I found it really helpful for me to*
 409 *be able to have that contact with other mothers. (OB mother 3)*

410 Interactions with other mothers also enabled mothers to share information and make
 411 comparisons (both positive and negative) about the progress of their infant.

412 *Sometimes it can be comforting for certain things, so like with expressing you might say*
 413 *"Oh how are you going with expressing? How often are you doing it? (OB Mother 2)*

414 *Or they might say oh well I've started um doing more breastfeeds and you'll think "oh*
 415 *that baby's about the same. Mine's not (breastfeeding)" (OB Mother 2)*

416 Nurses similarly talked about the value of mothers being able to interact with one another.

417 *Having four babies and four mums in the same room for a few days or a week or two*
 418 *weeks...they form really close friendships and keep in touch. (OB Nurse 12)*

419 These descriptions need to be seen against the earlier discussion about the problem of
 420 the lack of privacy in the OB nursery. Often comments about the value of interactions with
 421 other parents were preceded or followed by a description of the problem with the lack of
 422 privacy in the OB nursery.

423 *It was nice because there was three of us, so you had people to chat to. It was nice*
 424 *having three but you have everyone walk past you (OB mother 2)*

425 Mothers and nurses in the SFR environment differed to some extent in their
 426 perceptions of interactions with each other and between mothers. Mothers' accounts were
 427 more negative than nurses about their interactions (or lack thereof) with nurses and
 428 particularly other mothers. One theme was identified for both mothers and nurses, *Changing*
 429 *the norms of interaction*, and one theme was identified for nurses only, *Enhanced*
 430 *interactions*.

431 **Changing the norms of interaction.** The descriptions given by both mothers and
 432 nurses highlighted how SFRs changed the norms for interactions between mothers and
 433 nurses, and mothers and other mothers. This theme could also be called "*Privacy but*" as
 434 many of the participants would juxtapose their descriptions of this theme with "*single rooms*
 435 *are great but...*". A number of mothers in SFRs talked about the difficulties in connecting
 436 with nurses and communicating with nurses, describing nurses as "*sometimes hard to find*".

437 *I think it would be very confronting first time to be in a room on your own, only*
 438 *because like where the girls were they had like six babies per room and there was*
 439 *critical nurses in there at all times, so if you needed anything you could always see*
 440 *somebody. But here it's sort of you've got to yell out or press your buzzer and you*
 441 *don't have that much contact with the nurses. (SFR mother 7)*

442 Nurses similarly described how "*Some mothers don't feel they can ring the buzzer*".

443 However, other mothers adapted to more easily to the SFR environment.

444 *When I need to call one of the nurse I just go around here and call someone or press*
 445 *the little button here so no problems down there. (SFR mother 8)*

446 Nurses also spoke of the challenges of dividing their time between parents in the
 447 nursery, and getting caught up in one room with a baby or parent, and being unable to attend
 448 to families in another room.

449 *One negative of separate rooms is that you can get tied up and find it hard to get out to*
 450 *other parents. It can be hard to break conversation to check up on the other patients*
 451 *(SFR nurse 1).*

452 At times, this led nurses to feel that they had provided inadequate care to parents. *“In some*
 453 *ways you can feel inadequate that you haven’t got around and spent enough time with your*
 454 *parent.”* In particular, nurses perceived that they *“miss opportunistic moments”* to interact
 455 with parents, particularly those who visited the nursery only for a brief while. Whereas nurses
 456 were able to interact with a few mothers at the same time in the OB nursery, SFRs prevented
 457 these efficiencies from occurring.

458 *The parents can get a bit stressed as well with that, I reckon, because they never see the*
 459 *nurses, because they are always in different rooms and if they are trying to find us we’re in*
 460 *another room and they can’t really just come and find us. (SFR Nurse 2)*

461 *The single rooms have been great for the families to have their own space, but at the*
 462 *same time because we’re spending a lot of one-on-one time with one mum other mums*
 463 *might miss out. Whereas, at the old hospital to be in that room and be talking to all four*
 464 *mums at the same time...I do miss that a little bit. But I think it’s more important that*
 465 *they have their own space. (SFR Nurse 12)*

466 Mothers and nurses also spoke about the challenges for mothers in SFR nursery to
 467 connect with other parents, which was in stark contrast to how mothers and nurses talked
 468 about interactions between parents in the OB nursery. They described (negatively) the lack
 469 of interaction between mothers, although nurses talked about this less than did mothers.
 470 Mothers in SFRs talked about being *lonely* and *isolated*, and most mothers clearly desired
 471 more contact with other mothers.

472 *You don’t necessarily speak to the other mums, though, in these single rooms.*
 473 *Everyone’s sort of in dealing with their own stuff. So it is a bit isolating..... I haven’t*
 474 *had a conversation with one other mum in the whole time I’ve been here. Yeah, so if it*
 475 *was longer I might’ve gone a bit crazy. (SFR Mother 4)*

476 *Yeah I think it’d be cool to just talk to other mums and stuff like that. (SFR Mother 6)*

477 At the same time the mothers regarded it as important to respect the privacy of mothers in
 478 other SFRs and it seemed that the norms that would apply to visiting people in their own
 479 home also applied in the nursery.

480 *Yeah I s'pose one of the things I've noticed with having the single rooms is that you're*
 481 *quite separated and because of the privacy side of things, and all of that, I s'pose I*
 482 *don't feel as comfortable just you know walking in to someone else's room and striking*
 483 *up a conversation (SFR Mother 5)*

484 *If I was to walk into a room and try and start a conversation, I reckon maybe some*
 485 *parent might around and think "Oh my god, why is this person coming in here and*
 486 *randomly talking to me?" (SFR Mother 3)*

487 Nurses similarly expressed that although single rooms had many advantages for
 488 families, SFRs also restricted social contact between parents. Nurses acknowledged that other
 489 parents were often a source of support in the nursery, but single rooms afforded limited
 490 opportunities for parents to interact, share information and connect with one another.

491 *Single rooms are great for the mothers and parents although there is less interaction*
 492 *between other mums compared with the old hospital (SFR Nurse 12)*

493 *I do feel parents have more privacy. I feel though that some parents are isolated in*
 494 *their single rooms- especially English as second language parents, young or older*
 495 *parents. (SFR Nurse 6)*

496 **Enhanced interactions.** This theme was identified only in the nurse interviews in the
 497 SFR nursery. Nurses described a number of ways in which SFRs enabled their interactions
 498 with mothers to be more effective. Nurses appreciated that the SFR environment provided a
 499 space for more confidential interactions than the OB nursery.

500 *The single rooms mean you can keep things private. I don't have to worry about*
 501 *when I'm speaking about private things with a mother that another parent or other*
 502 *people just walking through are going to overhear that conversation. (SFR Nurse 2)*

503 Unlike the OB nursery, where nurses were conscious of giving information to parents in
 504 the presence of other parents, nurses felt they were able to communicate more openly
 505 with parents in the single rooms and no longer needed to filter information. The privacy
 506 of SFRs enabled nurses to personalize communication more, which in turn they described as
 507 facilitating more family-centred care.

You can just talk one to one. You used to have your back to two other mums so you were very conscious of the information you were giving...now you can give information and it can be very much family-centered. (SFR Nurse 5)

You can be yourself, you don't have to worry about being overheard (SFR Nurse 5)

They could tailor the information to parents with different skill levels. Nurses thought that SFRs fostered discharge planning by providing a safe environment for parents to ask questions.

Nurses (and to a lesser extent mothers) observed that the whiteboards in the SFRs greatly assisted communication. Nurses were able to leave messages for mothers updating them of their baby's progress, and similarly parents left messages for nurses informing them of what they were doing.

They've got the whiteboards. There is far more communication going on than was ever going on before. (SFR Nurse 2)

Overall, nurses described SFRs as improving the quality of their interactions with mothers, but they perceived that they had fewer face-to-face interactions, particularly those of an informal nature. Alternative communication tools were developing, possibly balancing the perception of less face-to-face communication, and helping to support the nurses' perception that overall the quality of interactions with mothers was improved within SFR's.

Discussion

Our study examined the influence of neonatal nursery design on mothers' interactions in the nursery in a more detailed and nuanced way than has been previously reported. Overall, our findings suggest a range of ways in which the design of the nursery may influence interactions mothers have with nurses and other mothers, repositioning and foregrounding traditional connections and interactions. Consistent with previous research (Jones et al, 2015; Reid et al, 2007; Reis et al, 2010), both our survey and interview findings indicated that mothers (and nurses) were very positive about their interactions in both nursery

types. Key interaction qualities were highlighted in the interview findings, including clear and consistent information, emotional support, and interactions that enable mothers to be able to care for their infants, which also reflect previous research (Cleveland, 2008; Fenwick et al., 2000; Jones et al., 2015; Kowlaski et al., 2006).

There were a number of differences in both mothers' and nurses' accounts and perceptions of nurse-mother interactions in the OB compared to the SFR nursery. Mothers in the OB nursery particularly valued how the OB nursery enabled them to build relationships with multiple nurses. Nurses also described how the OB nursery made it easier for them to interact with multiple mothers at the same time. Mothers reported being able to observe nurses interacting with other mothers and infants. These interactions provided support and enhanced their learning. What is of note here is that it was the capacity to observe that was important, not just the interactions that mothers had with nurses themselves. This is consistent with the findings in Rowe et al.'s (2005) study, where parents of preterm infants talked about parenting by watching what other people do.

Accounts of interactions in the SFR environment revealed a more complex and contrary picture. The SFR, while consistently described as better for mothers and the mother-infant relationship, was also identified as a barrier to mother-nurse interactions. Previous research (see Ortenstrand, 2014) has questioned whether parents would have fewer interactions in a SFR nursery environment. Both mothers and nurses in our study indicated that SFRs made it more difficult for both mothers and nurses to initiate interactions with each other. The norms for initiating contact were different to the OB nursery, and included use of buzzers and whiteboards, which some mothers found challenging. SFRs also reduced the level of chatting or informal communication, which has been identified as important in previous research (Fenwick et al., 2001b).

Nurses perceived that interactions with mothers in SFRs while negatively affected in some ways were enhanced in other ways. They noted that SFRs enhanced the quality of their interactions with mothers, as they were able to adapt their communication to particular mothers, their situations and needs. Tailoring or accommodating communication in such a way (Jones et al., 2007) is more consistent with the philosophy of family-centred care (Griffin, 2006). Yet mothers did not describe these same benefits and, indeed, in their survey responses rated nurses as encouraging them slightly less to engage in care tasks such as feeding, cuddling, and bathing their baby in the SFR compared to mothers' ratings of nurses in the OB nursery. Moreover, mothers were more likely to mention negative interactions with nurses in SFRs than in the OB nursery. It is not clear whether this is because negative interactions were more frequent or the changed context made mothers more aware of these negative interactions. Future research needs to explore more why nurses' and mothers' perceptions differed, as well as whether these differences are consequential.

While the nursery design was associated with differences in nurse-mother interactions, the most notable difference between OB and SFR mothers' descriptions was their descriptions about interactions with other mothers. Both mothers and nurses described SFRs as a barrier to interactions between mothers. Consistent with Sheeran et al (2013) and Pearson and Anderson (2001), such interactions were regarded by mothers in the OB nursery as ones which provided support, normalized their experience, and enabled the development of mothering skills. In providing *my/their room*, the SFR provided both a physical and a social barrier to interactions between mothers. The norms of "visiting" that operate outside the hospital also seemed to apply to SFRs, resulting in mothers initiating less contact and expressing reservations about how such contact would be received. What our study does not address is what are the consequences for mothers and their infants of the reduced contact between mothers, but it was clear that most mothers wanted more contact with other mothers.

Despite acknowledging how SFRs were associated with some challenges for mothers' interactions, both mothers and nurses also described SFRs as providing an environment that promoted privacy, closeness, and a focus on the family unit. Mothers could personalize the space, which Flacking and Dyke (2014) argue fosters a mother's sense of ownership of her infant. Looking at the environment's influence on both maternal-infant closeness and interactions, the findings of the current study indicated both nurse and mother participants perceived that the SFR environment was a positive one for enhancing mothering skills and the mother-infant relationship and, despite some interaction challenges, one which was rated highly for the quality of interactions. These findings raise some important questions. The first question is whether the benefits of SFRs outweigh the interaction challenges in this type of nursery environment. The findings of the current study suggest this to be the case and other research has identified, for example, that SFRs decreased parental role alteration stress and increased breastfeeding (Jones et al., in press). A further question raised by our findings is whether interactions with nurses are less important for mothers in the SFR environment or whether the focus of communication and norms of interaction are being re-shaped in the changed care environment. This is a question for future research to consider.

Our findings have a number of implications for practice. Many hospitals are moving to SFRs. We argue they need to consider strategies to enhance both nurse-mother and mother-mother interactions, particularly informal interactions. Nurses have a key role in socializing mothers to the nursery, including ways for mothers to signal when they want contact with nurses, as well as how to use written communication. Parent support groups may provide a way to increase contact between mothers (although this is challenging if infants are consistently monitored, as occurs in some hospitals).

Limitations

There were a number of limitations to our study. We did not use an identical interview protocol for mothers and nurses, which means comparisons between findings for mothers' and nurses' interviews need to be treated with caution. It is not clear from our study whether strategies to enhance nurse-mother and mother-mother interactions in SFRs will provide further benefits to mothers beyond those that come from a SFR environment, or whether interactions with nurses and other mothers are less important for mothers in this environment. However, future research should investigate appropriate nursing care and communication in the SFR environment, and for which mothers it is needed, to ensure interactions and care are tailed to accommodate specific mothers, infants, families and circumstances. Moreover, there is a need to examine the effects of reduced contact with other mothers, including the loss of opportunities for social comparison, which previous research has found is important for normalizing their experience and easing stress (Sheeran et al., 2013). Finally, in the current study mothers and nurses in the SFR nursery were making extensive use of whiteboards to communicate, raising interesting questions about the role of new technologies to support communication and interaction in nursery environments.

Conclusion

Our study adds to a growing body of literature about the benefits of SFRs for mothers, but at the same time highlights the influence that nursery design may have on mothers' interactions. SFRs changed the norms for interactions between mothers and nurses or other mothers, creating a range of challenges for mothers. Nurses did however identify how the SFR environment could also improve the quality of interactions between mothers and nurses.

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