

IMPACT OF SINGLE FAMILY NICU ROOMS ON FAMILY BEHAVIOR

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Many hospitals are expanding or adding neonatal services, resulting in new construction and experimentation with innovative facility design. One of the most significant innovations has been to provide private single family rooms (SFRs) rather than multi-bed bays. This study examined the interactions between families and staff, families and other families, and families and infants in these two settings. Two Midwestern, Level III neonatal intensive care units were studied in this project. Forty hours of behavioral observation were gathered using pocket PCs preprogrammed with observational software which allowed the observers to record verbal, visual and body behaviors. The primary hypotheses of this study were that: 1) interactions between families in single-family rooms would decrease in the single family room setting relative to the Open Bay setting; 2) interactions between families and staff would decrease in the single-family room settings relative to the Open Bay Setting; and 3) interactions between families and infants would increase in the single family room settings relative to the Open Bay setting. Overall, the data suggested the occurrence of more frequent interactions in Open Bay units, but longer interactions in SFRs. From a design perspective it might be recommended that Open Bay units provide spaces which permit longer encounters between families and other families and staff, and that SFRs provide more spaces that allow for spontaneous encounters with other families and staff, while taking into consideration unnecessarily large distances between rooms.

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Introduction

Patients and families in intensive care hospital settings are extremely vulnerable to the physical environment. Neonatal intensive care settings are particularly significant in their impact due to the frailty of the infants and feelings of loss and fear experienced by their families. While recent design research focuses on patients and staff, the trauma experienced by family members is profound and long-lasting. The purpose of this research study, therefore, is to focus on the impact of neonatal intensive care environments on family members.

A number of medical, demographic, and technological changes have resulted in an increase in the neonatal intensive care unit (NICU) population. Many hospitals are expanding or adding neonatal services, resulting in new construction and experimentation with innovative facility design. One of the most significant innovations has been to provide private single family rooms (SFR) rather than multi-bed bays, and recently some NICUs have moved entirely to a single room design (Bowie, Hall, Fulkner, & Anderson, 2003; White, 2003).

The potential benefits of individual rooms for NICU patients in SFR design are control of light, noise and temperature based on the infant's needs, a decreased risk of infection, and family privacy and ability to stay near the infant (The Advisory Board, 2007). The disadvantages of SFR design may include increased space requirements up to 40 percent, need for extra pieces of equipment, and more distance travelled by staff (Brinkley & Lloyd, 2004).

The increased size of the unit and number of physical barriers may also cause problems in communication between staff and family members. It may necessitate an investment in advanced technology to help communication (Advisory Board, 2007). Communication between staff members is critical; novice nurses learn from interacting with expert nurses and physicians (Carlson, Walsh, Wergin, Schwarzkopf, & Ecklund, 2006). While nurses work as a team, studies show that in some SFR units they may not know who else is on their team (White, 2003). In addition to verbal communication problems, visual barriers in SFR may be problematic for nursing staff and physicians who believe direct observation of critically ill patients at all times is essential. Even with availability of monitoring technology and telemetry of patients' vital parameters, White (2003) reports that nurses prefer to be able to see patients directly.

Considering all the advantages and disadvantages of single bed design, designers have attempted to create environments that benefit both single-bed room and multi-bed room design models. Bowie, Hall, Faulkner and Anderson (2003) reported the three target objectives to guide such design for NICUs as: 1) family-centered design, 2) environmentally sensitive to the needs of the preterm and ill infant (light, noise, etc.), and 3) user friendly workspace for staff.

Brown and Taquino (2001) described a design in which both privacy and visibility needs were equally considered. In this design each room opens onto a central area which locates staff stations, with low desks and counters for maximum visualization. The entrance to patient rooms is a sliding glass door which allows easier access for large equipments. Despite all considerations such designs still have some of the disadvantages of single bed design. For instance, communication between staff in emergency situations requires the use of wireless phones, locator badges, audio stations, staff emergency buttons and alarms (Brown & Taquino, 2001). While new design projects are being implemented, the debate regarding the effectiveness of single-bed versus multi-bed room design persists.

Family Experience

Availability of social support can help parents in their coping efforts (Lau & Morse, 2001), so isolation from staff and other families can create difficulties (White, 2003). Studies show that families who create a network of social support cope better than isolated families (McCubbin & Figley, 1983).

NICU mothers might already be hospital patients, experiencing high blood pressure, analgesia, urinary catheters and the after-effects of anesthesia. Becoming mobile and making a connection with their baby can be challenging (Sim, 2000). Other sources of stress for parents are the way the infant behaves and looks (Bell, 1997), their perception of the severity of the infant's illness (Shields-Poe & Pinelli, 1997); and the infant's pain (Gale, Franck, Kools, & Lynch, 2004). Obtaining information regarding the infant's condition and treatments is another difficulty for parents. They are also dissatisfied with being excluded from medical decision-making and unnecessary barriers to breastfeeding (Harrison, 1993).

The impact of the physical environment on parental stress level is also considerable. Loud sound, unpleasant sights and procedures, and crowds of health care professionals are characteristic of many NICUs (Ward, 2001). Parental perception of the NICU environment is that of a cold, impersonal and highly stressful space (Lamzy, Gomez, & de Carvalho, 1997). Extended hospitalization of extremely low-birth weight infants is particularly stressful for the family, causing distress in other aspects of their lives, such as divorce, or increasing economic concerns (McGrath, 2001).

The primary family relationships in the NICU are between 1) one family and another, 2) families and staff and 3) families and infants.

1. *Family relationships with other NICU families.*

Research shows that mothers feel more confident when they have a sense of community with other mothers or their partners (Nystrom & Axelsson, 2002). Harrison (1993) suggested that access to the experience of other parents of NICU patients may come through parent support networks or videotapes in which experienced parents discuss different treatments and outcomes. Preyde and Ardal (2003) evaluated the benefits of parent-to-parent support for mothers of preterm infants in a NICU. In their study, the mothers in the intervention group were paired with trained mothers who already had a very premature infant in the NICU. Less stress and depression and greater perceived social support were reported in the intervention group. By observing interactions in NICUs, Sim (2000) noted that people often helped mothers overcome their stress when they visibly became distressed. Based on this information, researchers suggest that families should reach out to extended family, friends, and community to benefit from social support (Davis, Logsdon, & Birkmer, 1996).

2. *Family relationships with staff.*

Van Riper (2001) noted that positive and family-centered relationships between mothers of preterm infants and health care providers in the NICU result in more satisfaction with care. Ineffective patterns of communication among staff and parents, on the other hand, are a source of stress for parents of NICU patients (Holditch-Davis & Miles, 2000, Miles, Funk, & Kasper, 1991; Wereszczak, Miles, & Holditch-Davis, 1997; Yu, Jamieson, & Astbury, 1981). Attention should be paid to communication between staff and parents, as well as parents' roles in infant caretaking during hospitalization (Griffin, Wishba, & Kavanaugh, 1998). Healthcare providers can also reduce parental grief by communicating with them and providing adequate care for infants (Holditch-Davis & Miles, 2000). Understanding the infant's physiologic and behavioral cues, which parents can learn from healthcare providers, is another help for parents to cope with stress (Loo, Espinosa, Tyler, & Howard, 2003).

3. *Family relationships with infants.*

Parent-infant interactions can be undermined by stressful experiences in the NICU (Goldberg, 1978). These negative experiences may negatively impact the parenting role (Miles & Holditch-Davis, 1995; Perehudoff, 1990). Mothers of NICU patients sometimes find it difficult to admit the reality of their labor and feel like visitors to the unit. Preterm births, in particular, may delay maternal identity (Reid, 2000). Another barrier for some mothers is accepting other people, nurses and health care providers, as primary caregivers to their baby (Sim, 2000). Supportive NICU environments for parental participation may also have significant benefits on the growth of the infant (Browne & Taquino, 2001), but mothers need the help of nurses to be able to engage with the care of their infant (Heermann, Wilson, & Wilhelm, 2005). Sasidharan, Gokul, Anoop and Vijayakumar (2005) found a decrease in neonatal mortality when mothers were involved in caregiving. Physical separation and being unable to hold, feed or comfort the infant, on the other hand, is harmful to both mother and infant (Bell, 1997). Skin-to-skin care for premature infants in NICUs improves physiologic stability, behavioral organization, and positive attachment relationships. (Brown & Taquino, 2001). The most helpful behavior for mothers to practice their status as their baby's mother is breastfeeding (Sim, 2000). Meier (2001) found that breastfeeding can be promoted with support for mothers to overcome separation and understand infant behaviors and intolerance to feeding.

In summary, it is clear that the interactions between families and staff, families and other families, and families and infants may be impacted by the separation imposed by single-family design. The purpose of this study is to examine these interactions.



Methodology

Sites

Two Midwestern, Level III NICUs were studied in this project, one providing 45 single family rooms in a tertiary medical center, and the other providing 36 beds in a multi-bed, open bay setting in an academic medical center. Staffing ratios in both units are one nurse to two infants, except for infants in the step-down beds, which are staffed at a ratio of one nurse to three or four infants. The average daily census for the single family room unit was 38 for 2006 and 34 for 2007 (YTD), and the average length of stay was 15.7 days. The average daily census in the open bay unit was 25 in 2006 and 2007 (YTD) and the average length of stay was 24.7 days. The research was approved by the Institutional Review Boards of both hospitals.

Methods

Forty hours of behavioral observation were conducted in each facility. The nurse observers were pre-trained for inter-observer reliability. Observations were made simultaneously of one to three patient families. Data was gathered using pocket PCs preprogrammed with Noldus observational software which allowed the observers to record the intended behaviors. The data was then downloaded onto a spreadsheet for the statistical analysis of the results. The Noldus equipment has been used to record communication between patients and physicians (Graugaard, Holgersen, & Finsest, 2004) and to observe parent-infant interactions (Reissland & Stephenson, 1999).

The subjects of the observation in this research were the parents of neonates. The program allowed nurses to observe one to three different subjects at each observational session and record related data separately. The start/stop time of each behavior was recorded. The software could later estimate the durations and do the further basic calculations. The behaviors of subjects programmed into the device fell into the three categories of verbal, visual and body behavior. The subdivisions of each category are as follows:

1. Verbal Behavior:

1.1. Conversation

- a) Conversation with staff: Each time the subject talked to any number of staff
- b) Conversation with family member: Each time the subject talked to any number of people in his/her own family except the infant.
- c) Conversation with family member of other patient: Each time the subject talked to any number of other neonates' family members.
- d) Talking to the infant: Subject speaks or reads to his/her infant.

1.2. Null verbal behavior: Subject stopped speaking or subject making conversation in other circumstances out of the interest of the research.

2. Visual Behavior:

2.1. Observing

- a) Observing staff: Each time the subject observed staff providing care for his/her infant
- b) Observing infant: Whenever the subject observed his/her infant
- c) Observing family member: Whenever the subject was observing his/her own family member except the patient.
- d) Observing other families: Whenever the subject observed a member of another family.

2.2. Seeking

- a) Seek Staff: Whenever a family member is looking for or requests the assistance of any staff member (MD, NNP, RN, RT, SW or Parent Care Coordinator).
- b) Seek family member: Whenever the subject seeks out his/her family member.
- c) Seek other family member: Whenever the subject seeks out a family member of another infant.
- d) Seeking Unknown: It was noted that in single family rooms it was difficult to know when/if a family member is seeking a staff member. To deal with this the observer attempted to determine what the family member was seeking, and when it wasn't clear, recorded it as seeking unknown.

2.3. Null visual behavior: While the subject stopped observing or seeking or had a visual behavior out of the interest of the research it was recorded under null visual behavior.

3. Body Behavior:

3.1. By infant

- a) Sitting/standing by infant: Whenever the subject is seated or standing next to infant's bedside without touching or interacting with infant.
- b) Touching infant: Whenever the subject touches the infant as a caress or for comfort and not to provide care to infant.
- c) Holding infant: Whenever the subject holds the infant, including when feeding the infant.
- d) Care of infant: Infant being fed or cared for by subject.

3.2. Walked out: Whenever the subject left the room to go to eat, have a walk, go to rest room, etc.

3.3. Null body behavior: Whenever the subject stops one of the by infant behaviors or is present in the room but doing something out of the interest of the research.

Hypotheses

The primary hypotheses of this study were that:

1. Interactions between families in single-family rooms (SFR) would decrease in the single family room setting relative to the Open Bay setting
2. Interactions between families and staff would decrease in the single-family room settings (SFR) relative to the Open Bay Setting
3. Interactions between families and infants would increase in the single family room (SFR) settings relative to the Open Bay setting

Results

Family interactions with family members or families of other infants

Hypothesis 1, that there would be significantly more family interactions in the Open Bay setting than the SFR unit was not supported. The data in this study indicated that the mean time spent in conversation between the subject (parent) and parents of other infants was greater in the SFR unit than the Open Bay unit ($p < 0.05$).

Family interactions with staff

Regarding hypothesis 2, no significant difference between the impact of unit types (SFR or Open Bay) on family interactions with staff was demonstrated.

Family interactions with their infants

Hypothesis 3, that families in SFRs would have more interactions with their infants than families in the Open Bay setting was supported for two of the variables. In the SFR, parents spent more time sitting and/or standing by their infant than in the Open Bay unit ($p < 0.05$); also, parents in the SFR spent more time holding their infants than those in the Open Bay unit ($p < 0.05$).

Family interactions with their infants

Hypothesis 3, that families in SFRs would have more interactions with their infants than families in the Open Bay setting was supported for two of the variables. In the SFR, parents spent more time sitting and/or standing by their infant than in the Open Bay unit ($p < 0.05$); also, parents in the SFR spent more time holding their infants than those in the Open Bay unit ($p < 0.05$).

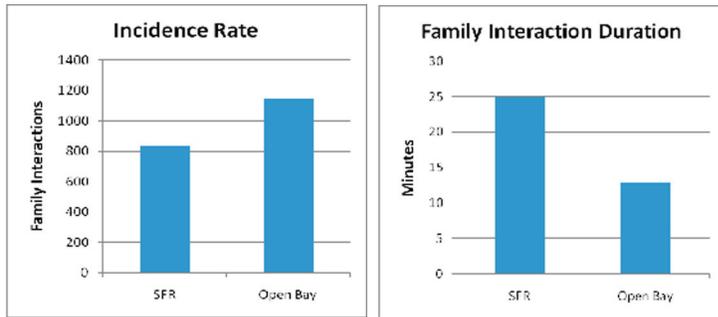


Figure 1. Family interactions defined by number of incidents and the mean of recorded duration.

Incidence and duration of family interactions

Based on the results regarding individual behaviors, we collapsed the data to combine the total number of incidents of family interactions and total time spent in family interactions, both of which proved to show significant differences. Fifty-eight percent of all recorded incidences were in the Open Bay unit, compared to 42 percent in the SFR ($p < 0.05$). However, the story differs when comparing the means of the duration of time spent on these activities. The mean for the SFR unit was 24.98 minutes with a standard deviation of 36.38 minutes. The mean for the Open Bay unit was 12.97 minutes with a standard deviation of 17.67 ($p < 0.05$). The average amount of time spent on recorded incidences was nearly double in the SFR compared to the Open Bay unit. It is important to note that the standard deviation suggests that durations of incidences varied widely in both units.

Discussion and Conclusion

There are potential limitations of this study. First, it is based on experiences at two NICUs of similar size and philosophies, but different staff which may differ in their operational protocols. Secondly, the study addressed the rate of incidents and time of activity based on a limited number of hours (40). The SFR consistently had less number of incidents in almost all activities. The statistical outcome may have been stronger if the same number of incidents were recorded regardless of time required. This would have allowed for a paired samples test design, and the strength of the statistics might have been increased. Another impediment to data collection was the frequent closing of curtains in the SFRs which impeded observation.

The data in this study suggests that the mean time spent in conversation between the subject (parent) and parents of other infants was greater in the SFR unit than the Open Bay unit. However, this number only reflects two recorded incidents in the SFR (with a mean time of 30.65 minutes) as opposed to 9 incidents in the Open Bay unit (with a mean time of 3.35 minutes). While fewer interactions resulted in longer discussions among family members for the SFR unit, the family interactions in the Open Bay unit were more prevalent, but shorter in duration. It is possible that short, frequent encounters are not desirable, as meaningful exchanges do not typically occur in short time frames, whereas the longer conversations between families in the SFR may build a more intimate relationship. On the other hand, this study did not examine parent feelings of inter-parental social support. Therefore, although more time was spent in conversation in the SFR, fewer families benefited from the impact, and overall support may have been diminished. There was no significant difference between the SFR and Open Bay unit in regard to a parent seeking a particular family member of another patient, indicating that social interaction between family members is opportunistic rather than planned. From a design perspective, these results suggest that easily accessible spaces (i.e., location within view of infant) which permit more interactions are desirable in SFR NICUs.

This study did not show significant differences between SFR and Open Bay settings on family interactions with staff. While there were recorded incidents of parents seeking staff, the average amount of time spent on this activity was similar at both study sites. Another activity documented in the study was parental observation of staff with their child. Parents benefit from the confidence that their infant is being monitored and cared for by the NICU staff. While this study showed no significant difference between the SFR and Open Bay setting on family interaction with staff, the time spent in parental observation of staff with their infant was higher in the SFR. As with family to family interaction, the Open Bay setting had a higher number of recorded incidents of parents observing staff with their infant.

Conversations between parents and staff showed the greatest difference between the means, though still not statistically significant. While time spent in conversation was higher in the SFR setting, the difference in the rate of incidents was 42 percent greater in the Open Bay setting. The trend showing a lower rate of incidents with a longer amount of time in the SFR compared to the Open Bay suggest that the Open Bay provides a venue for interaction, but perhaps does not provide other environmental attributes to support extended interaction. Another view may suggest that the level of activity in the Open Bay may give a greater sense of urgency, rather than the less active environment of the SFR.

Parental interaction with their infant encompasses a variety of activities, including sitting and/or standing near the infant, touching, holding, providing care, and conversing with the infant. The literature has shown that the bonding of parents with their premature newborn impacts the welfare of both the infant and the parents. Again, in this set of data, the rate of occurrence was higher in the Open Bay unit compared to the SFR unit. However, only 2 of the 5 activities monitored showed significant difference between the means: the amount of time parents sat and/or stood near their infant and the amount of time parents held their infant was significantly higher in the SFR environment. Another variable, parents conversing with their infant, indicated a trend of parents spending more time with their child in conversation in the SFR unit, with parents in the Open Bay unit showing a higher rate of incidents. A follow up study comparing the relative merits of frequency versus duration of interactions would be useful.

Overall, this data suggests the occurrence of more frequent interactions in Open Bay units, but longer interactions in SFRs. From a design perspective it might be recommended that Open Bay units provide spaces which permit longer encounters between families and other families and staff (e.g. small alcoves with seating that provide privacy for conversation and views of the babies), and that SFRs provide more spaces that allow for spontaneous encounters with other families and staff (e.g. shared spaces between rooms), while taking into consideration unnecessarily large distances between rooms.

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