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The Single Patient Room in the NICU: Maternal and Family Effects

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Abstract

Objective—To explore differences in maternal factors, including visitation and holding, among premature infants cared for in single patient rooms (SPR) compared to open-bay in the neonatal intensive care unit (NICU).

Study Design—Eighty-one premature infants were assigned to a bed space in either the open-bay area or in a SPR upon NICU admission, based on bed space and staffing availability in each area. Parent visitation and holding were tracked through term equivalent, and parents completed a comprehensive questionnaire at discharge to describe maternal health. Additional maternal and medical factors were collected from the medical record. Differences in outcome variables were investigated using linear regression.

Results—No significant differences in gestational age at birth, initial medical severity, hours of intubation, or other factors that could affect the outcome were observed across room type. Significantly more hours of visitation were observed in the first two weeks of life ($p=.02$) and in weeks three and four ($p=.02$) among infants in the SPR. More NICU stress was reported by mothers in the single patient room after controlling for social support ($p=.04$).

Conclusions—Increased parent visitation is an important benefit of the SPR, however, mothers with infants in the SPR reported more stress.

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Introduction

Alterations in the parental role have been reported as one of the most stressful features of being a neonatal intensive care unit (NICU) parent [1]. Many parents report being frightened by the technological environment of the NICU, which can make them feel like outsiders and may delay their parental involvement in caregiving [2]. Subsequently, there is a high incidence of postpartum depression and anxiety among mothers with infants hospitalized in the NICU [3]. Accommodating environments may help facilitate parental involvement and attachment, which in turn can have long-term positive effects on the parent-infant relationship and on maternal health, and can promote infants' developmental outcome [4].

Despite the benefits of the traditional multi-bed open-bay design for nurses, this crowded setup leaves little room for privacy or personalization of space to meet the needs of the infant and the family. One strategy for decreasing stressful stimuli and improving parent-child interactions in the NICU is the use of private or single patient rooms (SPR). The SPR design can provide some protection from the stressful NICU environment and allow a private space for parents and infants to have their first interactions.

The prospective benefits of the SPR design in the NICU have been theoretically appreciated; however, the proven benefits of this emerging design are limited. Recent research has demonstrated increased satisfaction and decreased stress levels among nurses after transition to the single patient room design, as well as reductions in the incidence of sepsis, decreases in length of stay and decreased use of supplemental oxygen [5–8]. Despite the single patient room being assumed to benefit the parents of the premature infant, there are few studies that have investigated the effects of the single patient room on the family.

While most studies investigating the effects of single patient room type focus on staff perceptions and medical factors, there are a few studies that have investigated the effect on the family or mother. Higher rates of breastfeeding at discharge have been documented among infants in the SPR [7]. However, no significant differences in maternal health factors have been observed among mothers with infants in private rooms compared to the traditional NICU set-up [9]. All studies on the use of the SPR are limited by being conducted in separate facilities with differing policies or limited by being conducted before or after a hospital renovation from open-bay to single patient rooms. With only a few current studies investigating the effect of the SPR on maternal health, it remains unclear what benefits the SPR provides for the parents of NICU infants.

The purpose of the present study was to explore the relationship between NICU room type (single patient versus open-bay setup) and parent practices (e.g., hours of visitation, frequency of holding, and whether the infant was provided breast milk at discharge) and maternal health (stress, anxiety, coping style, and depression). It was hypothesized that, with the private environment of the SPR, parents would receive some protection from stress in the NICU and be more likely to visit and hold their infant. It was postulated that there would be additional positive effects of private rooms with lower rates of postpartum depression, less anxiety, less stress and more breastfeeding.

Methods

This investigation was a quasi-experimental study exploring the relationship between NICU room type (SPR versus open-bay setup) and parent visitation, holding, breastfeeding, and maternal health. This study was approved by the Human Research Protection Office of the study site.

Participants

This study was contained within a longitudinal parent study, investigating the developmental progression of infants born prematurely. Consecutive new admissions of infants born less than 30 weeks estimated gestational age (EGA) were recruited over a three-year period. Infants were excluded if they experienced severe respiratory distress or sepsis at birth and were not expected to live, or if the infant had a suspected or confirmed congenital anomaly. Infants were enrolled in the study when their parents gave informed consent. Daily parent visitation and holding were tracked throughout the hospitalization, and whether the infant was receiving breast milk at discharge either by breast or bottle was recorded from the medical chart. At discharge each primary caregiver completed a detailed questionnaire that consisted of standardized assessments of maternal health.

Setting and Room Types

The study setting was a 75-bed Level III NICU housed within a 275-bed freestanding hospital for children. In this NICU, there are 38 traditional open-bay beds available and 36 SPRs. When infants were admitted to the NICU they were assigned a bed space based on availability. Availability was defined as an open bed space and staffing availability resulting from patient discharge, transfer, or death. Anticipated bed space assignment is made each morning by the charge nurse. Each infant is assigned to one of the medical teams/bed spaces, based on having an even distribution of infants across each team, balanced with acuity level, and related to the census on the day of admission. Exceptions to this are when an infant has congenital diaphragmatic hernia and/or may necessitate extracorporeal membrane oxygenation, in which there is a bias for the infant to be assigned to the single patient room, when space and staffing are available. Bed space assignment occurs as standard clinical practice and was not manipulated for the purposes of this study. Once patients were admitted and assigned to a room type, they remained in that type of room throughout their length of stay. Room assignment for infants enrolled in the study occurred independent of research study involvement, gestational age, or medical status.

As both room types are contained within the same NICU, general procedures and policies do not differ between the open bay and SPR. Patient-nurse ratios are similar across room type. Both the open bay area, as well as the single patient room area of the NICU, have 2 private breast pumping areas available for mothers to express breast milk. In both the single patient room area as well as the open-bay area of the NICU, nurses encourage early parent involvement and holding. Parents are encouraged to hold their infant as soon as they are physiologically stable enough to tolerate this interaction. Infants can be held when they are on mechanical ventilation or continuous positive airway pressure, but these interactions are often limited to once per day to prevent the infant from too much energy expenditure.

Although there are instances when holding is encouraged when an infant is on an oscillator, this is not standard practice at the study site. Instead, it is advised to wait until the infant is more medically stable and off of the oscillator before facilitating parent holding.

Single Patient Rooms

Each SPR is approximately 168 square feet and enclosed by three walls. A sliding glass door separates each room from the main hallway and makes up the fourth wall. Cardiovascular monitoring in the SPR is visible through windows adjacent to nursing charting areas as well as through the sliding glass door. When an alarm sounds, a light outside the room blinks, nurses can visually see cardiovascular signs from adjacent rooms on the monitor, and an alarm sounds outside and inside the infant's room. Each SPR contains a bed for the infant, medical equipment, built in closet, a trash can, and a sink. Each SPR has customizable individual lighting with approximately two fluorescent lights above each bed space. These lights can be turned off when they are not needed. Sound from outside the privacy of the room is buffered by the walls. Parents are allowed to visit the infant in the SPR 24 hours a day and are permitted to sleep at the bedside. A lounge as well as storage space is available for parents inside their child's room. Showering facilities, lockers and a lounge with a microwave and refrigerator are available immediately outside the NICU. A cafeteria is located 5 floors below the NICU.

Open-Bay Setup

The open-bay setup is comprised of four large rooms (called A, B, C, and D rooms). Rooms A, B, C, and D are approximately 802, 1295, 1375, and 1000 square feet, respectively. There are approximately eight beds in room A, 12 beds in rooms B and C, and 10 beds in room D. Beds are arranged against a wall with three to four beds on each wall. There is also a central pod, which has space for four beds that are placed diagonal to a central beam housing electrical outlets and monitors. An average space of 75 inches separates each bed. In the open-bay area, there are approximately two fluorescent lights over each bed space; however, there is a central control for all lights so that they are either all turned on or none are turned on. Additionally, general noise from ventilators, monitor alarms, infants crying, and staff activities is not buffered. A lounge or chairs can be pulled to bedside for the parents. Screens can be put up during breastfeeding attempts or when privacy is needed. A small amount of storage space is available under each infant's bed. Parents are permitted to visit 24 hours a day, but parents are not permitted to sleep at their infant's bedside in the open-bay area. However, there are three sleep rooms down the hallway from the open-bay area. When NICU sleep rooms are full, parents can take advantage of sleep rooms on other floors in the hospital. The same lockers, showering facilities, and lounge are utilized for parents with infants in either the single patient room or the open bay design.

Infant and Demographics

Comprehensive medical information was collected for each infant during the hospitalization. This included the number of completed weeks of gestation at birth, the number of days intubated, the presence of brain injury, and initial medical severity. Brain injury was defined as the presence of intraventricular hemorrhage Grade III or IV, cystic periventricular leukomalacia, or cerebellar hemorrhage on either cranial ultrasound or magnetic

resonance imaging. Initial medical severity was determined by the Critical Risk Index for Babies, assessed by a physician in the first 12 hours of life. In addition, the race and socioeconomic status of each infant's primary caregiver was documented. Race was defined as African American or Non-African American. Socioeconomic status was defined as eligibility for public insurance.

Parenting and Maternal Health Variables

A modified version of the Neonatal Infant Stressor Scale [10] was used for all infants enrolled in the study. An easy-to-use single record sheet listed 36 procedures that contribute to infant stress. Parent visitation and holding were added to the form to capture these practices. Nurses tracked the information during each shift and these daily logs were checked against the medical record. In the event of a discrepancy between the nurse's note in the log and the electronic medical record, the higher amount of visitation was used for analyses.

Due to significant differences in visitation and holding patterns at different time periods across the hospitalization, the data was handled and grouped according to specific timeframes. The average number of hours visited per week over the first two weeks of life, the third and fourth weeks, the fifth week through term equivalence, as well as from birth until term equivalence were calculated. Hours of visitation per week from the 5th week until term equivalence, as well the summary score for number of hours per week visited from birth until term equivalence, were averaged over a variable number of weeks, depending on the gestational age at birth of each infant. Infants born at lower gestational ages were averaged over more weeks, while infants born at later gestational age were averaged over fewer weeks. To study holding patterns, the average number of days per week that the infant received either a cuddle hold (defined as holding the clothed infant) or skin-to-skin care (holding the unclothed infant against the parents' bare skin) was calculated over weeks one and two, weeks three and four, week five until term equivalence, as well as from birth until term equivalence. Lastly, the number of days of life of the infant on the first day held was noted.

At discharge from the NICU, each mother or primary caregiver completed a parent-report questionnaire collecting information about family demographics, lifestyle, maternal wellbeing, social support, the child, caregiving experiences, coping strategies, family issues, and professional support. Questions contained within the questionnaire are from standardized assessments placed together with questions of general inquiry. This questionnaire has been used in longitudinal studies of premature infants since 2000 (more information available from the author upon request).

Caregiver anxiety, depression, coping, and stress were measured with the following self-report questionnaires: State Trait Anxiety Inventory (STAI)[11], Edinburgh Post Natal Depression Scale (EPND)[12], Coping Inventory for Stressful Situations (CISS)[13], the parental role alteration subscale of the Parental Stressor Scale: Neonatal Intensive Care Unit (PSS)[14], and the life stress subscale of the Parenting Stress Index (PSI)[15]. In addition, social support was measured with the Social Support Questionnaire (SSQ)[16]. Social

support was assumed to have significant effects on maternal health factors, therefore, this was measured to control for it in the statistical model.

Parent visitation and holding practices were investigated for significant differences between open-bay and single patient room types using multivariate regression, controlling for variables that could affect the outcome, such as race, gestational age at birth, socioeconomic status, days of intubation, brain injury, and initial medical severity [17–19]. For the analyses investigating the amount of infant holding, the amount of parent visitation was controlled to isolate the effect of room type on infant holding independent of the amount of visitation. Finally, differences in maternal health factors, as well as rates of breast milk feedings at discharge, across room type were investigated using multivariate linear regression. Simple and multivariate linear regression were used to investigate differences across outcome using $\alpha=.05$.

Results

Eighty one infants were enrolled in the study. Of these, 48% (n=39) were assigned to open-bay rooms and 52% (n=42) of infants were assigned to single patient rooms. Table 1 contains descriptive statistics of the sample with p-values, investigating the differences in sample characteristics across room type. There were no differences between SPR and open-bay infants for the incidence of brain injury, gestational age at birth, initial medical severity, hours of intubation, presence of sepsis, patent ductus arteriosus, necrotizing enterocolitis, type of insurance, maternal age, or gender.

Table 2 describes the amount of parent visitation, cuddle holding, and skin to skin holding across the length of stay, as well as maternal health characteristics of the sample. There was a lot of variability in visitation, holding, and skin to skin practices, with some parents visiting and holding every day and others rarely present. Approximately 20% of mothers were considered to have postpartum depression, with a score of 13 or more on the EPND. Approximately 42% of mothers had moderate to severe levels of state anxiety, with a score of 40 or greater on the STAI-st.

Parents of infants hospitalized in the SPR demonstrated more hours of visitation over the first two weeks of life, after adjustment for potential confounding factors of gestational age, race, socioeconomic status, maternal age, length of intubation, brain injury, and initial medical severity (Table 2; $p=.021$). Similarly, more hours of visitation over weeks three and four ($p=.017$) were observed and from birth to term equivalence ($p=.047$). No differences in the amount of holding were detected across room type, nor were there differences in when the infant was first held.

After controlling for social support, mothers with infants in the SPR reported more NICU stress ($p=.040$). No other significant associations were detected across room type in maternal depression, anxiety, life stress, coping style, or parenting confidence (table 2).

Twenty seven percent of infants in this sample received breast milk at discharge. There were 26% of infants with breast milk at discharge in the SPR and 30% with breast milk at discharge in the open bay, which did not reach significance ($p=.751$).

Discussion

The results of our study provide new evidence about the effects of the SPR in the NICU on the family. Parents with infants in the SPR design demonstrated more hours of visitation during their infant's NICU stay compared to parents with infants in the open-bay area. Although it was anticipated that there would be more of an effect on maternal mental health, NICU stress appeared slightly increased among mothers with infants in the SPR.

There is a paucity of research on parent visitation and holding practices in the NICU, despite the assumed benefits. This study demonstrated a wide range of parent visitation practices, with some parents visiting an average of one day a week and others visiting every day. These findings support other research describing varied visitation practices in the NICU [20]. However, this naturally-occurring visitation has no comparison to the amount of visitation achieved through the Stockholm Study, in which parents assigned to the single family room (SFR) were required to stay 24 hours a day from admission until discharge [5]. To our knowledge, no facility in the United States requires continuous parent visitation in the NICU, but this would be an important area to research to determine compliance and the effect on the infant and child. Low rates of visitation in the United States may not only be affected by lack of policy, but may also be further complicated by low socioeconomic status and education levels in urban NICUs as well as the lack of automatic governmental support for new mothers, which could potentially enable new mothers to stay with their infants in the NICU without the pressures of needing to return to work immediately.

In addition to visitation policy differences between the current study and the Stockholm Study, the use of private rooms is also very different. The current study uses the SPR from the time of admission, and the infant remains in the assigned room type throughout the length of stay. In contrast, other studies conducted in Sweden and Turkey transition the infant from the traditional open-bay room to the single family room (SFR) during the NICU hospitalization, as the infant becomes medically stable [5, 9]. Determining the optimal timing of room assignment (upon admission or when medically stable) necessitates further investigation. Even after transition of the infant to the SFR when stable, differences between the SFR and the SPR remain. The focus of the SFR is on the family, with a bed for the infant and for the parents as well as private showering facilities for the family. The use of the SPR in the current study is focused on reducing stimuli for the developing premature infant, while providing a private space for the family to engage in the care of the infant. However, the SPR in the current study is focused on the infant, with a lounger for parents to sleep on with shared facilities outside of the NICU to shower. To our knowledge, the feasibility of using the SFR design in the United States has not been explored.

Although NICU design appears to have some effect on the amount of visitation, it is important to further explore factors that may improve the amount of visitation in the NICU, including policy (ranging from public assistance to NICU policy) and social interventions. The SPR design can provide some protection from the stressful NICU environment and allow a private space for parents and infants to have their first interactions, however an increase in reports of stress among mothers with infants in the SPR in this study raises questions on whether the isolation that the private room affords can be protective or harmful.

Links to explore could be how increased time in the NICU contributes to stress, if mothers in the SPR feel isolated and miss the camaraderie of other mothers, or if the SPR promotes an increased feeling of obligation and responsibility for a fragile, vulnerable infant. Finally, research into appropriate social interventions that may ameliorate the effects of stress in the NICU, are warranted.

Erdeve et al investigated the effects of the SFR on maternal health factors but found no statistically significant differences between infants in traditional open-bay care versus infants in the SFR[9]. However, the assessment of maternal health was conducted 3 months after discharge, in comparison to the current study, in which maternal health was assessed at NICU discharge. Assessment of maternal health at discharge in the current study revealed higher levels of stress among mothers with infants in the SPR.

Although increases in parent visitation were observed in infants in the SPR, it was hypothesized that parents would be more likely to hold their infant in the private, intimate space of the SPR. The private SPR provides a different environment to hold the infant, compared to the open-bay area with multiple infant beds and a screen pulled over to the bedside. However, no significant differences in skin to skin holding or in cuddle holding were observed. In the study NICU, parents are encouraged to hold their infants as soon as the infant is physiologically stable, even in the presence of mechanical ventilation and placement of lines. With this practice being standard throughout the unit, this study demonstrated that parents will hold independent of the physical space in which it is to be done. However, this study did not investigate the amount of time the infant was held or the comfort the parent experienced during the holding process, which would be another important area to research.

Room type in the NICU is a modifiable environmental feature that may be implemented as a developmental care intervention to support infant outcome. The current findings suggest that the NICU design can be a powerful tool and that accommodating environments can affect how much time mothers spend with their infants, which can have long-lasting consequences. However, more research is needed.

Although this study shows promise for use of the SPR design as a NICU intervention, some limitations may have affected the results. First, this was not a randomized trial. Although the method of room assignment was done to enable group homogeneity, there could be inherent differences in the groups that were not evident. The small sample size prevented achieving greater power to detect changes in maternal health and holding practices, as well as restricting the ability to investigate specific sociodemographic groups. There are infants in the NICU with different gestational ages, demographic backgrounds, and medical courses. Having a larger sample size would allow better interpretation of findings based on specific groups of parent-infant dyads. Lastly, there was a large amount of variability in nurse charting of parent visitation and holding practices, which may have decreased the accuracy of data and increased error. The double charting method may have helped, but not fully resolved, this issue.

Examining the visitation and holding practices of parents who regularly visit their infant may also further isolate the effect of room type, as the large variability of visitation practices by mothers can make it more difficult to detect changes. In settings such as the one in which this study was conducted wherein half of the NICU beds are open-bay design and the other half are single patient rooms, a randomized clinical trial should be conducted for better generalization of findings and to minimize confounds in the data.

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Table 1

Sample characteristics and differences across room type.

Continuous Baseline Variables	SPR Infants M \pm SD	Open Bay Area Infants M \pm SD	P-Value
EGA at Birth	26.81 \pm 1.824	26.31 \pm 1.908	0.23
Maternal Age	27.86 \pm 6.881	28.44 \pm 8.611	.738
CRIB Score	3.24 \pm 3.267	4.82 \pm 3.879	.099
Continuous Acquired Variables	Mean \pm Standard Deviation (SPR Infants)	Mean \pm Standard Deviation (Open Bay Area Infants)	P-Value
Length of Stay	88.12 \pm 33.375	92.69 \pm 29.667	.518
Intubation Hours	365.17 \pm 856.291	346.37 \pm 491.233	.905
CPAP Hours	171.43 \pm 241.085	171.49 \pm 297.978	.999
Total Oxygen Hours	1496.19 \pm 1039.931	1631.631 \pm 974.673	.551
Categorical Baseline Variables	Single Patient Room Infants (%)	Open Bay Area Infants (%)	P-Value
Public Insurance	.20	.41	.087
Married	.38	.33	.655
Caucasian Race	.55	.41	.216
Male Gender	.55	.44	.315
Categorical Acquired Variables	Single Patient Room Infants %	Open Bay Area Infants %	P-Value
Sepsis	.21	.39	.201
Use of Steroids	.24	.39	.280
Brain Injury	.39	.41	.482

Table 2

Differences in visitation, holding and maternal health across room type.

Cuddling, Visitation, and Skin to Skin Factors	SPR Infants M \pm SD	Open Bay Area Infants M \pm SD	P-Value
Average Hours Visited Per Week (Week 1–2)	32.664 \pm 38.3663	19.232 \pm 11.6601	.039/.021*
Average Hours Visited Per Week (Week 3–4)	27.11 \pm 31.268	14.97 \pm 11.878	.026/.017*
Average Hours Visited Per Week (5 to Term)	23.0629 \pm 23.13628	17.0137 \pm 17.75103	0.193
Average Hours Visited Per Week (Over LOS)	25.4914 \pm 25.41355	16.8546 \pm 13.46834	.062/.047*
First Hold (Days)	9.60 \pm 13.158	11.05 \pm 11.060	0.593
Average Days Cuddled Per Week (Week 1–2)	1.646 \pm 1.6250	1.554 \pm 1.7472	0.810
Average Days Cuddled Per Week (Week 3–4)	2.005 \pm 1.7891	2.244 \pm 1.7125	0.542
Average Days Cuddled Per Week (Week 5 until Term)	3.0231 \pm 1.78850	2.8209 \pm 1.57908	0.592
Average Days Cuddled Per Week (Over the LOS)	2.3245 \pm 1.53069	2.2563 \pm 1.41300	0.361
Average Days Held Skin to Skin Per Week (Week 1–2)	.845 \pm 1.1125	1.038 \pm 1.4206	0.496
Average Days Held Skin to Skin Per Week (Week 3–4)	.87 \pm 1.335	1.36 \pm 1.400	0.111
Average Days Held Skin to Skin Per Week (Week 5 until Term)	.8032 \pm 1.34760	.6275 \pm .84921	0.489
Average Days Held Skin to Skin Per Week (Over LOS)	.7199 \pm 1.05619	.6911 \pm .81672	0.360
Maternal Health Factors	SPR Infants M \pm SD	Open Bay Area Infants M \pm SD	P-Value
Depression (EPND)	7.08 \pm 5.11	3.30 \pm 3.13	0.512
Trait Anxiety (STAL-tr)	37.36 \pm 11.63	31.50 \pm 5.21	0.152
State Anxiety (STAL-st)	48.62 \pm 16.31	59.80 \pm 16.48	0.830
NICU Stress (PSS)	3.21 \pm 1.21	2.58 \pm .91	.183/.040**
Life Stress (PSI)	3.21 \pm 2.19	1.67 \pm 1.32	0.071
Avoidance Coping (CISS)	40.42 \pm 12.89	44.10 \pm 15.73	0.603
Emotion Oriented Coping (CISS)	31.50 \pm 14.29	27.60 \pm 5.60	0.967
Task Oriented Coping (CISS)	51.25 \pm 16.00	54.2 \pm 18.10	0.506
Social Support (SSQ)	4.90 \pm 3.15	4.80 \pm 2.76	0.951

* p-value investigating differences across room type while controlling for gestational age, length of intubation, medical severity, brain injury, socioeconomic status, maternal age, and social support.

** p-value after controlling for social support