

Nurses' Interaction in Two Midwest Single-Patient Room Designed  
Neonatal Intensive Care Units

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## Abstract

This study sought to understand nurses' interactions with one another in two small-sized single-patient room (SPR) designed neonatal intensive care units (NICU). Data gathered from ten nurse participants at two Midwest hospitals gave insight into what designed features enhance or inhibit nurse interaction. Rashid's (2009) theoretical framework linking hospital clinician's face-to-face interaction, based on patient type, framed the data collection and analysis, and several collective findings were uncovered. The majority of nurse participants expressed concern about their decreased visibility of one another. Participants noted the increased need for trust of one another, and awareness throughout the unit. Participants also expressed new patient safety concerns as a result of over-reliance on technology, including infection control and miscommunication. Practical implications for these findings suggest including nursing staff in the design process. Interior designers must incorporate designed features that allow nursing staff to visually monitor patients, while simultaneously having clear visibility of one another.

*Keywords:* Interior design, neonatal intensive care unit, single-patient room, nursing, nurses' interaction, face-to-face communication

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## **Chapter One: Introduction**

### **1.1 Introduction**

The Neonatal Intensive Care Unit (NICU) is a dynamic hospital unit, taking into account the needs of high complexity and high acuity infants, their families and staff. Appropriate design of the built environment, along with organizational culture, can directly affect patient and staff safety on the unit (Joseph, 2006). Perhaps nowhere else is it more critical to consider an evidence-based design (EBD) approach to enhance patient and staff safety, than in the NICU (Bosch, et al., 2012), where vulnerable infants and their families spend time during their hospital visit. White (2012) states, “A case can be made that no other part of the hospital is providing an optimal physical environment more important than the NICU, because nowhere else will the adverse effects of noxious physical elements have more profound effects than there” (p. 3).

Of all the research topics surrounding NICU design, the impact of single-patient rooms (SPR) is the most common (Shepley, 2014). Presently, NICU design is experiencing a shift from open bay to SPR's. Generally speaking, families are more satisfied in SPR designed NICU settings (Shepley, 2014), and advanced practitioners report higher satisfaction, but a 2013 study showed nurses did not (Swanson, Peters & Lee, 2013). Swanson, Peters & Lee (2013) suggest lower nurse satisfaction scores may be due to decreased interaction with peers, and decreased face-to-face interaction. Interaction between nurses is critical in delivering safe patient care, as effective communication is now recognized as being at the heart of patient safety (Hor et al., 2014). However,

evidence still remains ambiguous as to whether we can design environments to maximize communication effectiveness.

The goal of this phenomenological study is to fill a gap in research on nurses' face-to-face interaction with one another in SPR designed NICUs. Currently, literature surrounding the transition to SPR designed NICU is exploratory, and researchers have encouraged more in-depth, narrow studies on the phenomenon (Harris et al., 2006). Contributing to this evidence-based design body of knowledge (BoK) will help guide healthcare design to improve user's health, safety and welfare, enhance sustainability and reduce waste (Berry et al., 2004).

## **1.2 Problem Statement**

Research indicates a general overall satisfaction in SPR designed hospital units, with patients and families enjoying more privacy, better sleep, and lower spread of infection (Ulrich et al., 2008). However, nurse satisfaction varies in terms of improving teamwork and social support, leaving some nurses struggling with the outcome of isolation from other team members, and decreased face-to-face interaction. Hence, despite being an overall improvement in patient experience, there is still a lack of knowledge surrounding how the physical environment contributes to nurses' face-to-face interaction with one another in SPR designed units. The NICU is of particular interest, as high complexity/high-acuity newborns and their families depend on safe and efficient care delivery, arguable more than other units within the hospital.

### **1.3 Purpose and Research Questions**

The purpose of this phenomenological study was to explore nurses' face-to-face interaction with one another in two SPR designed NICUs. It is anticipated that a deeper understanding of nurses' interaction with one another will contribute to the design BoK, and inform future design of SPR designed NICUs. To overview the problem, the following research questions were addressed:

1. How do nurses' interactions within the built environment contribute to overall communication of information in single-patient room designed neonatal intensive care units, and what does this mean for interior designers?
2. How are nurses' face-to-face interaction patterns affected by the shift to single-patient room designed neonatal intensive care units?
3. What designed features do nurses perceive to enhance and/or inhibit face-to-face interaction in single-patient room designed neonatal intensive care units?

### **1.4 Research Approach**

This phenomenological study explored nurses' face-to-face interaction in two small-sized SPR designed NICUs. The NICU was purposefully selected as a study site, based on Rashid's (2009) theoretical model linking at-risk patient type and face-to-face clinician interaction needs (Figures 1 and 2). Additionally, this study analyzed the interaction patterns of one community of practice (CoP), which consists of a group of providers who share a particular knowledge, such as a NICU nurse. With the approval of the University of Minnesota's Institutional

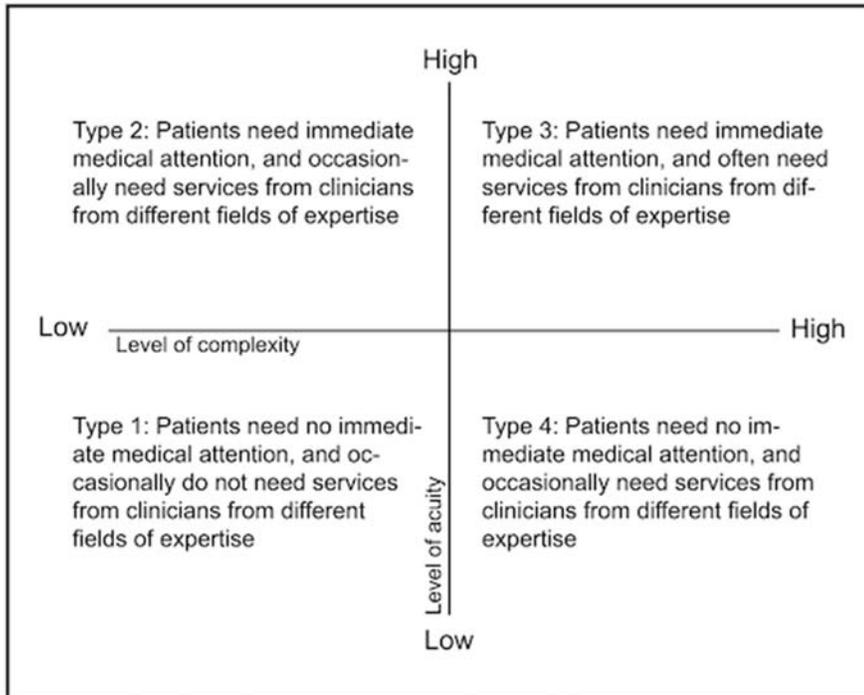


Figure 1. Defining at-risk patients (Rashid, 2009, p.67)

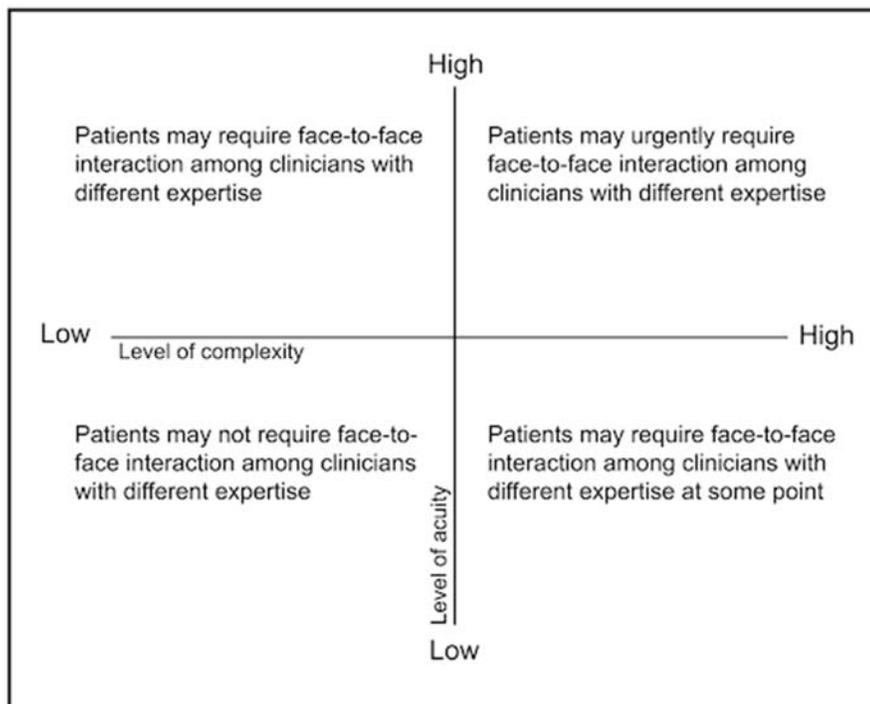


Figure 2. Defining patient interaction needs (Rashid, 2009, p.68)

Review Board (IRB) (study number 1411E56781), and the additional approval of two criteria-based hospitals IRBs, the experience and perceptions of ten NICU nurses were studied. The two NICUs selected met the study inclusion criteria as they had undergone remodel or renovation, and staff had moved into the new SPR designed units between twelve and eighteen months prior from the time of interview, allowing time for staff to adjust to the restructure changes. Participating nurses also had to meet the study inclusion criteria and have a minimum of five years of experience as a nurse, as well as a minimum of six months experience in the old NICU prior to the move into the new unit.

Following the methodological approach of Hua et al. (2012), in-depth interviews were conducted following the move into the new NICU. Interviews were used to obtain a deeper understanding of nurses' perception of the relationship between the built environment, nurse teamwork and communication patterns. In addition, unstructured observations of the unit took place with several NICU nurses, as five participant interviews were required to be conducted on staff time at one hospital setting. Using Bloomberg and Volpe's (2013) data analysis approach, responses to the interview questions were transcribed verbatim and reviewed, identifying six collective themes across the two small-sized Midwest NICUs.

### **1.5 Researcher Assumptions and Biases**

Based on the researcher's relationship to several nurses, and having taken coursework in the University of Minnesota's School of Nursing, a few assumptions were made regarding this thesis study. First, transitioning into SPR

designed units is difficult, and there is a lot of pre-move anxiety surrounding the transition and the changing care delivery model. But it was assumed that nursing staff has the patient's best interest in mind, and that they adapt and change the behavioral environment to provide the best care feasibly possible. Second, upon conducting a pilot-study of four nurses' experience of moving into a NICU nine months following restructure (previous coursework assignment), the researcher interpreted that information sharing on that unit was still a work in progress. However, data collection of the pilot-study did not ask particular questions on the topic of staff communication. Third, it is imperative to note biases of the researcher in favoring the nurses voice in the design process, as they are the largest group of healthcare providers, and work closely with patients and families. Some nurses feel their voices are not heard in the design process; nurses interested in the design process have established the Nursing Institute for Healthcare Design (NIHD). The non-profit arose from the lack of inclusion of nursing staff and healthcare providers in the design process, and the desire to educate all those interested in the design, planning and construction of new and renovated healthcare facilities. Interior designers have the opportunity and responsibility to ensure that healthcare environments are suitable and satisfactory for all users, including the providers.

## **1.6 Rationale and Significance**

The NICU is undergoing change across many hospitals, transitioning from open-bay (or ward-style) patient rooms to SPRs. Evaluating the interaction patterns amongst nursing staff in this setting is of particular interest, as they

currently represent the largest stakeholder group in the healthcare system (Porter O'Grady & Malloch, 2011). Nurses have had to shift the ways in which they interact with the environments; however, no significant research has been documented on this phenomenon. In fact, very little research is documented on how clinicians in general communicate with each other (Coirra, 2000). This is surprising, since the literature consistently cites communication as a critical component for improving quality of care (Becker, 2007b).

Changes to the physical environment should also fit with the rest of the larger system of patient care, such as nurse communication with one another (Gurses & Carayon, 2007). Blythe, Baumann and Giovannetti (2001) note that much research following restructure focuses on the nurse as an individual, such as satisfaction and productivity, but considerably less attention has been paid to the effects on internal relationships and workflow that restructuring brings. In order to design healthcare spaces that support effective staff interactions, we must first understand clinician needs and how staff communicates and interacts with one another; this is a crucial piece of the patient-safety puzzle, as many hospital mishaps have been linked to miscommunication (Coirra, 2000).

The rationale for the setting of this study comes through Rashid's position that "face-to-face interaction, because it is a rich communication channel, may be more appropriate for high-acuity, high-complexity patients because it provides more opportunities to resolve ambiguous and difficult problems in a limited time span" (2009, p. 81). According to Rashid's model, NICU patients (Type 3: high complexity and high acuity) require immediate medical attention, and may

urgently require face-to-face interaction amongst clinicians (see Figures 1 and 2). However, as stated above, evidence remains vague as to whether we can design NICUs that maximize communication effectiveness among nurses.

Lastly, according to Atencio, Cohen & Gorenberg (2003), the social climate of a workplace is a main factor of a nurse's intent to stay or leave. Working in the NICU is often suggested to highly stressful (Shepley, 2014), and studies show those who felt a sense of cooperation between staff experienced lower stress in difficult times (Rafferty et. al., 2001). Rafferty et al. also found that nurses who perceived a higher level of teamwork were much more satisfied at work, and planned to stay. Staff satisfaction is essential to retain staff, and nurse burnout rates are of concern in the United States, leading to challenges ranging from inadequate and poor quality patient care to increased costs for hiring, training and overtime (Atencio, Cohen, & Gorenberg, 2003; Atkins, Marshal, & Javalgi, 1996; Corley, Minick, Elswick, & Jacobs, 2005; VHA's Center for Research and Innovation, 2002). Not only is it costly to terminate, recruit and train staff --approximately \$64,000 for a critical care nurse (Abbasi & Hollman, 2000; Pendry, 2007)--, short staffing affects the social climate of the unit.

### **1.7 Definitions of Terminology**

1. Body of Knowledge (BoK): the complete set of concepts, terms and activities that make up a professional domain, as defined by the relevant learned society or professional association
2. Community of Interest (CoI): consists of [hospital providers] from different knowledge and/or practice domains to perform a specific task (Rashid, 2009); commonly known in the medical community as interprofessional collaboration

3. Community of Practice (CoP): consists of [hospital] providers who work in a particular knowledge or practice domain and who perform similar work (Wenger, 1998)
4. Evidence Based Design (EBD): a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project (Hamilton & Watkins, 2009, as cited in Hamilton, 2010)
5. Family-Centered Care (FCC): An approach to the planning, delivery, and evaluation of healthcare that is based upon a partnership between healthcare professionals and families of patients (Griffin, 2006)
6. Family Integrated Care (FIC): Similar to family-centered care, with the addition of creating a setting and protocols where parents provide the majority of the care for their infants, while being taught by nurses (O'Brien et al., 2013, as cited in Shepley 2014)
7. Neonatal Intensive Care: care for medically unstable or critically ill newborns, requiring constant nursing, complicated surgical procedures, continual respiratory support or other intensive interventions (White, Smith and Shepley, 2013)
8. Patient-Centered Care (PCC)- The Institute of Medicine defines PCC as “a partnership among practitioners, patients, and their families (when appropriate) to ensure that decisions respect patient’s wants, needs, and preferences and that patients have the education and support they need to make decisions and participate in their own care” (Robinson et al., 2008)
9. Enteral: Within or by way of the intestine, as distinguished from parenteral (medical-dictionary.com)

## **Chapter Two: Literature Review**

### **2.1 Introduction**

The purpose of this phenomenological study was to explore nurses' face-to-face interaction with one another in two SPR designed NICUs. In order to carry out the study, it was critical that an extensive review of the current literature surrounding this topic be explored. The literature review was carried out in the early stages of research design, throughout data collection, data analysis, and synthesis phases of the study. Topics explored through the literature review include patient centered care and its influence on the designed environment, the evolution of the modern NICU, the impact of nursing support space design, the role of communication in healthcare settings, and theory used to study the work environments of nursing staff.

### **2.2 Patient Centered Design and Physical Environment**

According to Rosenburg (1995), economic, professional, demographic and technological forces tend to shift the trends in hospital design. Today, these shifts have driven healthcare designers to focus on patient-experience, involving the acute attention to comfort and service amenities (as cited in Bromley, 2012). The growing BoK for EBD has validated many design-related best practices for improved patient experience, such as nature views in patient rooms (Ulrich, 1984), the single patient room (Ulrich et al., 2004), and providing adequate family space in the patient room (Kovacs Silvis, 2014); all of these design choices support current hospital trends of patient and family-centered care models.

It could be argued that patient-centeredness is a good thing in theory, as

patient-centered design is linked to improving patient outcomes (IOM, 2001). As early as the 19<sup>th</sup> century, Florence Nightingale (1863) conducted studies linking the physical environment attributes to patient outcomes. Although patient-centered care (PCC) is largely a product of organizational culture (France et al., 2005), physical aspects such as single patient rooms, lighting, sanitary conditions and patient views have all been found to reduce length of stay (Ulrich et al., 2004), and improve patient experience. From the provider side, patient-centeredness has influenced the development of decentralization of unit support and patient care services, and workflow needs have been redefined from the PCC model (Redman and Jones, 1998). However, there is a paucity of research studies on how providers are experiencing these changes in hospital design.

Bromley (2012) identified a recent shift to consumerism in the healthcare field, and this has raised concern from anthropologists and sociologists. Hospitals now employ a business culture and marketing strategy around patient-centeredness, defining their services as a product rather than “providers of essential services to a community” (Bromley, 2012, p. 1059). Mikesell and Bromley (2012) note that some hospitals have expressed discomfort with the suggestions that PCC might have any negative impact whatsoever. This statement very closely aligns with the researcher’s previous pilot-study findings; although many nurses stressed that the single patient room designed unit may be difficult for them, in the end, the focus should be on the patient, and they adapted to do their job as best as possible. This suggests that hospitals and staff may be reluctant to implement anything but a PCC model, but administrators and

designers must strive for balance of both patient-centered and provider-centered in the design process (France et al., 2005).

### **2.3 Evolution of the modern NICU**

The need for pediatric specific services arose from the specialized needs of children. The NICU is one of nineteen pediatric subspecialties, overlapping with subspecialties such as development/behavior, and critical care (Figure 3). It provides care to all newborns whose health status is of concern, but almost half of NICU babies are premature (March of Dimes, 2011). In 2009, there were approximately 1500 NICUs with 20,000 NICU beds serving the United States (Society of Critical Care Medicine, 2012).

The core notion for critical care developed from Florence Nightingale's suggestion to locate the sickest of patients closest to points of supervision, and connected very closely with the development of anesthesia science and x-ray development (Shepley, 2014). Shepley also notes that the first contemporary intensive care unit (ICU) was developed based on the understanding that the source of the disease was less relevant than the success of the treatment, in response to common symptoms. The first United States ICU was most likely opened in 1955 at Dartmouth-Hitchcock Medical Center, followed by Johns Hopkins Bayview Medical Center in 1958, and Baylor Hospital in 1960. ICUs were developed under the need to provide specialized care with equipment and staff dedicated to a higher level of care and supervision than other hospital units.

Academic Generalist	Adolescent Medicine	Allergy/Immunology
Cardiology	Child Abuse	Child/Adoles. psychiatry
Critical Care	Dermatology	Developmental/Behavioral
Emergency medicine	Endocrinology	Gastroenterology
Hematology/Oncology	Infectious diseases	Neonatology
Nephrology	Neurology	Pulmonary medicine
	Rheumatology	

*Figure 3. Pediatric subspecialties (adapted from CoPS, 2013).*

The development of the pediatric ICU and neonatal ICU followed shortly after the opening of ICUs across the United States; Yale-New Haven Hospital opened the first NICU in October 1960 (Shepley, 2014). Surprisingly, the early adoption of the 1960's NICU actually spawned negative response from the medical community, as they were fearful of infection spread between pre-mature and full term infants; over time, research showed no increase of infection spread from locating pre-mature and full-term infants in the NICU (Shepley, 2014).

Current and early design of the NICU centers on the isolette, or the baby incubator. In 1960, the primary focus of the NICU was to provide life-saving support, however, very little resources were dedicated to enhancing the physical space as a nurturing environment. Many NICUs were actually using adult equipment due to a lack of established care techniques. In 1964, a generous donation allowed for the planning of an upgraded NICU at Yale-New Haven Hospital. Changes included locating medical equipment in the ceiling for

additional floor space, creating decentralized supply areas on the unit, and individualized monitors, infusion equipment, ventilation equipment and storage for patients (Shepley, 2014). Still, no radical shift has been as dramatic as the increase of single-patient rooms in the NICU.

### **2.3.1 Levels of Care**

Including information on the Levels of Care is significant to this research study, as hospital sites sharing the same level of care were chosen. According to *The Recommended Standards for newborn ICU design, eighth edition*, “No consensus national standard of what constitutes a NICU exists...some states have defined levels of care, whereas other states have informal or no classification at all” (White, Smith & Shepley, 2013, p. S5). The American Academy of Pediatrics (AAP) defines NICU care in four levels, and the levels are created with four objectives: a basis for comparison of health outcomes, resource use, and health care costs; standardized nomenclature for public health; uniform definitions for pediatricians and other health care professionals providing neonatal care; and a foundation for consistent standards of service by institutions, state health departments, and state, regional, and national organizations focused on the improvement of perinatal care (CoFN, 2012, p. 587). A timeline of events in the history of neonatal care, and the most recent 2012 levels of care, can be seen in Figure 4 and Table 1.

### **2.3.2 NICU Configurations**

*The Recommended Standards for newborn ICU design, eighth edition* presents recommended standards for the physical environment specific to NICU

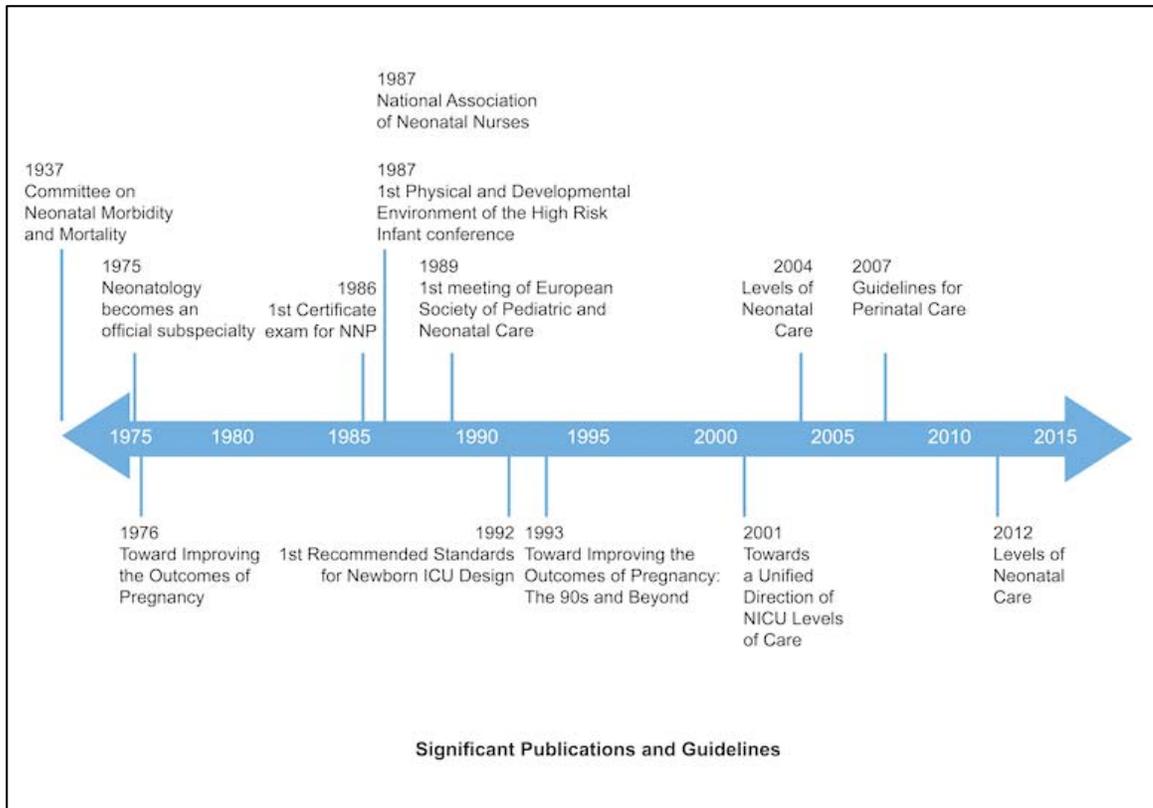


Figure 4. Significant Publications and Guidelines of the NICU (Shepley, 2014 p. 42).

design. *Standard 1: Unit Configuration* suggests that the design of the NICU be “driven by systematically developed program goals and objectives that define the purpose of the unit, service provision, space utilization, projected bed space demand, staffing requirements, and other basic information related to the mission of the unit” (White, Smith and Shepley, 2013, p. S6). Historically, NICUs were configured as multiple multi-basinet rooms, and phased into open-bay units in the 1960’s due to the emergence of Staphylococcus infections (Walsh, McCullough, and White, 2006). Open-bay units include a central open area with four-to-six infant isolettes in close proximity to one another (eight feet), with no fixed partitions in between (Shepley, Harris, & White, 2008; Smith, Schoenbeck, &

Table 1  
NICU Levels of Care

Level	2001	2004	2012
I	<i>Basic Neonatal Care:</i> well-newborn nursery, resuscitation, stabilization prior to specialty transfer	<i>Well-Newborn Nursery:</i> resuscitation at all deliveries, postnatal care for healthy newborns, stabilize ill infants and those born < 35 weeks until transfer	see 2004 Level I
II	<i>Specialty Neonatal Care:</i> specialty care nursery, care of infants > 1500g, resuscitation, stabilization prior to ICU transfer	<i>Specialty Care Nursery:</i> A- resuscitate and stabilize newborns before transfer to NICU, stabilize ill infants and those born >32 weeks and >1500g B- Same as level A plus ventilation for <24 hours	2004 Level I <i>capabilities plus:</i> Stabilize infants <32 weeks gestation and <1500g until transfer to NICU
III	<i>Subspecialty Neonatal Care:</i> A- Restrict ventilation B- No major surgery or restriction of ventilation C- Major surgery on site D- Major surgery: bypass	<i>Subspecialty Neonatal Care:</i> A- Care for infants < 28 weeks and < 1000g, life support, and minor surgery B- Same as level A plus advanced respirator support, imaging, and pediatric surgical team close by C- Same as level B plus surgical repair of cardiac malformations	2004 Level II <i>capabilities plus:</i> Provision of sustained life support, comprehensive care for infants <32 weeks gestation and <1500g, and all critically ill infants; pediatric medical and surgical specialists close, as well as anesthesiologists and ophthalmologists close by
IV	n/a	n/a	<i>Level III capabilities plus:</i> Surgical repair of complex congenial cardiac malformations or acquired conditions, maintain a complete range of pediatric medical, surgical and anesthesiologist specialists on site, and facilitate transport and outreach programs

Note. Adapted from Shepley, 2014, p. 43-47.

Clayton, 2009); some units used curtains to separate the space for family privacy. This configuration is desirable for nurses in the sense that staff is able to monitor several patients at once, and communicate more freely with one another; however, this configuration lacks privacy for patients and families, and inflexibility in individualized control of sound and light for young patients. The 1970's and 1980's brought about a shift, and parent involvement in patient care became more popular. This led to pod/cluster designed rooms and divided bed spaces open on one side, and finally to the single-patient room design for neonates and their families (Shahheidari & Homer, 2012).

Based on a study of ninety NICUs throughout the United States, the Netherlands, Europe and Canada, four common NICU configurations were found to be most prevalent (Shepley, 2014):

1. Loop with core design- patient rooms are located on the perimeter, with central hallways running in the shape of a racetrack; support storage spaces are located in the center of the racetrack (Figure 5)
2. L-shaped corridor design- patient rooms are located on the perimeter, with an L-shaped hallway creating access to patient rooms (Figure 6)
3. Open-bay design- multiple isolates are located in open space, with decentralized nursing stations around the perimeter of the space (Figure 7)
4. Pod/cluster design- patient rooms are clustered in several "pods," with a small central nursing station within each pod (Figure 8)

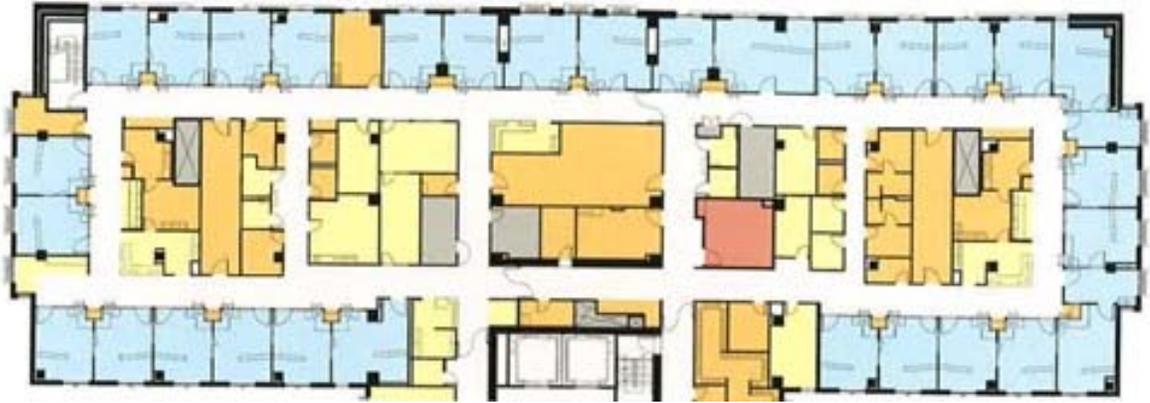


Figure 5. Loop with core design floor plan (Source: Shepley, 2014, p. 99)



Figure 6. L-Shaped corridor design floor plan (Source: Shepley, 2014, p. 99)

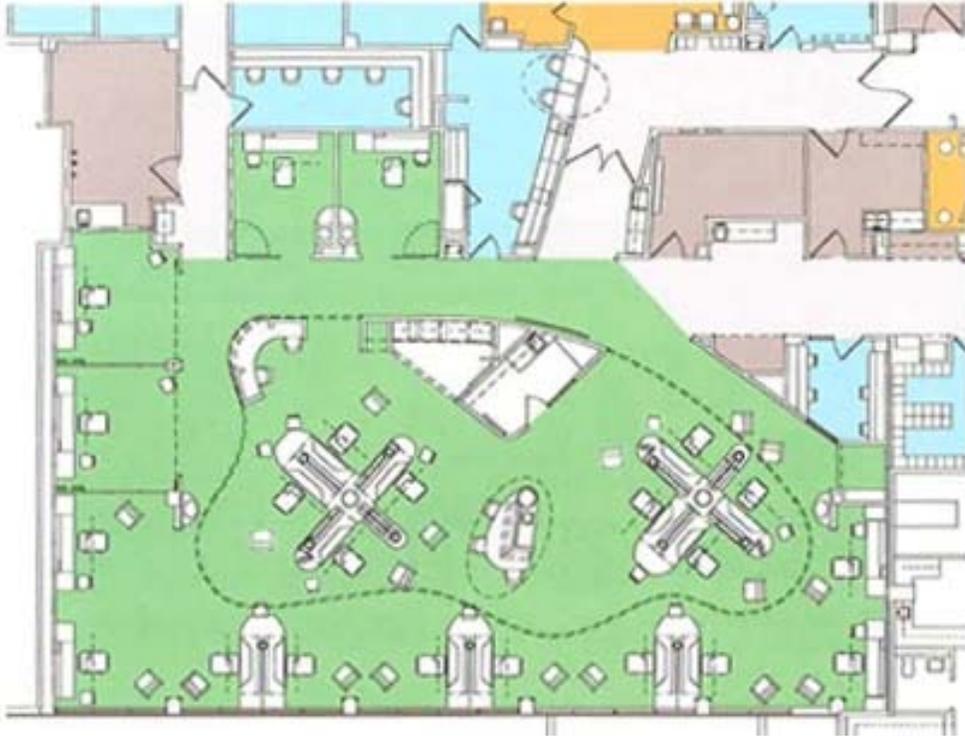


Figure 7. Open-Bay design floor plan (Source: Shepley, 2014, p. 100)

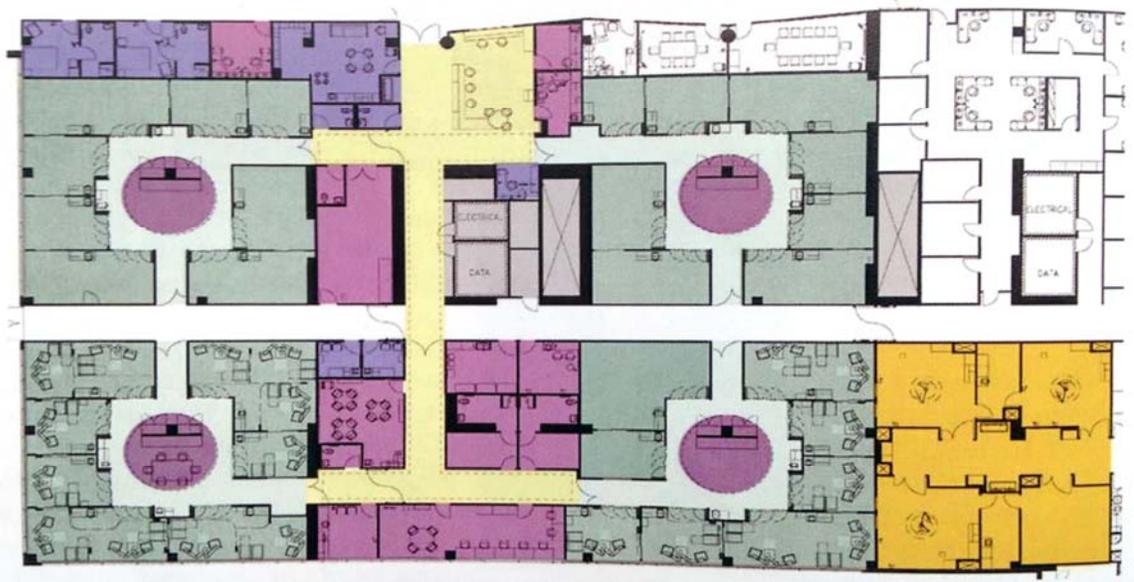


Figure 8. Pod/Cluster design floor plan (Source: Shepley, 2014, p. 100)

### **2.3.3 Single-Patient Room (SPR)**

The most radical change in the development of the modern NICU design is the increase in SPR. This design was first suggested in literature as an optimal healing environment for newborns in 1992 (Walsh, et al., 2006), and continues to be influenced by several factors. These factors include a trend toward SPR to control the spread of infection (Mathur, 2003; Ulrich et al., 2004; Walsh, McCullough & White, 2006), recognizing the importance of control over the sensory environment to improve patient outcomes (Domanico et al., 2011), the integration of family-centered and family-integrated care models (Griffin, 2006) and the influence of the Health Insurance Portability and Accountability Act (HIPAA) (Mathur, 2003; Shepley, Harris & White, 2008).

First, similar to the adult private patient rooms, the desire to control infection has prompted the shift toward SPR designed NICUs (Mathur, 2003; Ulrich et al., 2004; Walsh, McCullough & White, 2006). Ulrich et al. (2004) suggests a clear pattern showing lower infection rates in SPR rather than multi-bed rooms; this includes reducing airborne transmission, as well as contact acquired infections. Additional benefits of SPR designs in adult units, such as fall reduction and improvement in patient satisfaction, might not apply to the NICU.

Nonetheless, several research studies show an improvement in patient progress in a SPR designed unit. The 1990's brought about evidence that the sensory environment, especially visual, sound and lighting, does in fact contribute to NICU patient outcomes (White, 1996). SPR allow for complete control over background noise, temperature and light levels (Mathur, 2003),

contributing to a more individualized care plan for patients and families.

Domanico et al. (2011) found that infants in SPR designed units had fewer apneic events, reduction in mortality, earlier transitions to enteral nutrition, and more infants were discharged successfully breastfeeding.

Third, the integration of family-centered and family-integrated care into the NICU has driven the need for family spaces within the room, as well as family training space, family consultation rooms and breast-feeding rooms. At present, the recommendations for family space within the patient room includes space for a comfortable reclining chair suitable to skin-to-skin care, a recumbent sleeping area for at least one-parent, a minimum of four electrical outlets, a desk surface, and no less than six cubic feet of storage space. Each room must allow for visual and speech privacy for families. The inclusion of additional family space has created a need for slightly larger space per patient than in open-bay designed units, with a recommended minimum standard size patient room of 165 square feet (White, Smith and Shepley, 2013).

Lastly, HIPAA includes a speech privacy rule called the “Standards for Privacy of Individually Identifiable Health Information,” which went into affect on April 14, 2003. Prior to SPR designs, units had to be creative in order to protect patient privacy, including placing headphones on other families present in an open-bay designed unit (participant P2-2 interview). Mathur (2003) suggests that private rooms are essentially the only reasonable way to meet the acoustical privacy requirement under HIPAA.

Overall, SPR undoubtedly shows improvements in patient outcomes, and

privacy for families is unmistakably improved. It is important to understand that SPR design alone are not the source of positive neonatal outcomes, but rather, the opportunity it provides for more intimate human contact (White, 2014), especially for mother and baby. But White (2014) suggests that this may be a double-edged sword, as SPRs can isolate families and staff from one another. He even suggests that SPRs may delay verbal development for babies if families are not present for most of the day; however, this may be unrelated to the SPR design, and more related to leaving the baby alone in the private room.

The literature shows very clearly that the most frequent concern of SPRs fall on nurses' transition into the space. One study concluded that although staff nurses felt that patient care was safe, they expressed concern around the perception that fewer colleagues were visible/available if an emergency arose, and that the SPR design was more physically and emotionally demanding (Stevens et al., 2010). Other potential concerns cited include a perceived decrease in quality of staff communication, leading to staff isolation (Black & Osan, 2014; Bosch, Bledsoe & Jenzarli, 2012; Smith, Schoenbeck & Clayton, 2009; Stevens et al., 2010), decreased opportunity for new staff training and education (Carlson et al., 2006; Walsh, McCullough, & White, 2006) and loss of control due to decreased visibility of patients (Black & Osan, 2014). Altering the nurses' environment has potential to influence nurse workload, satisfaction, burnout and retention, as well as patient safety (Hendrich et al., 2009).

Few studies document the staff experience in SPR designed NICUs. Therefore, one of the biggest challenges of adapting to SPR is addressing the

communication patterns between staff (Brown & Taquino, 2001), because caring for patients with increasing acuity may require an even higher quantity/quality of information to be shared (Rashid, 2009). Chaudhury, Mahmood, and Valente (2004) concluded that the effectiveness of the SPR design is largely tied to the nurses work environment, and the design, whether SPR or multi-occupancy, needs to be evaluated in the context of different nursing unit layouts.

#### **2.4 Nurses Work Environment**

Nurses play a vital role in the healthcare process; according to Porter O'Grady & Malloch (2011), nurses represent the largest stakeholder group in the healthcare system. Therefore, designers have the responsibility to question the following: What are the needs of nursing staff in the NICU, and what is the best way to support diverse forms of communication in a rapidly changing healthcare unit? Why is nursing staff not currently involved in the design of *all* hospital units- Magnet hospital designation, or not? With research suggesting a relationship between the built environment and staff experience (Joseph, 2006; Mroczek et al., 2005; Ulrich et al., 2004), healthcare organizations have the responsibility to provide spaces that support the physical needs, and meet the physiological demands of their staff.

A nursing station is the hub and primary workplace for nurses within a unit; it includes unit reception, patient records, and charting area (University of Michigan Office of Space Analysis, 2006). Trzpuć and Martin (2010) identified three types of nursing station layouts: centralized, decentralized and hybrid; Hua et al. (2012) more recently added a fourth category: multi-hub.

Centralized nursing stations are located in a central location within the unit, and act as a concentrated zone for nursing staff. Centralized nursing stations can provide a place for nurses to collaborate, educate, and to engage in emotional support of one another. However, noise related issues are of concern (Flynn, 2005), especially in the NICU, where vulnerable neonates have increased sensitivity to environmental factors. Additionally, a centralized station can be a place of frequent interruptions.

With the advancement of technology, and trend for single-patient room designed units, decentralized nursing stations were introduced in the beginning of the 21<sup>st</sup> century. Smaller sub-stations are distributed throughout the unit, with the intent of increasing visibility of the patient, and decreasing the amount of walking for nursing staff (Zborowsky et al., 2010). Visibility of patients and other nursing staff is cited as one of the most important criteria in monitoring patients in an intensive care unit, since conditions can change fast and unexpectedly (Hor et al., 2014).

Nevertheless, research suggests that a decentralized nursing station design may decrease the social interaction of nursing staff, and create a physical distance among nurses (Hua et al., 2012). Although not specific to the NICU, Dutta (2008) sought to explore the relationship between communication and nurses station layouts in one Intensive Critical Care Unit (ICCU). In testing a theory of affordances, systematic observations of one ICCU were conducted before and after relocation to a unit with decentralized nursing stations. Gibson's theory of affordances suggests that the physical layout of space can influences

communication through affordances, or “whatever it is about the environment that contributes and supports the behavior that occurs in it” (Gibson, 1977, as cited in Dutta, 2008, p.55). When the physical space contributes to increased interpersonal relationships, the space is considered “affordable.” Looking primarily at the implementation of decentralized nursing stations, Dutta’s study results indicate that the use of decentralized nursing stations in the ICCU decreased interaction by 62% after relocation, creating an “unaffordable” environment. Nursing staff commented on the feelings of isolation from the central hub when working in the decentralized stations.

A contradicting study found that decentralized nursing stations actually increased team communication among staff (Guarascioio-Howard & Malloch, 2007). These contradictions suggest that nursing unit design impacts performance and communication among staff, however findings cannot yet be generalized to all units. Recent articles identify the nursing unit design as a variable in staff communication (Becker, 2007b; Gurascio-Howard & Malloch, 2007; Rashid, 2009), but there is no right or wrong answer whether centralized or decentralized stations are the best solution as a general rule. Unit management and communication culture varies across settings, and has a great impact on which nursing station approach fits.

Less literature is documented on hybrid and multi-hub units. Hybrid units combine the centralized station design, with several touchdown spaces throughout the unit. A medical architect defined the hybrid nursing model as a “balance of nurses at the bedside and collaborative spaces” (Flynn, 2005). It

keeps nursing staff close to patients, while providing a central area for greater collaboration when necessary. Hua et al. (2012) identified a need to include a fourth unit, multi-hub, in which several larger nursing stations (hubs) are distributed throughout the unit.

Visibility of other nursing stations can be a valuable factor in enhancing nurse-to-nurse communication. Using space syntax theory, Trzpuć & Martin (2010) sought to understand nurse communication patterns in three Medical/Surgical units, addressing the location of nursing stations. Developed by Hillier and Hanson (1984), the theory tests “the layout of space and its connectedness to other spaces,” and states that the layout “is capable of including (and being influenced by) social behavior” (as cited in Hasell & Peatross, 1991, p. 54). The six constructs of space syntax theory include openness (boundary partitions), depth (path length), connectivity, accessibility (rings, circuits and chains), degree of control, and visibility (line of sight) (Zeisel, 2006). Using two constructs of space syntax theory— visibility and accessibility—, finding from Trzpuć and Martin’s study suggested that the optimization of visibility, in regards to sightlines to other nurse stations, was indeed found to enhance nurse team communication.

## **2.5 Role of communication in healthcare setting**

Clear communication between clinicians is continuously cited as a major variable in patient safety (Bayramzadeh & Alkazemi, 2014; Becker, 2007b; Coiera, 2000; Hartung & Miller, 2013; Hor, Iedema, & Manias, 2014; Joseph, 2006; Rashid, 2009; Trzpuć & Martin, 2010). In fact, the Agency for Healthcare

Research and Quality (AHRQ) (2013) lists communication as one of the five key principles of teamwork in its TeamSTEPPS framework (as cited in Bayramzadeh & Alkazemi, 2014), an evidence-based curriculum which strives to optimize patient outcomes by improving communication and teamwork.

For the purpose of this study, [face-to-face] communication will be defined as “a system of communication behaviors that may fall anywhere from unplanned, serendipitous interaction (e.g., chance encounters in the corridor) to planned, collaborative interaction (e.g., highly ‘formal’ interactions that may last for hours)” (Rashid, 2009, p. 63). Key factors in promoting this behavior include visual and verbal connection to one another (Joseph, 2006; Rashid, 2009; Trzpuć & Martin, 2010), and flexible workspace. The recent shift from open-bay to SPR within the NICU sparks particular interest in communication pattern shifts; studies showed much more unplanned communication in open bay, and reduced levels of face-to-face communication and patient monitoring in SPR designed units (Shahheidari & Homer, 2012).

Designing flexible environments that support the appropriate level of communication, based on patient type (Figures 1 and 2) is essential, given that research has found that the majority of hospital mistakes are a result of poor communication among staff, and many of them are potentially preventable (Becker, 2007b). As hospitals are experiencing nursing shortages, it is more important than ever to explore the work environments of nursing, as nursing units that contribute to overall better communication for the purpose of building social support, can contribute to job satisfaction (Trzpuć & Martin, 2010), and

consequently may contribute to nurse retention. Becker (2007b) points out that one reason less attention has been paid on communication is the idea that conversation is “socializing” and therefore not work related. However, it can be argued that the social aspect of nursing contributes to building trust among staff, forming the “social capita that in turn supplies community (team) members with the ‘resources’ (e.g., information, support, training) they need to learn and perform their job better” (Becker, 2007a, p. 7).

The role of informal face-to-face communication has received little attention, but it plays a very large role in the education of new staff. Brown and Duguid (1991) discovered that staff learned “tricks of the trade” by overseeing, and drawing on the experiences of others, versus reading a manual, or attending training sessions (as cited in Becker, 2007b, p.8). This social bond among co-workers, developed by face-to-face interaction, is especially important among critical care nursing staff that look for that emotional social support amongst other staff members.

Although SPR designed units are under study, there is very limited published literature on staff needs and interaction with one another post-move to this NICU setting—only two can be found in a design related peer-reviewed journal (Bosch, Bledsoe & Jenzarli, 2012; Shepley, Harris & White, 2008). Becker (2006) believes that in order for a culture of teamwork and interaction to thrive, we must provide the physical setting to support behavior. Therefore, this study seeks to contribute to this research gap, uncovering and confirming the needs of nursing staff in order to communicate efficiently and effectively with one another,

and offer implications for the design of future NICUs.

## **2.6 Theoretical Framework**

Rashid (2009) developed a theoretical model supporting the idea that spatial program and structure can help foster face-to-face interaction among hospital clinicians. The initial need for and the development of Rashid's theoretical model surfaced from evidence suggesting a clear association with face-to-face interaction and patient and staff outcomes in a hospital unit. The theoretical model can be discussed in two parts. Part I defines clinician interaction needs based on defining patient type; Part II introduces strong and weak building programs, and their implications for reproduction and creation of knowledge through clinician interaction; Part I will be applied and adapted in this research study.

Through a literature review, Rashid (2009) discovered that hospital error and patient complexity have a positive correlation; patient acuity and the need for medical attention also have a positive correlation. Therefore, a model for the urgency of medical attention based on patient type (defined complexity and acuity) was developed (refer to Figure 1).

From there, Rashid concluded that communication and interaction needs varied amongst patient type. Literature displayed examples of this outside of healthcare; when groups with greater task uncertainty engaged in face-to-face interaction, their outcome was more successful. From this information, Rashid developed a model defining patient interaction needs, based on previous constructs of complexity and acuity (refer to Figure 2). The higher the level of

complexity and acuity, the more urgent need for face-to-face interaction amongst healthcare providers.

Third, Rashid's theoretical framework seeks to define the appropriate communities of practice (CoP) and communities of interest (CoI) for each patient type. A CoP consists of a group of providers who share a particular knowledge, such as a NICU nurse; a CoI is formed of healthcare providers from different knowledge backgrounds to form a particular task together (also known in the medical community as interprofessional collaboration). Using the same constructs of complexity and acuity, Figure 9 shows Rashid's definition of hospital communities in patient care.

### **2.6.1 Adapting the Theory**

In the present study, some adaptations of Rashid's model are necessary in order to answer the proposed research questions. Rashid's model only tested face-to-face interaction amongst clinicians as a whole, but did not show relationships among members within each CoP. Assuming the NICU patient population are all high complexity/high acuity patients, Figure 1 and Figure 9 show that Type 3 patients may urgently require face-to-face interaction, directly involving members of CoPs (i.e. NICU nurse). Thus, the model has been adapted to consider dimensions (Levels of Care) for the particular population of NICU neonates, and take into considering the face-to-face interaction of one CoP—NICU nurses (Figure 10). NICU Levels of Care (i-iv) further detail the level of complexity within this particular patient population.

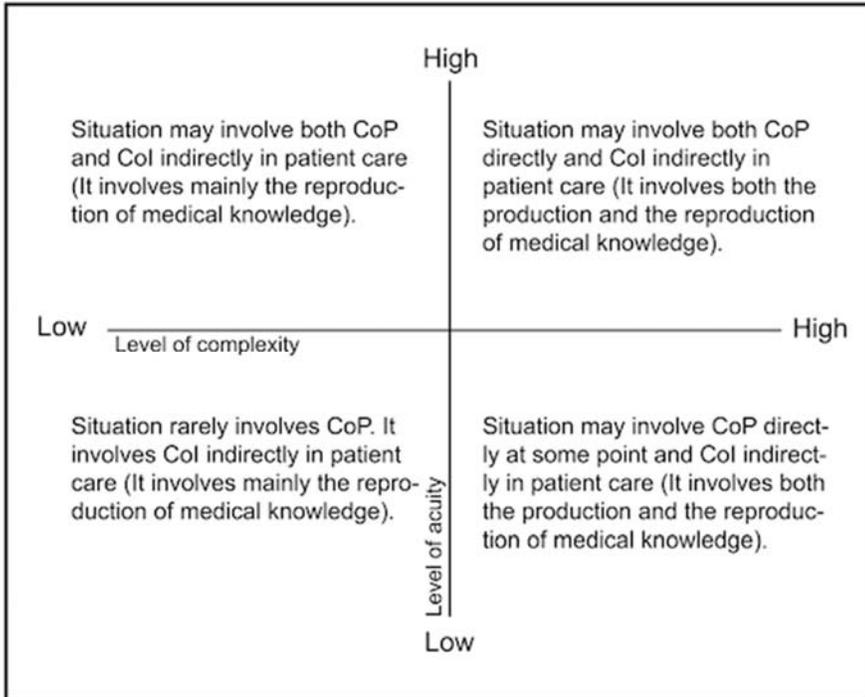


Figure 9. Defining the role of hospital communities in patient care (Rashid, 2009, p.71)

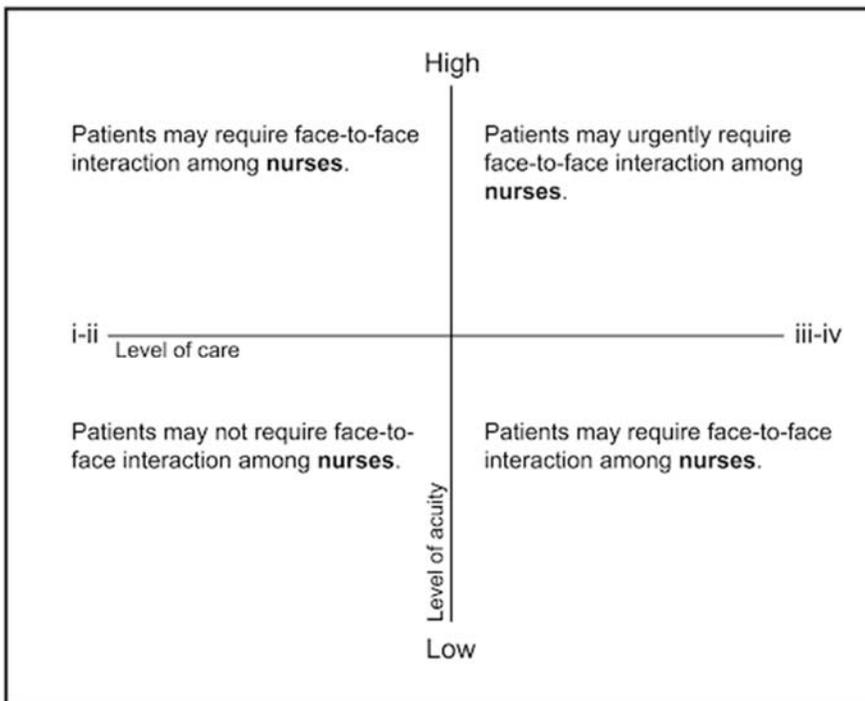


Figure 10. Adapted model for NICU nurse face-to-face interaction (adapted from Rashid, 2009)

## 2.7 Summary

In summary, the transition to SPR designed NICUs has brought about clear positive impact amongst patient and families, although, gaps still exist in understanding how to balance patient, family and nurse needs. There is a lack of literature in the design community surrounding staff perceptions following the transition to a SPR designed NICU-- only two such studies were located in a peer reviewed design journal (Bosch, Bledsoe & Jenzarli, 2012; Shepley, Harris & White, 2008); other studies of staff perception following the transition can be found in *The Journal of Perinatology* (Harris et al., 2006; Stevens et al., 2010; Swanson, Peters & Lee, 2013). *The Journal of Perinatal and Neonatal Nursing* (Brown & Taquino, 2001), *Newborn and Infant Reviews* (Cone, Short & Gutcher, 2010), and *Advances in Neonatal Care* (Carlson et al., 2006). In addition, it was discovered that a lack of qualitative research exists surrounding the transition to SPR designed NICUs. As a result, the objective of this study is to add a narrative piece supporting the nurse perceptions of the transition, and their perceptions on the importance of nurse interaction in the NICU.

## **Chapter Three: Research Methodology**

### **3.1 Introduction**

The purpose of this study was to explore nurses' face-to-face interaction with one another in two SPR designed NICUs. It is anticipated that a deeper understanding of nurses' interaction will inform future design of SPR designed NICUs. In seeking to understand this shared experience, the following research questions were addressed:

1. How do nurses' interactions within the built environment contribute to overall communication of information in single-patient room designed neonatal intensive care units, and what does this mean for interior designers?
2. How are nurses' face-to-face interaction patterns affected by the shift to single-patient room designed neonatal intensive care units?
3. What designed features do nurses perceive to enhance and/or inhibit face-to-face interaction in single-patient room designed neonatal intensive care units?

This chapter describes the study's research methodology and includes discussions around the following areas:

1. Rationale for a qualitative phenomenological methodology
2. Site selection
3. The research sample
4. Overview of the research design
5. Method of data collection

6. Data Analysis and Synthesis
7. Ethical considerations
8. Issues of trustworthiness

### **3.2 Rationale for a Qualitative Phenomenological Methodology**

Current research studies on NICU staff transition into SPR designed units have primarily used a quantitative survey instrument for data collection (Bosch, Blendsoe, & Jenzarli, 2012; Carlson et al., 2006; Cone, Short & Gutcher, 2010; Harris et al., 2006; Stevens et al., 2010; Swanson, Peters & Lee, 2013). While this methodology does increase the understanding of staff experience, it leaves a gap in capturing the real lived stories and emotions associated with the phenomenon, limiting the perspective of the issue.

Qualitative research methodology is useful when little is documented on about a particular phenomenon. The phenomenon under study involves the feelings and perceptions of nurses' interaction with one another, following the move into a SPR designed NICU. Coiera (2000) argues that we must first understand the nature of interaction on the unit, in order to improve the processes and technologies involved in patient care. Yet, as stated above, very little research is documented on NICU staff interaction.

What a qualitative approach will contribute to the body of knowledge is the narrative behind the experiences of these staff members. The importance of a narrative in understandings one's experience is supported by philosophical writings on human emotion; Nussbaum's (2003) position holds that certain truths about the human experience can only truly be expressed in the form of a story.

### **3.3 Site Selection**

Selection of hospitals was based on the criteria of a recent transition from open-bay designed NICU, to a SPR designed NICU. Hospitals had transitioned between twelve and eighteen months ago, at the time of data collection. This time frame was chosen to allow time for staff to adjust to the restructure change, and researchers recommend at least one year of time to pass before collecting post-occupancy information (Shepley, 1996). In addition, hospitals and NICUs of similar size and Level of Care were selected; the NICUs differed in terms of nursing station design (Table 2). Choosing units of similar size allowed the researcher to focus on physical layout differences while reducing the variations in level of care, nurse to patient ratios, and number of patient rooms.

#### **3.3.1 Site Description: Hospital Site One**

Hospital site one employs approximately 5,000 full-time and part-time professionals. The not-for-profit health care organization provides 489 licensed beds, serving a community of approximately 66,000 people (128,000 including surrounding metro population). This hospital has received the Magnet Award for Excellence in Nursing through the American Nurses Credentialing Center in 2004-2008, 2009-2013, and has recently been re-designated the award in October of 2014. Magnet hospitals are recognized for their quality patient care and nursing innovation and excellence.

Until August of 2013, the NICU was functioning in an open-bay designed space, covering approximately 3,500 square feet. Post-move, the unit now occupies a 13,500 square feet space, utilizing a single-patient room loop-with-

Table 2  
*Descriptive Statistics for NICU Sites Selected*

	Hospital site one	Hospital site two
Move-in Date	August 2013	January 2014
Square Footage	13,500 sf	10,050 sf
Nurse Station Configuration	Decentralized	Centralized
Number of Patient Rooms	25	18
Level of Care	Level II & III	Level III
Nurse to Patient Ratio	1:1 to 1:4	1:1 to 1:3

core design (Figure 11). A group of nursing staff was actively involved in pre-construction site visits and interaction with mock-up spaces on the hospital campus. The latter design uses a distinctly decentralized nursing station layout, placing the charge nurse’s desk at a location close to the entrance of the unit and physician offices. Despite the changes, the nurse to patient ratios have remained the same, ranging from 1:1 to 1:4, based on patient acuity.

As the name suggests, the decentralized nursing station layout locates staff throughout the unit, with the intention that staff are located in close proximity to patient rooms. Each nursing station is meant to serve approximately three to four patient rooms, with room for one to two staff members to meet at the station. The 15-30 square foot stations have a work surface and computer, meant for charting and patient monitoring. Recently, additional monitors have been added to the three stations [enclosed on three sides], where the unit’s most critical patient’s can be monitored.

The central service core includes all medical utility rooms, such as



Figure 11. Hospital site one: NICU floor plan

clean/soiled utilities and medical equipment, and can be accessed from both sides of the unit. However, they are not meant to be “pass-through” rooms. The nurse’s lounge and family lounge are strategically located outside of the main unit, in order to promote socializing among families, and to reduce noise.

The current patient monitoring system includes central monitoring at the Charge Nurse desk, computers with the ability to monitor patients in each decentralized nursing station and patient room, and three additional monitors located in three decentralized nursing stations in order to monitor the highest acuity patients. Webcams are installed over every patient isolette, and patients can be monitored via webcam from a computer station. In addition, a ‘real-time’ patient call or patient alarm is sent to the assigned nurse; after a designated time period, the alarm is then sent to an additional staff “buddy.”

### **3.3.2 Site Description: Hospital Site Two**

Hospital site two employs approximately 5,000 staff members. The not-for-profit teaching health care organization provides 325 beds, serving a community of approximately 51,000 people. They have repeatedly been named one of the “Top 100” hospitals in the nation (source: healthcare organization homepage).

Until January of 2014, the NICU was functioning in an open-bay designed space, covering approximately 2,500 square feet. Current nursing staff was not actively involved throughout the design on the new unit. Post-move, the unit now occupies a 10,500 square feet space, utilizing a single-patient room loop-with-core design (Figure 12). The latter design uses a centralized nursing station layout, with two touch down stations located on either side of the unit. The main nursing station is located centrally in the unit, with patient rooms on either side, and is a space where staff can monitor patients, engage in charting, find social support, and find contact information for other staff on the unit. Despite the changes, the nurse to patient ratios have remained the same, ranging from 1:1 to 1:3, based on patient acuity. However, one new protocol is that the charge nurse does not receive a patient assignment.

The current patient monitoring system includes central monitoring at the central nursing station, computers with the ability to monitor patients at each of the two touchdown stations and in each patient room, and one additional set of monitors located in a designated hallway. In addition, a real time location system is installed throughout the unit, so that staff is able to visualize where

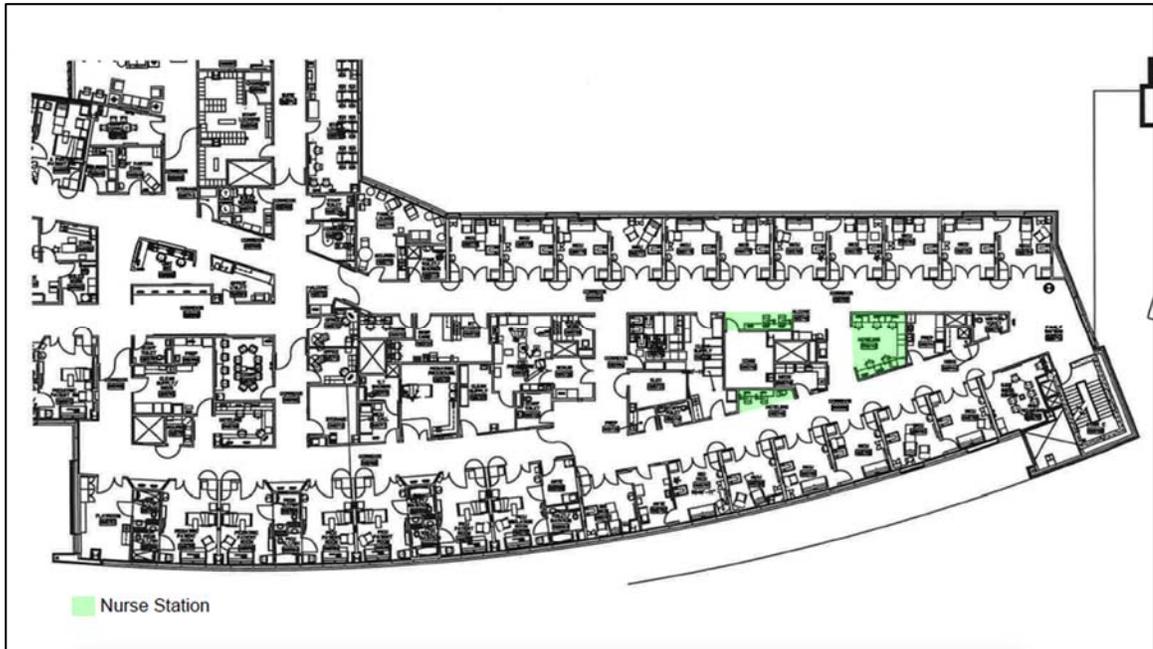


Figure 12. Hospital site two: NICU floor plan

other staff members are. A light outside of patient rooms will light up a designated color based on the healthcare provider in the room (e.g. blue for Registered Nurse).

### 3.4 The Research Sample

The participant selection process was purposeful with the objective that the participants selected would clarify the phenomenon under study. Nurses were of particular interest in researching user experience in hospital units, as they represent the largest stakeholder group in the healthcare system (Porter O'Grady & Malloch, 2011). The researcher sought to include nurses within two hospital settings, following the same criterion sampling method for each. The purpose of including two hospital settings was to uncover similarities and/or differences that organizational culture and nursing station design might play in

the way in which nurses engage in face-to-face interaction. The criteria for participants were as follows:

1. Participant must be nursing staff, working in the neonatal intensive care unit within one of the two identified hospitals.
2. Participant must have a minimum of five years of nursing experience.
3. Participant must be 18 years of age or older.
4. Participant must have six months of experience in the old unit, prior to moving into the new unit.

A time frame of five years of experience was decided on by the researcher to ensure adequate experience in the nursing profession. The research sample included ten nurses, five nurses from each hospital site.

### **3.5 Overview of Research Design**

The following list summarizes the steps used to carry out the research; following the list is a more in-depth description of each step:

1. A review of literature was conducted to survey existing knowledge surrounding the topic of NICU design and the transition to SPR designed units.
2. Criteria were developed for the hospital sites and the research sample, along with semi-structured interview questions.
3. Following the researcher's thesis committee approval, the researcher acquired Institutional Review Board (IRB) approval from the University of Minnesota. The process involved outlining all procedures, including participant recruitment, interview questions, consent form design, and data

analysis plan.

4. In-sync with University IRB approval, three potential hospital sites were contacted, and required an in-depth proposal application to be submitted, outlining research purpose, participant recruitment, interview questions, consent form design, and data analysis plan.
5. Following the approval of two hospital sites, based on criteria-match and availability of nursing staff, a nurse recruitment e-mail was sent through NICU Directors; the e-mail outlined participant criteria, a brief overview of the study, and four potential interview dates per site (Appendix A).
6. Semi-structured interviews were conducted with ten NICU nursing staff within two hospital sites.
7. Interview data responses were transcribed verbatim, and analyzed for themes following the completion of all interviews.

### **3.6 Literature review**

An ongoing literature review was conducted to inform this study. Topics explored began with a general understanding of the evolution of the modern NICU, the experience of nursing staff in transitioning to a SPR designed NICU, the overall role of communication in healthcare, and helped provide a theoretical base for the study. The literature gave a thorough basis for understanding of where current NICU design is grounded. The familiarity with the literature was a preparation tool for the interviews conducted with nursing staff. Understanding the variation in NICU physical environments (overall shape of the floor and nursing unit design) informed the site selection, and helped to shape the

questions asked.

### **3.7 IRB Approval**

The University of Minnesota IRB granted an exempt review because the study met exemption category #2 (Surveys/Interviews; Standardized educational tests; observation of public behavior). In addition, hospital site one granted expedited approval for a “Category #9” study (research on individual or group behavior or characteristics of individuals such as studies of perception, cognition, specific theories, or test development), based on the knowledge the researcher would not be manipulating participant’s behavior and the research would not involve stress to the participants. Interviews were required to be conducted during staff shifts [hospital site one], based on a cost/resource analysis completed by the Director, and sent through the Nurse Research Review Board. Hospital site two’s Human Subjects Committee also used an expedited review process to give approval for the study on terms that a progress report is presented within one year from approval.

### **3.8 Data Collection Methods**

The information needed to answer the research questions fell into four categories: contextual, demographic, perceptual, and theoretical. Each category is described in detail below (Table 3); additionally, this section outlines the process of data collection in detail.

Following the recruitment e-mail sent through two unit Directors early in January of 2015 (Appendix A), the researcher then communicated via e-mail with prospect participant replies. Participants were thanked for their interest in the

Table 3  
*Data Collection Plan*

Type of Information	What the Researcher Requires	Method
Contextual Information	Organizational background of each hospital; mission; vision; services; staff and site description	Observation/ Director supplied
Demographic Information	Descriptive information regarding participants, such as age, gender, education, work title, hospital work shift, NICU experience, employer	Interview
Perceptual Information	Participants' descriptions and explanations of their experience as it relates to the phenomenon under study	Interview
Theoretical Information	Theoretical grounding for the study	Literature Review
Research Question 1	Nurse perception and experience with interaction with other team members; what role does face-to-face interaction play in the role of NICU nursing staff?	Interview
Research Question 2	What unique needs to nursing staff have in single-patient room neonatal intensive care units?	Interview
Research Question 3	What parts of the support space (location of storage/ nursing stations) are successful and/or challenging in nurses' workflow, and what can designers learn from this?	Interview

study, and invited to select one of the dates provided and a time that was most convenient for them. Hospital site one required interviews to be conducted during staff time; Hospital site two did not provide criteria for interview location. Interviews were scheduled over six different days in mid-January 2015 and throughout February 2015.

Interviews were chosen as the main tool for data collection; Creswell (2007) states, “a major benefit of collecting data through individual, in-depth interviews is that they offer the potential to capture a person’s perspective of an event or experience” (as stated in Bloomberg & Volpe, 2012). Eight one-on-one interviews and one group (two nurse) interview were conducted with nursing staff of the two selected hospitals (five participants per hospital).

Written consent was obtained from all participants prior to data collection (Appendix B). Upon informed written consent, recording of the interview began, and participants were asked to discuss their perception of nurse communication in a SPR designed NICU, prompted by questions surrounding the needs of nursing staff, challenges that exist, and successful aspects of the unit. Questions sought to understand the perceptions of nurses on the importance and role of face-to-face interaction in Level III NICUs. At the end of each interview, participants were asked to voluntarily provide demographic information (Appendix C). Interviews ranged in length from twenty-five minutes to fifty-six minutes. A \$5 gift card incentive was offered to the ten nurses participating in the study.

In addition to interviews, participating NICU Directors were asked to

provide a floor plan, and general information about the unit (Appendix D). Casual observations took place during six of the nine interviews, as they were conducted within the unit.

### **3.9 Data Analysis and Synthesis**

Nine total interview sessions were audiotaped and transcribed verbatim [by the researcher]. Transcripts were checked against the audio for accuracy. Final transcripts and field notes were chronologically ordered, and organized in a binder. The researcher used thematic content analysis to analyze transcripts and field notes. The data were checked for relationships, and grouped into six common themes. A table was created to organize each theme, including a description of the finding, supporting quotations and what the theme means for interior designers. Finally, transcripts were read for exceptional themes that do not necessarily contribute to the research question, but do contribute to further questions of research.

### **3.10 Ethical Considerations**

Although it was anticipated that no direct threat or ethical risk was incurred by participating in the study, precautions were taken to ensure the rights of all participants. First, the study was approved through the University of Minnesota's IRB, and both hospitals Human Subjects Research Boards. Second, informed and written consent of the participant was obtained prior to interviews. Lastly, all participant's names and identifying data were excluded in the reporting and dissemination of the data. Measures were taken in the secure storage of all data, including password protection of all technology devices storing data.

### **3.11 Issues of Trustworthiness**

During the development of the study, the researcher confirmed that methodological validity was met by validating that the problem was appropriate for qualitative research, the problem was clearly stated in the report, the problem is situated in literature, the significance is made clear in the report, and its contribution to existing literature is made clear in the report. These provided a guide for the construction of high quality and credible research.

Additionally, data was gathered using interviews and observation, yielding a more full description of the phenomenon. Advisor-reviews occurred during the development of the research questions, methodology, interview question, data collection and data analysis phase. Finally, reviewing and discussing research design and findings with an additional professional content reader was a further way of ensuring that the experiences of participants was accurately and captured in an unbiased way, and that the findings contribute to existing health care design literature.

The keeping of an audit trail helped to create transparency. A table was created, documenting dates, activities, notes and journaling. This chronological account of the design process documents peer-reviews, interview notes, meetings, and decision points. This helped to create a rich, thick description in the final report.

## Chapter Four: Presentation of Findings

### 4.1 Introduction

This chapter presents the findings from eight one-on-one interviews and one group (two nurse) interview. Although participants were all NICU nurses, there were differences along the following parameters: age range, education, and work shift (day/ evening/ night/ variable). Years of experience in the NICU ranged from 18 months to 27 years, with the average years of experience in the NICU of 12.15 years (Table 4).

Six major findings emerged from this study (Table 5):

1. The majority (eight of ten) of participants discussed the importance of *social and emotional support* amongst nursing staff in a single patient room designed NICU.
2. The majority (seven of ten) of participants discussed the importance and challenges in *collaborating with and educating* new staff in a single patient room designed NICU.
3. The majority (seven of ten) of participants discussed their need for *visibility* of one another throughout the shift in order to effectively communicate in a single patient room designed NICU.
4. Some participants (five of ten) indicated that a new level of *trust* and *awareness* between nursing staff has to be established in a single patient room designed NICU.
5. Some participants (four of ten) expressed new *patient safety* concerns in the single patient room designed NICU, including reliance on technology to communicate and infection control, however, overall improvement and ease in patient care was evident.
6. Some participants (four of ten) expressed concern over *miscommunication* between staff and between family members in a single patient room designed NICU.

### 4.2 Finding One: Support

The NICU nurse culture is one that was not explicitly defined by one participant. Nevertheless, many participants expressed the “close knitted-ness”

Table 4  
*Descriptive Statistics of the Research Sample*

Participant Code	Age Group	Gender	Highest Education	Work Title	Work Shift	Years of Experience in NICU	Site
P1-1	46-55	F	Associates	RN	Variable	18 mo.	1
P2-2	36-45	F	Bachelors	RN	Variable	11 yrs.	2
P3-2	26-35	F	Associate's	RN	Day	8 yrs.	2
P4-2	36-45	F	Bachelor's	Nurse Educator	Day	8 yrs.	2
P5-1	26-35	F	Bachelor's	Core Charge RN	Variable	10 yrs.	1
P6-1	46-55	F	Bachelor's	RN, Certified	Day	27 yrs.	1
P7-1	36-45	F	Bachelor's	RN, NICU Certified	Variable	16 yrs.	1
P8-2	26-35	F	Bachelor's	RN	Variable	10 yrs.	2
P9-1	26-35	F	Bachelor's	RN	Variable	3 yrs.	1
P10-2	46-55	F	Bachelor's	RN	Day	27 yrs.	2
D1	46-55	F	Bachelor's	Clinical Director	Day	26 yrs.	1
D2	56-65	F	Master's	Clinical Manager	Day	35 yrs.	2

*Note.* F= female, RN= Registered Nurse, Variable= Rotating Day and Night Work Shift

Table 5  
*Summary of Findings*

	Theme 1-2: Support and Education	Theme 3: Visibility	Theme 4: Trust and Awareness	Theme 5: Safety and Patient Care	Theme 6: Miscommunication
Finding	There are additional challenges in educating new staff appropriately in SPR design. Additionally, social support is of high importance in a high acuity patient unit.	Visibility of other staff is limited in Hospital 1 (decentralized nursing stations) and Hospital 2 (centralized nursing station)	A new level of trust and confidence between staff has to be established, and there are challenges around being aware of other patient needs	Patient safety is of concern, including reliance on technology to communicate, and infection control as a result.	Due to the division of patients and staff into single rooms, there is room for error in communication between staff and between family members.
Participant Perspective	Nurses are struggling to support one another  New nurses have learning opportunities with experienced nurses	Difficult to find one another	Added confidence that other nurses are watching other patients; Lack of awareness of what is happening in rest of unit.	Reliance on phone is not effective, as hands can be tied up in an isolette and access to phone is limited; phones carry germs from room to room	One nurse conveys message to family, another nurse conveys different message to family.
Implications for designers	A small central area serves as reference point for staff, with the addition of smaller stations throughout for small group conversation near patient care areas.	Addition of alcoves, or desk space in-between patient room  Design needs to seamlessly integrate technology.	Create areas with high visibility to one another (ex: alcoves in-between patient rooms)	Design needs to seamlessly integrate with technology, such as voice activation systems (ex: Vocera).	Create spaces for small group meetings and interaction

of the group of nurses within the unit. Bartholomew (2009) addresses this silent nurse culture stating, “so deeply entrenched is [nurse] culture that no one talks about it: the unspoken rules and behaviors (called norms) are never written down, and yet everyone knows them” (p. 48).

The internal support amongst staff is not only important to new staff, though; eight of the ten participants expressed the need for interaction as a means to social and emotional support for the entire unit to build camaraderie. It was also mentioned in a couple interviews (two of ten) that face-to-face interaction is preferred over a phone call. Nurses are hesitant to call one another if they know other staff is interacting with a patient or family members. Also, it was expressed that in some instances, it is much easier to read someone’s emotions by physically seeing their face. Participant P6-1 states:

If you, you pick up the phone, ‘how are you?’ ‘I’m fine.’ And then if you see them and... ‘you’re not doing fine, what can I help you with, or what do you need?’ You know, I can just tell.

When working in a team-oriented profession, such as nursing, feelings matter. Not only is 93 percent of our communications non-verbal, our bodies consistently express what we feel (McGrail, Morse, Glessner & Gardner, 2008). Bartholomew (2009) notes that healthcare workers do not typically share their feelings in high-pressure environments, due to fear of being perceived by the “general culture as soft” (p.49). In a high acuity environment such as the NICU, nursing staff are under pressure to appear in control and confident.

One nurse participant struggled with the conflicting needs of nursing staff and patients and families. On one hand, patients and families need quiet

environments for health and healing, while nursing staff simultaneously need collaborative space to interact, learn and support one another. She said,

When you're talking about quiet, healing environments, [a central nursing station] doesn't really at times support that. But then, like I said, nurses need an outlet. It's very stressful at times, they work really long hours, and you know, you may need an outlet to support each other. So, I don't know what the answer to that one is (P4-2).

A few participants (three of ten) also discussed the importance of socializing amongst staff as a means for professional development. Participant P5-1 expressed the importance of establishing a comfort level at work, even outside of work, to improve teamwork. Participants P6-1 agreed, saying that she gravitates toward asking for the help of the nursing staff she knows and trusts, over nursing staff that are unfamiliar. She fears asking for the help of someone without knowing where his or her professional skill level is. P9-1 confirmed similar feelings, saying:

There's a different comfort from like 'I'm going to go ask somebody that I know well'...its actually part of like a professional development, not just a personal development (P9-1).

Lastly, it became evident that due to the high-stress environment of the NICU, nursing staff might simply need face-to-face interaction to comfort and encourage one another in times of high stress, and the SPR layout may create barriers for this type of social interaction to occur. Participants noted they don't have the same social interaction as they did in the open-bay designed unit, and at times, feelings about difficult times are held in, rather than "getting it out." Participant P10-2 also noted, "if nothing else, sometimes you just need a sounding board....you just need to bounce something off them or you need to

collaborate on figuring out how to do something.”

### **4.3 Finding Two: Collaboration and Learning**

Interview data suggests that the culture of nursing staff in the NICU favors face-to-face collaboration for new staff education, but also for social and emotional support amongst nurses of all levels of experience. This was transparently evident after uncovering that the majority of participants (seven of ten) expressed the challenges that exist in a SPR designed NICU amongst staff in this respect. For instance, new nursing staff may have additional challenges, as experienced nurse participants discussed their learning experience in the open-bay as more efficient and effective; they were able to easily eavesdrop on the experienced nurses and observe basic bedtime manners and interactions with family members. Responses across participants were parallel:

I feel like when I learned in a pod style as a new nurse, I learned so much better. Because my more senior nurses were five feet away from me, and if something was going on, they were right there for me to ask them. Versus if I'm in the moment with a really sick patient now, you know if you were a new nurse, if you're in a room with a baby and you have a question, you have to go find somebody (P5-1).

It is important to note that this is the perception of experienced nursing staff, as a five-year minimum nurse experience was included in the criteria; no new (less than five years of experience) nursing staff was interviewed. One nurse noted that as it may appear to be a struggle for new staff, they might not know the difference from open-bay to SPR. In interpreting these statements, it appears that the challenge for experienced nurses lies in the increased anxiety as a result of the inability to see a new nurse in crisis, and the perceived additional

responsibility in preventing repercussive incidents from occurring.

Participants P2-2, P7-1 and P9-1 express the importance of empowering new staff to “speak up,” as experienced nurses are unable to see a new nurse in crisis when alone in a private room. Participant P9-1 says, “We’re finding they’re not, and I say ‘they’ very generally because it’s not all of them, but they’re not asking the questions because there’s not somebody there.” Participant P7-1 speaks of the education piece as the biggest obstacle in a SPR designed NICU, for new staff, as well as experienced staff looking out for one another. One participant (P6-1) notes that experienced nurses have adjusted to the increased accountability of training new staff “on the fly.” She says, “If I know there is something they have never seen, and they are here, I’ll go find them and say ‘you need to go into that room.’”

Participant P7-1 added that the unit sometimes experiences delays due to needing to find people, and not being able to support one another as quickly and easily as in an open-bay designed NICU. She stated in the open bay unit, you never had to ask someone for help, as they were always within sightline of another nurse; she indicated that this was both a time and step-saver for nursing staff. Recalling that the implementation of decentralized nursing stations is intended to decrease the amount of steps that nursing staff take (Zborowsky et al., 2010)-- locating staff nurses nearby patients--, participant responses indicate that there are repercussions in this layout; now that nursing staff are spread throughout the unit, and unaware of each others locations, valuable time is sometimes used to go looking for each other.

#### **4.4 Finding Three: Visibility**

The majority (seven of ten) of participants discussed their need for visibility of one another, mirroring Trzpuć and Martin's (2010) findings that visibility of other nurse stations can enhance nurse team communication. As stated in the literature, a centralized nursing station often gets a bad reputation for being a contributor to high noise levels. However, hospital site two participants consistently referred to the central station as a positive for nurse's workflow. Unfortunately, it also posed threats to patient safety due to lower visibility of patients located far distances from the central station. Participant P2-2 noted:

I don't think necessarily having the centralized nursing station is a bad design. I think we would have missed a lot of the exchange that we do on a daily basis...so from a nursing perspective, I don't know if it's a bad design. I think it's actually beneficial. Having sightline on our patients, it's a bad design.

The centralized nursing station designed NICU (hospital site two) had nursing staff feeling pulled in opposite directions. Participant P4-1 alludes to the conflicting needs of nursing staff in saying that nursing staff need to have clear sightlines to their patients, and as a result, critical patients are placed in the closest rooms surrounding the central nurses station for fear of placing critical patients at the end of the hallway (Figure 13). In the unit's current state, it lacks sufficient locations to sit outside of the central nurses station that allows clear sightline to patients and other nurses. A similar phenomenon is occurring in hospital site one. Nursing staff is locating the most critical patients around the



*Figure 13.* Hospital site two: location of most critical patients.

entrance of the unit, near the charge nurse and physician rooms (Figure 14). This is ironic, because when the unit was originally designed, the largest patient rooms, intended for the highest acuity patients, were located on the opposite side of the loop in order to take advantage of a quieter atmosphere.

Staff in both hospital sites (centralized and decentralized nursing stations) also discussed the challenge of finding one another in non-emergent situations, where a second set of hands would be helpful. Nurses no longer have sightlines on one another, and lack “back-and-forth” communication. A common experience of looking down an empty hallway left nurses at hospital site one feeling distant from one another. Indeed, technology (staff assist button) is in place in every patient room to allow staff to communicate an emergency situation, but staff is



Figure 14. Hospital site one: location of most critical patients.

way to use this call for non-crisis help, as the button is strictly meant for emergency circumstances. Participant P7-1 contributes the following:

If you need help starting an IV or if you're intubating, you can always hit a staff-assist button and it sends out a coo-coo and everyone comes running. But you don't really want to do that. Yes, we all carry phones. However, if you're busy, you don't have time to go out to one of the substations to look at the phone list and call somebody."

Experienced nursing staff now feel the additional responsibility to *seek out* new staff, and be aware of their comfort level in all situations-- emergent or not--, because sightlines of one another are minimized in a SPR designed unit. They are continuously encouraged not to hesitate to ask questions, because with a high complexity and high acuity patient population, if they "try and figure it out, wrong can come, and you would hate to have a bad outcome" (Participant P7-1).

Another barrier on nurse-to-nurse visibility falls on the loop-with-core

layout of both units, as it creates limited opportunities for sightlines to the opposite side of the unit. Although, it is important to note that the decrease in visibility and social interaction was not perceived as a negative consequence for all participants. Participant P9-1 argues that this type of layout fosters autonomous work for the nurses; it benefits nurses who prefer to work independently, but hinders interaction for those who prefer to seek out fellow nurses for help. New questions then arise around the reliability of the technology in place to communicate with one another in times of emergency, when face-to-face interaction is urgently needed.

#### **4.5 Finding Four: Trust and Awareness**

Some participants (five of ten) indicated that a new level of trust and awareness between nursing staff has to be established in a SPR designed NICU. Participants discussed the newly established *feelings* of hoping other staff members are paying attention to one another's alarms. Participant P2-2 explains, "It's confidence that we have in our staff as part of this move, I know that someone else is sitting out there or is in the hallway and can hear that alarm going off...they're gonna get up and go." The feelings associated with being caught up in one room, and not being able to immediately respond to another assigned patient's alarm has caused feelings of isolation in others. Some participants felt uneasiness associated with hoping somebody is watching, but not knowing, because you can't directly see other staff. For patient safety, both hospitals have phone systems that relay alarms to other staff if the assigned nurse is unable to respond in a given time period.

In both settings, the charge nurses are no longer taking patient assignments unless the census is low. This has allowed the charge nurse to be a second set of eyes. A few participants expressed that if the charge nurse were not available to watch the central monitors, it would be very easy to miss patient events.

Participant P6-1 said that one of the biggest adjustments was the increased reliance on one person versus a group in general, as was the case in the open-bay designed units. She finds herself asking, “Who do I call to help me, because if I haven’t worked with them, I don’t know what they know or what they do. Are they comfortable with everything? So I’m gonna call the person I know, knows.” Participant P5-1 also discussed nurse face-to-face interaction with one another as a positive, as a way to develop a level of respect and a level of comfort, so that if staff have issues, they are comfortable seeking out one another.

#### **4.6 Finding Five: Safety and Patient Care**

Some participants (four of ten) expressed new patient safety concerns in the SPR designed NICU, including reliance on technology to communicate with one another and infection control. Yet, an overall improvement and ease in patient care was expressed. One participant noted that her concern was not on the SPR layout, but on the technology and the support space around it. She questioned, “Can I do my work and keep the baby safe in the room with the door shut?” Expressions of feeling “left out” in the decision-making process have left some participants upset, and struggling to adapt. Participant P4-2 emphasized

that major nurse workflow flaws could have been prevented if a staff nurse would have been involved in the design process, because the NICU is the only unit in the whole new hospital without alcoves with desks between rooms.

Additionally, a few participants expressed their concern with the substantial reliance on technology to communicate with one another. Although the use of phones does not directly address face-to-face interaction, one participant noted that in order to achieve a face-to-face interaction with another nurse, the first step is the use of a phone to call them. The heavy reliance on technology to monitor patients and to locate staff is presenting unexpected repercussions. Hospital site two nursing staff is experiencing the phenomenon of alarm fatigue, or the unintentional “tuning out” the alarm. In fact, the issue of alarm fatigue is now nationally recognized, and The Joint Commission (2013) announced clinical alarm safety as a 2014 National Patient Safety Goal.

In addition to relying on a telephone to communicate, accessibility of the phone also came into conversation. A few participants (three of ten) shared the difficulty of accessing their phone in a time of need, and in turn, caused interruptions to patient care. One participant (P3-2) expressed concern over the amount of time it takes to remove gloves, make a phone call, put their phone away, re-wash their hands, and re-glove; time can be critical when caring for vulnerable neonates. New levels of anxiety have washed over nursing staff, as they feel they are unable to voice their need for staff aide in a timely manner. For example, Participant P4-2 illustrated a common troubling situation: if a nurse is in a private room doing cares for a NICU patients, and other nursing staff are

spread throughout the unit, the nurse is unable to reach their phone (to call for help) or the staff assist button when their hands are tied up in the isolette; removing their arms from the isolette can interrupt critical patient care in an emergent situation.

Infection control is heavily cited as a benefit to SPR designed units.

However, two participants noted that the constant touching of things, in particular their phones, raised new infection control concerns. Participant P1-1 shares:

I would think that single patient rooms would be an advantage to infection control, and things like that, but I think the things that we're using to make this more accessible are creating an infection control problem. We're constantly touching stuff. We're constantly touching our spectra-links, or the monitors...*constantly*.

In response, one participant shared her experience with a voice-activated system that would permit hands-free calling amongst nursing staff. Allowing hands-free calling addresses infection control, and supports the communication between nurses without losing valuable time searching for and dialing a phone number. In addition, the voice-activated system could alert a staff nurse if another assigned patient was alarming, and immediately could give staff the option of deflecting the call to another nurse.

#### **4.7 Finding Six: Miscommunication**

Some participants (four of ten) expressed concern over the error in communication between staff and between family members in a SPR designed NICU. Because of the limited amount of back-and-forth conversation, nurses are finding that unintentional miscommunication amongst themselves has caused upset families. For example, one nurse might abide by the family member

capacity in the patient room, and after shift change, the next nurse might abide by a different number. It becomes a “good-cop, bad-cop deal,” shares Participant P4-2. Disagreements amongst nursing staff can also balloon quickly. Due to the separation of staff, a minor hiccup, can “all of a sudden turn into a big huge mushroom cloud,” shares Participant P1-1, “because we weren’t able to discuss it.

#### **4.8 Summary**

Using content analysis, data from eight one-on-one interviews and one group (two nurse) interview showed six major themes, including support, education, visibility, trust and awareness, safety and patient care, and miscommunication. The next chapter discusses the findings in relation to the three research questions. In addition, theoretical and practical implications for interior designers will be discussed.

## **Chapter Five: Discussion and Conclusions**

### **5.1 Introduction**

The purpose of this study was to explore nurses' interaction with one another in two SPR designed NICUs. Using a qualitative methodology, data from eight one-on-one interviews and one group (two nurse) interview were transcribed verbatim, and analyzed. This chapter presents the meaning associated with six key findings by addressing the research questions, practical and theoretical implications, limitations of the study, and suggestions for future research.

### **5.2 Discussion of Findings**

Findings will be discussed in their contribution to answering the following research questions:

1. How do nurses' interactions within the built environment contribute to overall communication of information in single-patient room designed neonatal intensive care units, and what does this mean for interior designers?
2. How are nurses' face-to-face interaction patterns affected by the shift to single-patient room designed neonatal intensive care units?
3. What designed features do nurses perceive to enhance and/or inhibit face-to-face interaction in single-patient room designed neonatal intensive care units?

Mathur's (2003) article, *A Single-Room NICU-The Next Generation Evolution in the Design of Neonatal Intensive Care Units*, suggested a need to

develop NICU configurations based on the use of private rooms, while at the same time mitigating the inefficiencies in communication technology. While this study contributed a narrative piece to existing quantitative knowledge, it also reinforced that inefficiencies still exist in the SPR model. It is clear through the literature and the findings of this study that the SPR designed NICU requires more intentional effort by nursing staff to achieve face-to-face interaction; but the importance and desire for face-to-face interaction has remained. As a result, nurses have adapted to their environment, and shifted the ways in which they achieve face-to-face interaction by the integration and heavy reliance on technology. In addition, what became clear from the data was that the SPR layout was not the sole cause of the phenomenon of nurse isolation, but rather, the configuration of the support spaces surrounding the patient rooms.

Nurses at both hospital site one (decentralized nursing stations) and hospital site two (centralized nursing station) expressed difficulty in finding one another at times, however, both identified different challenges. Decentralized nursing stations allow for nursing staff to be located close to patient rooms, and hospital site one nursing staff expressed their appreciation for having the ability to monitor patient closely. However, the lack of a central area and the heavy reliance on technology in order to communicate with one another leads to feelings of being distant from other staff members, and challenges in training new staff. Carlson et al. (2006) reinforced this idea, stating that the “cross collaboration” for novice and expert nurses in an open-bay unit is typically taken for granted.

Expert nurse participants of this study note they have had to shift the way in which they train new staff, empowering them to voice their struggles early, as experienced staff is unable to see them in private rooms. In addition, participants are finding the use of technology in order to communicate lacks the emotional connection that nursing staff were used to in the past, adding another layer of emotional isolation for new staff. Designers must consider the unspoken culture of nursing when designing healthcare facilities; they must question how the built environment will affect the culture of nursing, and what posing barriers to nurse collaboration could mean for their identity as a nurse. Uncovering the perceptions of what it means to be a nurse would hold value to the design community; designers have the opportunity to either threaten or support nurses' identity. What could this essentially mean for a nurse's ability to provide efficient, safe patient care?

The use of a central station has potential to lead to more face-to-face interaction, and the ability to find nursing staff quickly. Nurses in hospital site two noted they would hypothetically struggle to collaborate and lose the teamwork approach to patient care that they desire with the removal of a central nursing station. However, the concern of the nursing staff of hospital site two was the distance between the patient rooms located the furthest away from the central station. As noted in Section 4.4, these patient safety concerns have led to the intentional location of patients and families surrounding the central station, and the deliberate avoidance of using the rooms furthest down the hall. Staff is essentially creating "pods" of patient rooms within a loop-with-core configuration.

Whether this phenomenon is unique to the loop-with-core design is unknown from this study alone; further exploration of NICU configurations in terms of the placement of patient rooms in proximity to staff areas is needed.

The ability to visually monitor patients and other staff remotely is arguably essential in SPR designed NICU. Nurse participants discussed the importance of stepping out of the patient room to allow for family bonding, while at the same time being able to monitor patients and see one another. This justified Hor et al.'s (2004) research finding that the visibility of patients is the most important aspect of patient care in an intensive care unit, as conditions can rapidly change. It could be argued that it is equally important for staff to have visibility of one another for emergent times as well. There seems to be a misconception that patient alarm systems are adequate for this purpose; however, a few participants noted that while the alarms are adequate to notify staff when an event has already occurred, they are inadequate in preventing patient events from occurring.

Some design decisions appeared to be missing the human element, relying on technology where face-to-face interaction used to fall. As Gregory, a healthcare design industry leader with both nursing and interior design education, states in a recent interview, "Technology can enhance communication but cannot substitute for mentoring or lending a helping hand, so considering new technology must always include an eye on the human element" (Ferenc, 2015, p.29). Interior designers can serve as catalysts in the development and implementation of technology that enhances communication, and that is sensitive to human needs.

Lastly, perhaps one of the most valuable unspoken truths uncovered by one participant was the perceived neglect of nursing staff insight for the new design of the unit. This challenges designers to examine if the values society places on professional status have prevented those (i.e. nurses) with valuable patient-care insight from sitting at the table. The healthcare delivery system is increasing the demands of nursing staff, thanks to the increase of interdisciplinary practice teams (Daley, 2015). Design teams can, and should, recognize the increased responsibility of nurses, by including nurses in design discussions.

### **5.3 Implications**

**Practical Implications:** One design solution that addresses visibility are charting alcoves, or desk space in-between patient rooms (Figure 15); this could allow close proximity to patient rooms, and efficient and effective monitoring of patients outside of the patient room. It could also presents the opportunity for nursing staff to be visible to one another for small group collaboration. One technological solution hospital site one has implemented is webcams in all patient rooms, allowing remote monitoring of their patients. This technological solution has allowed staff to monitor patients from a decentralized nursing station, without being physically in the room, thus making themselves available for group chat within the decentralized nursing stations. As the majority of nurses also desired a small central area for collaboration and support; the implementation of a smaller central area would serve as reference point for staff, with the addition of smaller stations, or alcoves, throughout for small group



*Figure 15.* Example of nurse alcove (image source: Kleinerman, 2010)

conversation near patient care areas.

Findings from this study support the notion that pod/cluster style can be the most effective configuration for the NICU, supporting patient, family and provider needs. White (2014) suggests that a pod-style NICU configuration that would incorporate all of the above stated needs: private rooms (for patients and families), small central nursing stations (for staff), and respite areas (for general gathering). Walsh et al. (2006) identified the ideal quantity of patient rooms in pod-style to be eight to twelve patient rooms, with staffing of approximately six nurses. With this layout, fewer concerns of isolation were mentioned in their study.

As stated earlier, working in the NICU is a highly stressful job. Shepley (2014) notes that the importance of respite space for critical care staff is arguable be higher than other inpatient units. The addition of lounge space and/or access

to nature, has potential to act as both a space for rejuvenation, as well as a space for nursing staff to bond and build positive relationships in. Findings by Zborowsky et al. (2010) propose that nurses weigh social and emotional support over walking distance, suggesting that locating respite space outside of the unit can provide a physical separation from the unit, but not hinder nurse's ability to use the space.

Overall, it became evident in participant interviews that the involvement of nursing staff in the design process was limited, especially in hospital site two. As a result, hospital site two is experiencing some major workflow challenges.

Nurses should be involved in the design of nurse hospital units. Participant P4-2, a Nurse Educator and Registered Nurse, emphasized this importance stating:

“[It] goes back to having the right people at the table, especially the nurses, to just say this is *why* we need it...and this really just comes down to workflow. And if you want safe, effective, efficient patient care you need to have the nurses there to say, I would never [do this or that].”

As the largest group of healthcare providers, their voice is of utmost importance in designing spaces that provide the highest quality patient care.

#### **5.4 Limitations**

Several limitation of this study exists in the site selection, the research sample, and the data collection tool utilized. First, only two loop-with core configured hospital units were selected for the recruitment of the study population. Because of the unit configuration, the small size and the geographical location of the hospitals, the organizational culture and procedures might not match that of all NICUs, and findings may not be appropriately generalizable to

all NICUs.

This study only collected the perceptions of experienced nursing staff; new nursing staff (less than five years of experience) perceptions were not included. This limited the perspective of NICU nurses as a whole, and the findings cannot be generalized to all NICU nurses.

The majority (six of nine sessions) of interviews were conducted during the participant's shift, as required by hospital site one. Interruptions occurred (i.e. monitors, staff member questions), and may have been an inhibitor of being fully present during interview. Some nurse participants appeared distracted, frequently checking their watch to not go over the time limit of their break, or be late for the start of their shift. In addition, one interview included two nurses, and there was not equal participation from both participants; Bloomberg and Volpe (2012) verify the risk of unequal participant cooperation as a limitation for using group interviews as a data collection tool.

Interviews were conducted over six different days, and as nurse participants were asked not to share interview questions and responses outside of the interview, the researcher had little control over the conversation that took place outside of the interview. Participants were told their name and responses were not going to be shared with organization, however, participants could hold biases toward their organization as a result of being included in the design decisions making process, or simply for fear of appearing weak or vulnerable with negative comments.

Rashid's (2009) model does not take into account the heavy reliance of

technology that nursing staff uses to communicate with one another, and whether this type of interaction could be considered for different levels of patient complexity and acuity. In addition, Rashid's (2009) model only considers face-to-face interaction as a positive communication vehicle, but fails to address any chance of negative interactions that could occur amongst nursing staff.

### **5.5 Future Research**

Findings from the present study imply the need for future research analyzing the relationship between hospital characteristic, NICU characteristics, and nurse perceptions of workflow. These studies could then be linked to hospital or unit-level patient outcomes and nurse retention rates, as suggested by Gurses & Carayon (2007). Second, further studies of SPR designed NICUs need to address all NICU configurations, including L-shaped corridor and pod/cluster style, as this study only analyzed a loop-with-core designed NICUs. A study primarily focusing on nursing station design in the NICU would be of benefit to the design community. This issue covers a wide variety of topics such as patient monitoring, noise control, collaboration, and visibility. As literature continues to identify the nursing unit design as a variable in staff communication (Becker, 2007b; Gurascio-Howard & Malloch, 2007; Rashid, 2009), there is still a limited amount of generalizable data surrounding the best SPR design for the NICU, as unit management and organizational culture varies across settings. Lastly, this study uncovered that many of the workflow barriers in communicating with one another were a result of inadequate technology. As the transition to SPR designed NICUs is still in its infancy, the technology to monitor patients, as well

as communicate with one another, must be further explored in small, medium and large SPR NICUs.

There is a need for the development of interior design theories that involve human to human interaction. Rashid's (2009) model can be adapted for many CoP and Col groups, specific to NICU care, as well as expanded into all other hospital units. Col's would include more stakeholders and interdisciplinary practitioners, such as social workers, for example. With the increase in interdisciplinary care, it is essential for interior designers to consider all users of the space. With the paucity of literature surrounding interaction in hospitals, theories can act as a starting point to begin understanding the needs of hospital staff. The utilization of Rashid's (2009) theoretical model linking face-to-face interaction with patient type is a valid starting point for individual hospital units to test, as it takes into account the unique complexity and acuity of each patient population. Adapting and testing theory will contribute the design body of knowledge, and contribute to future healthcare design.

## **5.6 Summary**

In summary, it is evident the ideal NICU layout can allow nurses to visually monitor patients, while simultaneously allowing for nurses' face-to-face interaction. The inclusion of nursing staff in the design process allows for valuable insight for the future design of NICUs. The importance of nurse support and education, visibility, trust and awareness, along with the integrations of communication technology can be achieved with a thoughtful evidence-based design process, and a more inclusive design process. As participants noted the

vast improvement in patient care in the SPR designed NICU, the challenge for designers exists in creating support spaces and nursing station configurations that support the workflow of nursing staff outside of the patient room.

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## Appendix A

### Recruitment e-mail script:

Dear NICU nurses of [insert hospital name],

My name is Angela Boyle, and I am a graduate student at the University of Minnesota. I am currently enrolled in my final semester of my master's degree in interior design, and the Health Care Design and Innovation Certificate through the School of Nursing.

I am in the process of completing my master's thesis project, studying nurses' communication in single-patient room designed NICUs. [Insert hospital name] has been selected as a site, and has been approved through the Nurse Research Review Board.

Currently, I am seeking **5+** NICU nurses to participate in the study. Criteria for participants includes the following:

- (1) Must be nursing staff
- (2) Must have 5+ years experience working as nursing staff
- (3) Must be 18+ years old
- (4) Must have worked in old NICU for a minimum of 6 months prior to move or remodel

Data collection will consist of an approximate 30-45 minute face-to-face interviews, including four open-ended questions about how the physical environment (single-patient rooms) affects staff communication on the unit. Interviews will be conducted [insert location information here]. Please see the attached consent form for more information about the study.

**Available interview times include the following: [insert dates here].** Please contact me to schedule interview times, or with names of other staff members you may think would be a good fit. I am willing to answer any questions that you may have for me by email ([giamb007@umn.edu](mailto:giamb007@umn.edu)) or telephone (320-266-8871).

Thank you very much!

-- Angela Boyle  
Graduate Student, Interior Design :: Teaching and Research Assistant  
College of Design, University of Minnesota

## Appendix B

### CONSENT FORM

*Interviews for Master's Thesis*  
*Angela Boyle, University of Minnesota, College of Design*  
Study Number 1411E56781

You are invited to participate in a research study about nurses' communication in single patient room designed Neonatal Intensive Care Units (NICU). You were selected as a possible participant because you are a NICU nurse, with a minimum of five years experience in the NICU, currently working in one of two identified hospitals. I am seeking your input to better understand how the built environment affects nursing staff interaction.

#### **Background Information**

The purpose of this study is to understand how the built environment affects nurses' interaction in single patient room designed NICUs.

#### **Procedures**

If you agree to be in this study, I will ask you to participate in an interview, asking for your opinions and needs. I will not ask you to share confidential information about patients or other staff members. Rather I want your own opinion about the physical environment in which you work. At the end of the study, demographic questions will be asked of you; you can respond or decline to respond any or all demographic questions.

#### **Risks and Benefits of Participating in the Study**

The study poses minimal risks. Interview questions will ask for your opinion, along with your needs and desires. You may refuse to answer any question that may make you uncomfortable.

#### **Compensation**

A \$5 gift card to a local coffee café will be offered with this research study.

#### **Confidentiality**

Interview answers will be kept confidential. No individual will be named on interview field notes, as well as any reports or presentations made on behalf of your experience. Final reports and presentations will not include any information that would identify a participant.

Research records will be kept in a secure, safe location and only the researcher will have access to those materials. All data, records, and potential photographs will be securely destroyed and shredded at the end of the spring semester or June 1, 2015.

#### **Voluntary Nature of the Study**

All participation in this study is voluntary. The decision of whether or not to participate in the study will not affect your relationship with your home facility (including staff and administration) or the University of Minnesota. If you decide to participate in the study, you are welcome to refuse any answer or withdraw your participation at any time without affecting the aforementioned relationships.

**Contacts and Questions**

Any questions or comments you may have about the project, interviews, reports, or presentations may be directed to the primary investigator’s academic advisor, Dr. Abimbola Asojo at aasojo@umn.edu. Any questions you may have now or later are welcomed.

If you have any questions or concerns of the study that you would like to discuss with someone other than Dr. Abimbola Asojo, you are encouraged to contact the Research Subjects’ Advocate Line, D528 Mayo, 420 Delaware Street SE, Minneapolis, MN 55455, or (612) 625-1650.

You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate. You may withdraw at any time without prejudice after signing this form should you choose to discontinue participation in this study.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

- I consent to have the interview recorded \_\_\_\_\_
- I do not consent to have the interview recorded \_\_\_\_\_

## Appendix C

### Intro and explanation of consent form:

I want to thank you for meeting with me today. Your story and experiences are so important in this study. As you know, you were selected as a possible participant because you are a NICU nurse, with a minimum of five years experience in the NICU, currently working in one of two identified hospitals. This study seeks to understand how the built environment affects nurse communication on your unit. I will be asking you a series of questions about your experience as a NICU nurse on the unit. First, I would like to go over the consent form, so you are informed of your rights as a participants [go through consent form]. Do you have any questions before we begin?

I would also like to record our conversation. I may not remember your exact responses tomorrow and beyond, and it is important to me that I accurately document your experience. With your consent, I would like to start recording now. This recording will not be shared with anyone else [participant: check box and sign on consent form if agree to record].

Question 1 and prompts: Describe the overall interaction between nursing staff in the single-patient designed unit. (**Prompt: Needs? Challenges? Successes?**)

Questions 2: Talk to me about the role of face-to-face communication versus phone conversation?

Question 3 and prompts: How would you rate the overall efficiency of information flow between nurses in the unit? (Prompt) What is preventing you from achieving max efficiency?

Question 4 and prompts: What single environmental [design] change would you suggest to improve nurse's interaction with one another?

### Participant Information:

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**Age (choose one):** 18-25, 26-35, 36-45, 46-55, 56-65

**Gender (choose one):** male / female

**Highest education:**

**Title at work:**

**Work shift (choose one):** Days / Evening / Night / Variable

**Years of experience in current NICU:**

Describe Interview Setting:

Appendix D

Name: \_\_\_\_\_

**Age (choose one):** 18-25, 26-35, 36-45, 46-55, 56-65

**Gender (choose one):** male / female

**Highest education:**

**Title at work:**

**Work shift (choose one):** Days / Evening / Night / Variable

**Years of experience in current NICU:**

**Questions:**

(please provide a floor plan, if possible)

NICU Level: \_\_\_\_\_

Date of transition to New SPR unit (MMYY): \_\_\_\_\_

Square Footage of unit: \_\_\_\_\_

Patient room square footage (this is typically on floor plan): \_\_\_\_\_

Patient room layout (# single rooms, # twins, etc): \_\_\_\_\_

Demographic of nursing staff (How many PCA/LPN/RN/APNP?): \_\_\_\_\_

Nurse-to-Patient ratio range: \_\_\_\_\_

Number of nursing stations: \_\_\_\_\_

a. Decentralized vs. centralized: \_\_\_\_\_

Other staff spaces on unit? \_\_\_\_\_

Call system used: \_\_\_\_\_

Patient monitor system used: \_\_\_\_\_

\*Additional information regarding effectiveness of nurses' communication on the unit: