

The Third Generation of Newborn Intensive Care Unit Design

Hospital environments for the tiniest patients have been evolving since the field of neonatology was established as a specialty during the 20th century. Recently, the volume of admissions and the number of hospitals with newborn intensive care units (NICUs) have soared. Hospitals have many reasons to change the way that these growing facilities are designed. NICU infants are no longer considered very small patients who can be cared for in large, open hospital wards with minimal space. Distinct signs of a new era are reflected in the latest generation of NICU designs.

Hospitals are altering their NICU facilities to respond to increasing family expectations, new clinical research findings, staffing shortages, budget issues and new technology related to monitoring, clinical care, and communications. A few hospitals are implementing innovative design concepts such as single-bed rooms, which are the most sweeping departures from the NICUs of previous generations. Other examples of change include building new headwalls placed at angles for privacy, adding family “villages”, and strategically positioning windows in NICU patient care areas with remote-controlled darkening. Anyone making decisions about a future NICU design should understand these recent innovations, what is driving change, and the latest planning tools.

EMERGENCE OF MODERN NICUS

A short visit to the past helps put into perspective the significance of what is on the horizon for NICU design. The advent of caring for fragile newborns in hospitals was a remarkable improvement over early non-hospital settings, such as incubators on the Midway at the Pan-American Exposition in Buffalo, New York, in 1901, and baby-tents on the wharfs of New York and Lake Shore Drive in Chicago where sickly newborns got fresh air in 1911⁽¹⁾⁽²⁾. The first premature infant center in the United States was not established until 1914 and was enlarged in 1922 at the Sarah Morris Hospital in Chicago⁽³⁾. This center was a landmark step in advancing concern for sick infants.

The first generation of hospital accommodations that resembled today's NICUs began in 1960 when Dr. Louis Gluck established the first American newborn

Unless recently renovated, most NICUs built during the 1980s and early 1990s are undersized with far less space than today's norm for new construction, which is at least 120 net square feet per infant.

intensive care center at Grace New Haven Hospital in Connecticut⁽⁴⁾. The NICUs that followed were typically large, open, brightly lit rooms. They had almost twice the usual 20 to 24 square feet allocated per baby in the nurseries for “well” infants, but far less than adult intensive care units. NICUs were established mostly in regional facilities and provided complex care of premature infants with specialized equipment and staff. In 1976, the March of Dimes published *Toward Improving the Outcome of Pregnancy*⁽⁵⁾, a seminal document encouraging the regionalization of neonatal care and putting levels of NICU care into action.

The second generation of modern hospital NICUs in the United States emerged twenty years later. The most notable changes of the 1980s included the remarkable event of successfully administering surfactant, which dramatically decreased mortality and morbidity for premature infants with respiratory distress. Surfactant replacement therapy and other clinical advances required facilities to accommodate an increasing percentage of micro-premies, as babies with gestational ages of only 23 – 25 weeks were surviving in record numbers.

During the same decade, the first edition of *Guidelines for Perinatal Care* was published (1983) and provided a set of design guidelines that became the “Perinatal Bible”⁽⁶⁾. The fifth edition was published in 2002 and remains a valuable planning resource. These guidelines and other publications and conferences pushed NICU design into the limelight and more state agencies began developing minimum NICU design standards. Three notable results of this attention were: (1) the eventual equipping of almost every delivery room or delivery suite in the United States for neonatal resuscitation, (2) specific hospital facility guidelines for planning intensive care nursery bedside space, and (3) recognition that families and family space should be part of the NICU.

By the late 1980s, it was good news that thirty states had minimum standards for intensive care nurseries, often referred to as special care nurseries. The bad news was that these standards were inconsistent, and some had size minimums as low as 24 to 50 net square feet per baby. This situation did not support

the efforts of NICUs to expand their cramped space that was increasingly being filled with ventilators, intravenous therapy (IV) poles, and places for staff and family to sit. Only California, Iowa, Illinois, Louisiana, Indiana, Michigan, North Carolina and Pennsylvania had minimum standards above 50 square feet, according to a 1988 study by Ross Laboratories⁽⁷⁾. Unless recently renovated, most NICUs built during the 1980s and early 1990s are undersized with far less space than today's norm for new construction, which is at least 120 net square feet per infant.

THE NEWEST GENERATION OF NICU DESIGN

What distinguishes members of the newest generation of NICU design is the boldness of their recent and planned changes. They are the first ones transforming their facilities to support significant changes in relationships among infants, their families and professional caregivers. They are striving to harness the environment rather than accept it as uncontrollable.

Where are these third generation hospital NICUs? As expected, some NICUs are in regional birth centers that replaced NICUs after exhausting renovation options, and others are at progressive children's hospitals. Other NICUs are part of a recent phenomenon, a new group of NICUs that popped up in numerous community hospitals and offer a level of care between the newborn nursery and the most comprehensive NICUs. Opportunities for innovative design changes paralleled rapid growth in NICUs in the United States. From 1982 to 2002, the number of NICUs in the United States more than doubled from nearly 350 to 825⁽⁸⁾⁽⁹⁾.

LESSONS FROM THE CUSP OF THE THIRD GENERATION

Retrospectively, several NICUs are viewed as having been on the cusp of the third generation of modern design and paved the way for the latest, innovative designs. The Washington, DC, area was the home of

several of these units, although there were others throughout the nation. The experiences of these hospitals provided lessons that are still valuable about what works and what does not work.

For example, Children's National Medical Center converted to six bays for their 40-bed unit in 1988, bucking the norm of large open NICUs. Six bays contained six beds each, with two of the bays enlarged to include two private isolation rooms each. The bays provided more control of the environment with diminished noise and flexible lighting. The design supported individualized care of the patients and allowed more optimal staffing patterns by integrating, rather than separating, intensive and non-intensive care patients. Another feature that was a relatively new idea at that time was a parent sleep room, where parent and infant could room-in prior to discharge.

Today, the concept of having parents practice caring for fragile babies in a "homelike" environment just before hospital discharge has become more of the norm than the exception.

In 1989, Dr. Gordon Avery, a neonatologist at Children's National Medical Center and a leader in the development of modern neonatal thinking, published an article that described "The Gentle Nursery: Developmental Interventions in the NICU"⁽¹⁰⁾. He and his colleagues advocated the philosophy of care defined today as managing "the environment and individualizing the care of the premature infant based on behavioral observations. The goal is to promote a stable,

well-organized infant who can conserve energy for growth and development"⁽¹¹⁾. Sharon Shoyer, responsible for critical care at Children's National Medical Center, said that the most important lesson learned was the imperative to have all disciplines participate in the design including intimate evaluation of a mock-up of the bedside prior to construction⁽¹²⁾.

Fifteen years ago, supporters of traditional NICUs were skeptical and often considered designs like National Children's to be "fads". These early alternative designs, although not perfect, seem to be withstanding the test of time as are many notions about developmental care.

Today, the concept of having parents practice caring for fragile babies in a "homelike" environment just before hospital discharge has become more of the norm than the exception.

A few years later, Dr. Lloyd Kramer and his colleagues were instrumental in the development of a 50-bed NICU in Northern Virginia at INOVA Fairfax Hospital for Children⁽¹³⁾. Their new facility opened in 1992. The NICU included many features indicative of the new generation of design. One of the most provocative features was the inclusion of seven two-bed rooms interspersed at the end of open pods of 10 beds each. Fairfax provided one of the highest ratios of these individual rooms to total beds in the country at that time. Although not necessarily intentional, the unit was one of the forerunners of the single and double bed room units. The smaller rooms were intended to provide isolation and flexibility when needing to close down areas for cleaning and for cohorting babies in the rare event of an infectious outbreak. Over time, Fairfax learned that they could effectively serve many other needs in these rooms, such as places for infants with prolonged lengths of stay, families with special social needs, and infants requiring minimal stimulation.

Fairfax worked carefully with their architects and engineers to include these other design features:

- Access to natural light but far enough away from the patient bedside to avoid heat loss and gain
- An air handling system that disperses air through tiny holes and helps eliminate the common draft problem found in many NICUs
- Consistent and flexible headwall design at every patient care space
- A unit without structural obstacles, such as support columns, located in the middle of the patient care area
- Adequate storage provided in three tiers (centralized, adjacent or within the patient care area, and bedside storage)

Another early innovator was Rainbow Babies and Children's Hospital, which had opened a unit for transitional care babies with mostly private rooms in 1987. Good communications technology and practices were critical elements for their success. Alta Bates Summit Medical Center in Berkley, California, was not far behind with their two-bedded room design that they had planned for many years and implemented in 1998. Concepts such as carpeted NICUs became more common throughout the country with early examples at Loma Linda University Medical Center in California and Memorial Hospital of South Bend, Indiana. The Children's Medical Center in Dayton added a few new innovations with an angled headwall design, referred to as a "pin-wheel", that provided increased privacy and new ways to personalize space at the bedside.

The forerunners and pioneers of the new generation of design are too numerous to mention individually, but excellent ideas can be drawn from a variety of NICUs, and are defined in the next section of this paper. The body of ideas continues to grow as research and an increased focus on evidence-based design shapes the development of new models of care and design.

SIGNATURE COMPONENTS OF THIRD GENERATION NICU DESIGN

What sets apart the third generation of NICUs from others? The following list is a compendium of fifteen actions and principles that define this unique generation of NICU design.

~ Deeply Involve Family and Hospital Caregivers in Design

- Actively and effectively involve families and other hospital caregivers from all disciplines in the development of the design
- Promote the principle that families and professionals working together results in the best design
- Have caregivers formally "sign-off" on the design to indicate their support of the general plan
- Examples of results of family involvement include relatively small changes, such as referring to the new nursery with a more parent-friendly term "newborn" intensive care rather than the clinical term "neonatal", to major design changes such as separating a family waiting area into one quiet and one active family lounge within rather than outside the unit

~ Make Privacy a Priority

- Significantly increase the percentage of single bed rooms or their equivalent, such as private cubicles with ample space for patients, families, staff, and technology
- Include visual and audible controls, whether in single bed rooms or open designs
 - Assure that measures support the practices of skin-to-skin contact and breastfeeding/pumping at the bedside in privacy, in addition to protecting confidentiality
- Provide more visual division of patient care areas:
 - Replace "fishbowl" unit designs
 - Eliminate large public viewing windows
 - Use video-viewing for family and close friends who are unable to come into the unit

~ Investigate and Procure Advanced Communications Technology and Monitoring Systems

- Acquire, train, and use communication and monitoring technology
 - Pay almost excessive attention to this technology when going to much larger space
 - Demonstrate the value of replacing “yell across the room” and “wave your arms” methods of getting assistance from a colleague with better systems
- Embrace the notion that communications technology provides safer environments and better connectivity among staff and between family and staff
 - Question the often closely held beliefs that all babies should be constantly visually watched by a nurse 24/7 and babies must be clearly seen from a central station(s)

~ Provide Flexible Infant Care Areas

- Provide a “universal” patient care area that will support a variety of levels of patient acuity
 - Universal does not mean that every NICU should have the identical design
 - Instead, most of the patient care beds within a hospital should be consistent in design and size
- The design should:
 - Support practices requiring decreased patient movement and fluctuating census (less “graduation” of NICU patients)
 - Have adequately sized infant care areas, usually exceeding a minimum standard of 120 square feet for intensive care (definitely more than 120 feet with private rooms)
 - Use a standard set-up rather than having to become familiar with a variety of outlet and headwall designs throughout the unit
 - Provide flexibility for a staff member to care for patients with different levels of acuities, assuming proper staff to patient ratios
 - Results often include easier nurse scheduling when staff are cross-educated to care for all levels of infant acuity versus specialized for only one level of care
- Demonstrate fiscal prudence by:
 - Documenting that lower risk patients do not need significantly less space than babies on ventilators due to need for therapy devices and family needs, excluding ECMO
 - Showing that designing for flexibility is more cost effective due to fluctuating census and staffing issues

- Separate lower risk babies about to go home and their families from babies who require higher technology and more intensive care when the appropriate amount of privacy and space cannot be provided for these patients through unit design

~ Provide Purposeful and Dedicated Space and Activities for Socialization

- Address socialization needs for both staff and families, do not simply assume it will happen with a new, bigger unit
- Examples of family socialization initiatives are:
 - Organizing family social hours on the unit
 - Mother’s breastfeeding support groups
 - Scrapbooking sessions
 - Group education
 - Father’s coffee
- Examples of staff socialization initiatives are:
 - Formal staff social committees to plan events
 - Top of the shift meeting to decide who is going with whom on breaks and meals and when
 - Staff newsletters and bulletin boards
 - Comfortable, convenient break rooms or other gathering areas
 - Champions to encourage the feeling of “family” and inclusion among multi-disciplinary staff
- Examples of combined social interaction between staff and families are:
 - “Ask the expert” lunches
 - Reunions
 - Joint participation in quilt-making and other craft projects

~ Design Efficient Non-Revenue Generating Space

- Use hoteling and hot-desking of office space that can be shared rather than providing individual offices for itinerate staff
- If needed, make trade-offs such as providing outstanding staff break and conference space instead of numerous private offices for people who occupy an office a small portion of their work time
- Provide staff with personal, mobile, lockable storage for office work and supplies
- Provide efficient corridors and other circulation space; consider typical staff travel time in the new design, maintenance costs and housekeeping costs
- Reinvent work stations for better productivity
- Replace large, loud, central “nurses stations” with more decentralized or mobile work sta-

- tions – prepare for technology changes
- Provide the right amount of inventory and storage space on the unit
 - Carefully plan storage and stocking systems rather than encouraging the hoarding of supplies and equipment

~ Make Provisions for Family Space

- Enable family to personalize the infant care area; consider the bedside the patient’s bedroom
- Provide a place to rest or sleep near or at the bedside (recliner, sleep chair, daybed, cot)
- Include sufficient space and technology for family access to computers, including access to Internet technology and web cameras
- Provide space or processes to accommodate siblings who accompany parents
- Address other needs such as waiting, lounge, sleep, security, showers, laundry, toilets and nourishment

~ Include Access to Natural Light and Flexible Light

- Provide staff and family access to natural light with attention to heat loss and gain of windows, especially nearest to infants
- Transform and control lighting
- Eliminate large banks of fluorescent lights over babies
- Add rheostats to electric lights and darkening features to windows
- Provide lamps for “light showers” for staff if natural light is limited

~ Measure and Attenuate Sound

- Use texture, carpet, ceiling tiles, inaudible alarms, quieter equipment, and behavioral changes that help control the environment
- Provide ability to reduce unwanted stimulation of infants due to sound, vibration, touch, light and other sources, when appropriate

~ Use Evidenced Based Design

- Review or do the research so that the design ideas are data and experience-driven
- Provide the documented rationale behind requests for new design features to the stakeholders and others

~ Connect with the Community, Families and Staff through Interior Design

- Use themes and replace traditional pink and blue baby decor with interior design that is meaningful for families and staff. Examples of themed NICU designs include:

- Bridge to home theme for a city noted for its distinct bridges
- River/nature theme for a city located on the banks of a river
- Victorian home theme that mimicked the local neighborhood architecture
- Choose artwork that is not offensive to diverse cultures represented in the population served and staffed by the NICU

~ Design Controls to Regulate Temperature

- Control/eliminate air drafts and provide adequate thermostat and humidity controls
- Equipment should provide notifications, warnings or controls so that range is maintained (from ambient temperature to refrigerator/freezer temperatures)

~ Design Sufficient Storage

- Analyze storage space needs for supplies, equipment, medicine, breastmilk, furniture, and anything else that needs to be stored for the NICU operations; well-document these needs and assure that they are used during design
- Think forward about advances or changes that are likely to impact future storage needs
- Consider three-tiered storage space and stocking process; include centralized, unit-based, and bedside storage

~ Provide Continuity of “Champions”

- Replace project champions and informal leaders from any discipline who change or leave during the process with people who are equally passionate and interested so that the process is less apt to become dysfunctional or revert to old habits

~ Use Proven Planning Tools

- Implement meaningful pre- and post-occupancy evaluations
- Use methods that provide more precise prediction of bed need
- Use change management processes so that philosophy and operations drive design rather than vice versus
- Use other tools such as site visit checklists, construction mock-ups and benchmarking

While there is a high level of focus on family in this list, the best NICU design cannot relieve stress from a family who learns that their baby is fragile or ill and requires intensive care. A key goal of good NICU design should be to not add stress to the family’s experience. While this goal seems simple, the medical envi-

ronment required to care for these tiny patients makes it complex.

The components in this list should not be viewed as cookie-cutter standards for NICU design. Each facility should have a multi-disciplinary team planning a facility that supports their own philosophy of care and needs. The team should challenge caregivers, architects, and others to think beyond the familiar.

THIRD GENERATION PLANNING TOOLS

Planning tools used by third generation NICUs merit further mention because they are so valuable for success. Simulation modeling, pre-and post-occupancy evaluations, site visit checklists, construc-

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FIFTEEN PRINCIPLES OF THIRD GENERATION NICU DESIGN

- 1) Deeply Involve Family and Hospital Caregivers in Design
- 2) Make Privacy a Priority
- 3) Investigate and Procure Advanced Communications Technology and Monitoring Systems
- 4) Provide Flexible Infant Care Areas
- 5) Provide Purposeful and Dedicated Space and Activities for Socialization
- 6) Design Efficient Non-Revenue Generating Space
- 7) Make Provisions for Family Space
- 8) Include Access to Natural Light and Flexible Light
- 9) Measure and Attenuate Sound
- 10) Use Evidenced Based Design
- 11) Connect with the Community, Families and Staff through Interior Design
- 12) Design Controls to Regulate Temperature
- 13) Design Sufficient Storage
- 14) Provide Continuity of "Champions"
- 15) Use Proven Planning Tools

tion mock-ups and operational improvement methodology are just a few of the tools that have been used successfully by many of the nation's leading health care organizations when planning new or renovated facilities.

Simulation modeling has been particularly beneficial in predicting the appropriate number, type and mix of patient beds and staff for NICUs and other hospital services. Simulation modeling is a method that is scientifically advanced beyond the Poisson mathematical model and ratio formulas used to predict bed and staffing needs in the past. Simulation allows the testing and analysis of the impact of practice changes on bed and staffing requirements. For example, the analysis can take into account

differences in census that occur by day of the week and hour of the day due to discharge processes.

Many hospitals are still basing the number of NICU beds on arbitrary or unorthodox methods such as asking a group of stakeholders how many beds they want or on what the architects think will fit in a defined space. Space constraints and stakeholder input are important considerations, but they are more powerful when validated by proven methods. These recent results from the use of simulation modeling by Smith Hager Bajo clients demonstrate the value of using this tool in the planning process:

- Confirmation and rationale for the number of NICU beds needed for a growing children's hospital service; information used successfully for Certificate of Need (CON) approval of more than 100 NICU beds, an increase from approximately 85 beds.
- Identification of the most efficient staffing mix and number and types of beds needed for a birth facility considering multiple types of models of care.
- Approval of a \$28.4 million building project given demonstrated cost savings over initial cost projections. Savings were achievable through changes in practice patterns and staffing identified through use of the model.
- Immediate approval of a contended CON, largely based on clear demonstration of bed need for a new perinatal facility, without the expected CON hearing.

Simulation modeling starts with an assessment

process to collect data. The assessment includes discussion of “what if” scenarios. The model provides the ability to compare results using different operational patterns, models of care, and volumes.

THE STATUS OF SINGLE ROOM NICU DESIGN

The single room design model for NICUs has been quietly and slowly gaining acceptance and is an example of third generation design. The number of hospitals with the model is small. Approximately a dozen pioneering hospitals had converted or were constructing a significant proportion of their NICU beds as single rooms, according to an early 2003 estimate by Smith Hager Bajo. This number is expected to continue to grow over the next decade, but this model is most likely to continue to be an alternative rather than the norm in the near future.

As with many innovative design ideas, the history of the “single room NICU bed” concept is more the result of evolution than a brand new invention. The evolution is similar to the transformation of many adult and pediatric intensive care units from open wards to single and double bed rooms during recent decades. The movement is now beginning in the newborn critical care setting. While hospitals are not required to provide single bed rooms for most of their critical care patients, pressure is increasing to move away from the open wards of the past. A sign of the times is the Texas Department of Health’s requirement that in hospitals providing a neonatal critical care unit (NCCU), “there shall be at least one enclosed private room for every six bassinets or cribs...with at least 100 square feet of clear space (each)”⁽¹⁴⁾. This Texas Administrative Code applies to new construction and is blazing new territory to address the needs of these patients and their families.

While the following observations about single room design are anecdotal and based on interviews by Smith Hager Bajo, they provide insight into areas that deserve empirical research:

- Hospitals with a large portion of single rooms reported that they did not increase nurse-staffing ratios, but reported that concerns about staff social-

ization and feelings of isolation need to be addressed in planning.

- More hospitals seem to be moving away from designing and separating infant care spaces by multiple levels of care and are designing “universal” NICU patient care areas to accommodate a variety of acuities. Their intentions appear to be to provide greater staffing flexibility, accommodate fluctuating census and respond to families’ requests.

- Some NICU management believes that their growers and feeders need less space and can double up in an area when census peaks, but other hospitals believe that the inclusion of more family and the use of swings and other devices for therapy require just as much space as intensive care – with the exception of requirements such as extra corporeal membrane oxygenation (ECMO), which are greater.

- If the hospital has a mix of single and other types of beds, then specific, logical criteria about who gets what type of space and compliance with these criteria are essential. Common criteria include prolonged length of stay, minimal stimulation, grieving, acuity, specific social needs, parent care, and isolation, if the air handling is appropriate.

- Provisions for multiple births should be factored into design, especially with the more common occurrence of

twins and triplets. Co-bedding is an option for some babies, while other patients should be near their hospitalized siblings for family convenience when co-bedding is inappropriate. Headwall design with the potential for expanded capacity and the clustering of patient care areas are two common solutions.

- Developmental care continues to be linked with ideas such as single rooms. A fairly recent study published in the *Journal of Perinatology* indicated that 64% of NICUs in the US reported that they had developmental care in place and 24% more NICUs were planning implementation at the time of the survey (Ashpaugh & Leick-Rude, 1999).

Examples of Hospitals with Significant Proportion of Single Room NICU Beds (*Number of Beds are Totals – not Number of Single Room Beds*)

- Blank Children’s Hospital, Des Moines, IA (35 beds)
- Children’s Regional Medical Center, Seattle, WA (19 beds)

Simulation modeling has been particularly beneficial in predicting the appropriate number, type and mix of patient beds and staff for NICUs and other hospital services.

- St. Luke's Hospital, Cedar Rapids, IA (22 beds)
- Rainbow Babies and Children's Hospital, Cleveland, OH (69 beds)
- Providence Medical Center, Everett, WA (29 beds)
- Evergreen Medical Center, Kirkland, WA (19 beds)
- Community Memorial Hospital, Menomonee Falls, WI (16 beds)
- Genesis Medical Center, Davenport, IA (20+ beds)

Hospitals Planning Significant Proportion of Single Rooms in NICU: *(Please note that this list is based on preliminary planning; all hospitals' plans are subject to change and none of these units were completed at the time this article was written)*

- Maine Medical Center, Portland, ME (50 beds)
- Monroe Carell, Jr., Children's Hospital at Vanderbilt, Nashville, TN
- The Maria Fareri Children's Hospital at Westchester Medical Center, Valhalla, NY
- Gaston Memorial Hospital, Gastonia, NC
- California Pacific Medical Center, San Francisco, CA
- Florida Hospital, Orlando, FL
- Magee-Women's Hospital, Pittsburgh, PA (62 beds)
- Nebraska Health System, Omaha, NE
- Children's Hospital of Denver, Co – (45 beds) reportedly considering 50% private beds in new facility at this stage

SUMMARY

What will the next generation hold? Technological advances will continue to play a large role in supporting design innovations. Technology will support even more global dissemination of information in this field and at a much faster pace than in the past. Information is being exchanged internationally already, as is evidenced by the single room NICU being planned in New Zealand and a European NICU that provided cots for parents between infant beds. A few NICUs used a Scandinavian benchmark to design family sleep space before there was relevant experience in the United States. Guidelines for design will continue to be researched, updated, and shared in a timelier manner. One example is the process begun in 1992 by a multi-disciplinary committee who produced and periodically updates the document, *Recommended Guidelines for Newborn Intensive Care Unit Design*⁽¹⁵⁾.

As a point of balance, some believe there is an over-supply of neonatologists and a disregard for the benefits of regionalization in the United States, but these beliefs have not resulted in widespread social and economic scrutiny of NICU admissions,

lengths of stay, outcomes and the number of facilities or beds. Increased scrutiny is likely in the future whether it is based on these beliefs or other drivers. The wise planner will balance innovation and cost-effectiveness, and will realize that the learning curve for designing the next generation of NICUs will get steeper. Yet, the results will be even more rewarding.

The following case study provides a glimpse into the story of how one hospital took on the task of planning a third generation NICU design.

CASE STUDY: SINGLE ROOM NICU DESIGN PLANNING PROJECT

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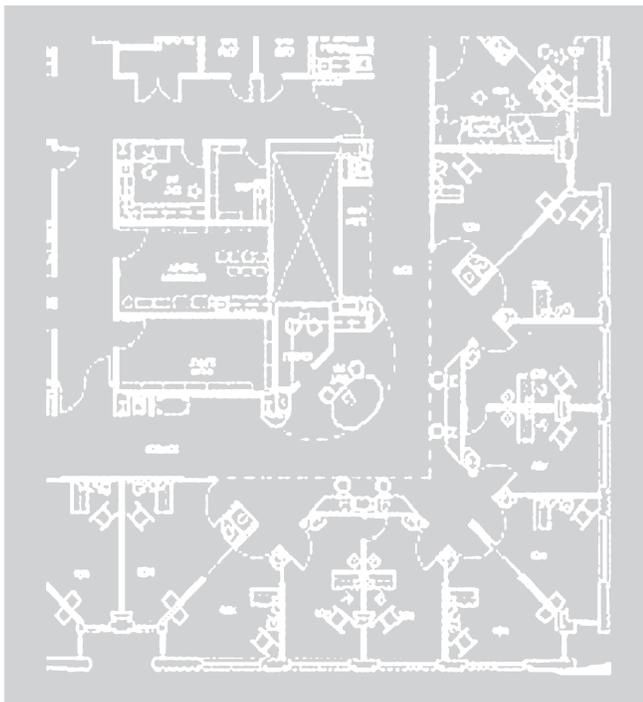
Recently, plans were developed for a new Woman and Infants building with a 50-bed newborn intensive care unit (NICU) at Maine Medical Center in Portland, Maine. Each of these beds will be located in a 180 square foot private room to enable parents to stay with their infants and enjoy greater privacy. Currently, all the newborn intensive care beds are located in a large open room with each patient care area having less than 80 square feet of floor space. The new private NICU rooms will be organized into five semi-circular clusters of ten; a staff station is located in the middle of each cluster to optimize visibility and minimize the walking distance to each room (Figure 1).

This change in delivery of care was a great concern to the clinicians, as they would have to drastically change the way they practice. They were not sure if they would be working as effectively as a team or as individual caregivers. In the proposed design, they would be working in separate rooms and even in different clusters instead of working in one large open room. During the process, several parent focus groups were conducted. Families expressed support for a design with increased privacy and more space in the NICU.

The hospital rented a space in a nearby warehouse to build a full size mock-up of one of the 10-bed clusters. Physicians, nurses, and support staff visited the mock-up numerous times with the design team. Walls were moved, details were reviewed, and sizes of wall openings were changed based on the user comments. Users demonstrated a mock "code"

response to test the size of the doors, width of the paths and critical dimensions of the rooms. Temporary equipment was located in the rooms to portray a sense of the space. At the end of the process, the design team documented and prioritized the comments and integrated them into the design. The process significantly changed the original design but actually did not add any cost to the construction value.

Hospital administration, the architects, TRO/The Ritchie Organization in Boston, other members of the design team, and the healthcare consultant from Smith Hager Bajo, could not alleviate the clinicians' communication concerns despite presenting numerous sketches, full-size mock-ups, and proven statistics. Eventually, the clinicians visited a similar NICU in Seattle, Washington. They saw a private room facility and discussed the new design and operational changes with their peers. Finally, the testimonies and experiences, including communication technologies of their peers, convinced them that the private room approach was a viable solution. Consensus was achieved and detailed design continued. This case study demonstrates the complexity of planning a new NICU. More importantly, it emphasizes that deeply involved staff from multiple disciplines must champion the project to assure success.



(Figure 1) Example of one of the 10-bed pods of single rooms within the 50-bed unit planned for the Barbara Bush Children's Hospital NICU at Maine Medical Center.

FOOTNOTES/REFERENCES

- (1) Correspondence, "Exhibit of Infant Incubators at the Pan-American Exhibition", *Pediatrics*, 12:414-419, 1901
- (2) Allin, F. "The Baby-Tents of Chicago", *JAMA* 57(27):2127-2128, December 30, 1911
- (3) "Neonatal Intensive Care, A History of Excellence", NIH Publication No. 92-2786, October 1992
- (4). Gluck L. "Why P/N?" *Perinatol. Neonatal.*, July/August 1977
- (5) *Toward Improving the Outcome of Pregnancy*. White Plains, NY, National Foundation-March of Dimes, 1976
- (6) *Guidelines for Perinatal Care*, American Academy of Pediatrics/The American College of Obstetricians and Gynecologists, 1983
- (7) Hager, D. Bajo, K. Smith, J et al, *Perspectives in Perinatal and Pediatric Design*, Ross Laboratories, June 1988
- (8) Basler, D. et al: 1982 *Guide to Centers Providing Perinatal Neonatal and Special Care*. Ross Planning Associates, Ross Laboratories, September 1982
- (9) *Hospital Statistics, 2003 Edition*. Chicago: Health Forum, LLC, 2002, p. 153
- (10) Avery, G. "The Gentle Nursery: Developmental Interventions in the NICU" *Journal of Perinatology*; Volume 9(2): 204-206)
- (11) Byers, J. F. "Components of Developmental Care and the Evidence of Their Use in the NICU", *MCN*, May/June 2003
- (12) Telephone Interview by Judy Smith with Sharon Shoyer, Director of Critical Care Nursing, National Children's Medical Center, June 2003
- (13) Telephone Interview by Judy Smith with Dr. Lloyd Kramer, neonatologist, June 2003
- (14) Texas Department of Health, "Spatial Requirements for New Construction", Texas Administrative Code, Title 25 Health Services, Part 1, Chapter 133, Subchapter 1, Rule 133.163
- (15) Smith, J. *The Family Birthplace: Designing Today's Obstetric Facilities*, American Hospital Publishing, Inc., November 1985

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