

Neonatal care at Baylor University Medical Center: You've come a long way, baby!

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When Texas Baptist Memorial Sanitarium—the predecessor of Baylor University Medical Center (BUMC)—was chartered in 1903, the notion of successfully treating premature infants must have seemed like an impossible dream. Although Baylor provided pediatric services from the beginning (the first pediatrician in Texas was Hugh Leslie Moore, Baylor's first chief of pediatrics), neonatology would require technological advances that would not be available until the 1960s and 1970s (1) (*Figures 1 and 2*).

Children were among the patients at the Texas Baptist Memorial Sanitarium in the early 1900s. In 1922, the addition of a 5-story Children's Building enhanced the provision of services in pediatrics as well as in obstetrics and gynecology (1). In 1937, obstetrical services were relocated to the new Florence Nightingale Maternity Hospital. As more women began to give birth in hospitals instead of at home, this maternity hospital became increasingly busy and was soon overcrowded. At the height of the post-World War II baby boom, the number of births at Baylor peaked at 7000 per year in a facility designed to handle about 1800 per year. In 1954, fundraising began for a new women and children's building, which opened in 1959 and was later renamed the Karl and Esther Hoblitzelle Hospital (2).



Figure 3. George W. Bush holding his newborn twin daughters, born at Baylor University Medical Center in 1981.



Figure 1. An early infant hyperbaric pressure chamber used for delivery room resuscitation in the 1960s. It did not work!

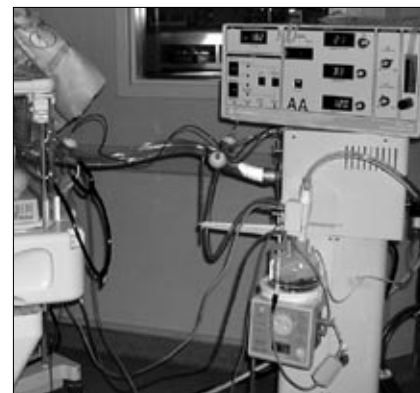


Figure 2. A modern high-frequency oscillatory ventilator with the capability of delivering very small tidal breaths at up to 900 breaths per minute.

The Blanche Swanzy Lange Special Care Nursery originally opened in 1975 on the first floor of Hoblitzelle Hospital next to the labor and delivery suite. The unit was named for Blanche Swanzy Lange, wife of the chairman of the board of the Communities Foundation of Texas, which provided initial funding. The foundation continues to support the nursery each year. In 1981, 2 famous births occurred at BUMC: Laura and George W. Bush became the proud parents of twin daughters (the granddaughters of then-Vice President George Bush) (*Figure 3*). Multiple births are considered high risk, so the neonatal facilities and specialists available at BUMC made it the logical choice for this special delivery.

By the 1990s, the labor and delivery area and the neonatal intensive care unit (NICU) needed to be expanded to accommodate the increasing number of high-risk deliveries (*Figure 4*). The Baylor Health Care System (BHCS) Foundation spearheaded the Labor of Love Campaign, and on February 29, 1996, the expanded and remodeled NICU opened on the seventh floor of Hoblitzelle Hospital as part of the James M. and Dorothy D. Collins Women and Children's Center. The nursery grew dramatically during the 1990s, with the number of patient days more than doubling to almost 20,000 in 2003. When the entire BHCS is considered,

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Figure 4. The new spacious, developmentally less-stimulating NICU environment with acoustic tile to decrease noise, indirect lighting, and 150 square feet per patient instead of the 50–80 square feet per patient that existed in the first floor of Hoblitzelle.

the current number of NICU patient days per year in neonatology is >25,000.

The Lange NICU has a multidisciplinary staff of almost 300 people, including physicians, nurses, respiratory therapists, neonatal nurse practitioners (NNPs), pediatric nurse practitioners, registered dietitians, social workers, educators, and a chaplain. Although the unit is designed for 72 patients, the division often sees more than that number. Widely recognized for its excellent care, the BUMC neonatal unit has been featured many times in both the local and national media over the past decade.

Almost 10 years ago, the staff in the neonatal division developed the following mission statement:

Neonatology will provide comprehensive, high-quality, and state-of-the-art care for well and sick newborn infants and their families. As caregivers in the neonatology team, we will utilize optimally all the resources of BHCS to provide an integrated and excellent service for the newborn in need of these services to all the communities we serve.

This mission statement, which hangs on the wall in the NICU, has served the unit well over the years and acts as a compass to help guide us along our challenging but rewarding path.

SURVIVAL AT THE THRESHOLD OF VIABILITY

The survival of the “micropremie” has become a focus of the unit over the years (Figure 5). Each year, neonatologists at Baylor care for >200 infants that weigh <1500 grams, most of whom are born in the hospital. The high-risk maternal transport program has grown rapidly and has been an emphasis at Baylor over the last decade. Care providers recognize the value of having neonatologists present the moment a high-risk baby is born. As the skills and technologies needed to support extremely low birth weight infants have evolved, the threshold of viability has continued to fall and is now considered to be between 23 and 24 weeks of gestation (full term being 40 weeks). Survival according to birth weight and gestational age has been tracked at BUMC for the past 10 years (Table). In 2002, the last year that data from the Vermont Oxford Network of Nurseries are available, BHCS ranked in the 95th percentile for survival—i.e., only 5% of >375 NICUs worldwide had better survival rates than Baylor.

Although the survival statistics from Baylor’s neonatal unit are impressive, this may be a double-edged sword and raises con-



Figure 5. A 500-gram infant on the threshold of viability being treated in the NICU. This infant is the size of a soda can; such small infants are being treated in NICUs around the world today.

Table. Survival of premature infants at the threshold of viability at Baylor University Medical Center

Birth weight (g)	No. that survived	Survival (%)
<501	39/77	51
501–600	89/143	62
601–700	151/209	72
701–800	214/254	84
801–900	194/219	89

cerns about costs as well as outcomes. To address these important questions, the Institutional Ethics Committee developed guidelines in 1992 to counsel parents who were expecting delivery of an infant between 22 and 25 weeks of gestation. These guidelines have been revised recently to reflect the improved survival of infants at 25 and 26 weeks of gestation. Infants <23 weeks are provided comfort care only, and infants at 23 and 24 weeks are resuscitated aggressively only if the parents, after receiving counseling and reviewing BUMC infant survival data, decide to proceed with intensive care. This approach reflects the consensus of the ethics committee, the Department of Obstetrics, and the Department of Pediatrics and reflects the serious concerns and ambiguities about the survival and long-term outcomes of infants <25 weeks’ gestation (3–8). The critical role parents must play in weighing the benefits and the burdens of neonatal intensive care for infants at the threshold of viability is central to the guidelines that were developed. Subsequent guidelines published by both the American Academy of Pediatrics (9) and the Canadian Pediatric Society (10) mirrored the approach used at Baylor.

SPECIAL PROJECTS

Outcomes database

To track the outcomes of all the infants admitted to the NICU at Baylor, a database was developed in 1992 and began tracking outcomes. This database was complemented when Baylor joined the Vermont Oxford Network of Nurseries in 1995. In this voluntary worldwide network, >375 NICUs report outcome data to the network offices. In turn, the NICUs receive quarterly and annual reports of performance with data on mortality and the major morbidities associated with neonatal intensive care, as well as benchmark statistics for year-to-year comparisons with

the pooled network outcome data. The Vermont Oxford database was expanded in 2001 to include all admissions regardless of birth weight. The databases are maintained by a data specialist and are an integral component of the program in neonatology at Baylor.

Costs of care

The costs of care for infants in the NICU, especially those at the threshold of viability, are a major concern. BUMC submitted data on the charges of care in 1997 and again in 2001 for analysis by the RAND Corporation in collaboration with the Vermont Oxford Network. This project was part of the Neonatal Intensive Care Quality Improvement Collaborative, which BUMC joined in 1998. The goal of the collaborative was to improve the efficiency and effectiveness of neonatal care. When actual costs of care are derived from the charges (using charge-to-cost ratios), results clearly showed that care of the small babies is very efficient at Baylor (*Figure 6*).

Follow-up care and study of long-term outcomes for NICU patients

Good perinatal and neonatal care begins with the referral of high-risk mothers and continues with good resuscitation of the infant after discussion with parents and high-risk obstetric specialists. Care moves to the NICU, where a multidisciplinary team provides round-the-clock care, responding to minute-to-minute changes with appropriate interventions and care. Traditionally, the “circle of care” is closed with the discharge of the newborn to home. However, many of the infant graduates have ongoing problems and health care issues related to their prolonged stay in the NICU; they require the ongoing expertise of neonatologists and others familiar with diseases of the newborn. To adequately close the circle of care requires continued outpatient neonatology and pediatric care and an evaluation of the long-term outcome as measured by health and development several years after discharge. To respond to this challenge, the BHCS Foundation has worked with the Crystal Charity Ball to fund a primary care clinic for the ongoing outpatient care of the high-risk and at-risk graduates of the NICU. The Infant and Young Toddler Outpatient Treatment Specialty (TINY TOTS) Clinic allows the neonatology team to help transition the infants over the 2 years after discharge to a point at which, in most cases, their care can be managed in a pediatrician’s office (*Figure 7*).

A project to assess the long-term neurological and health outcomes of graduates from the threshold of viability at 23 and 24 weeks will begin in fall 2004. With these data, it is anticipated that parents with high-risk pregnancies can be counseled with the best possible information—not only about survival rates at Baylor but also about the long-term neurological and other health issues of these high-risk infants.

STAFFING THE NICU: THE IMPORTANCE OF ADVANCED PRACTICE NURSING

Dramatic changes have occurred in the NICU over the last 100 years. The concept of special care for the premature infant was started when Pierre Budin in the late 1800s in Paris began using

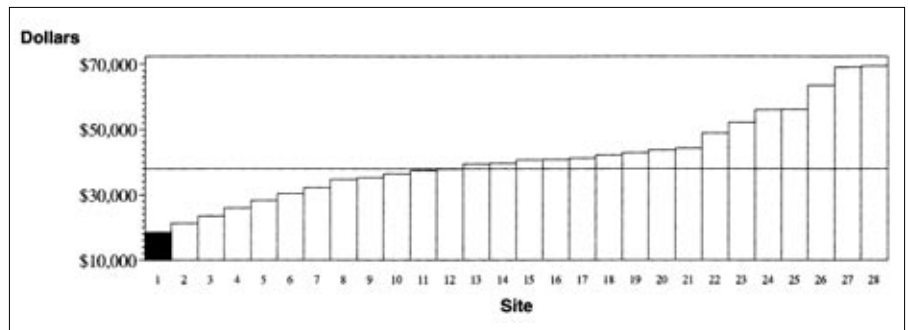


Figure 6. Median accommodation costs per infant at Baylor University Medical Center and other participating neonatal intensive care units for 1997 to 2000. Baylor was site #1, with the lowest median cost (\$18,333) of 28 centers. The median cost across institutions was \$38,063, represented by the horizontal line.



Figure 7. An infant being treated in the TINY TOTS Clinic.

the incubator to care for nurslings/weaklings (*Figure 8*). Other technological advances in the care of the newborn are many and include specially designed ventilators, surfactant replacement therapy, and special parenteral nutrition formulations. The technological wizardry should not detract from the real breakthrough in neonatal care over the last several decades: the explosion of knowledge concerning the care of the critically ill newborn.

However, the most important element in a successful NICU is expert staff (*Figure 9*). Knowledgeable, well-trained, and dedicated personnel are the key to a successful unit and good outcomes. The evolution of the neonatal nurse is perhaps the most startling. The sick neonate in the NICU for sometimes >100 days needs minute-to-minute monitoring. Needless to say, expert observation is critical. BUMC hired its first advanced practice nurse, known as a neonatal nurse practitioner (NNP), in 1991 to provide onsite care by highly qualified, skilled, and experienced personnel. BHCS has one of the most highly regarded groups of NNPs in North America; they staff the NICU round-the-clock at BUMC, Baylor Garland, Baylor Grapevine, and Baylor Irving. By rotating through the BUMC NICU, the NNPs at community hospitals maintain their resuscitation and stabilization skills to ensure optimal performance. Stories of the NNPs’ skills in resuscitation and stabilization of the unexpectedly depressed newborn are legion in the BHCS nurseries. NNPs currently provide care to neonates in the delivery room, emergency room, NICU, and

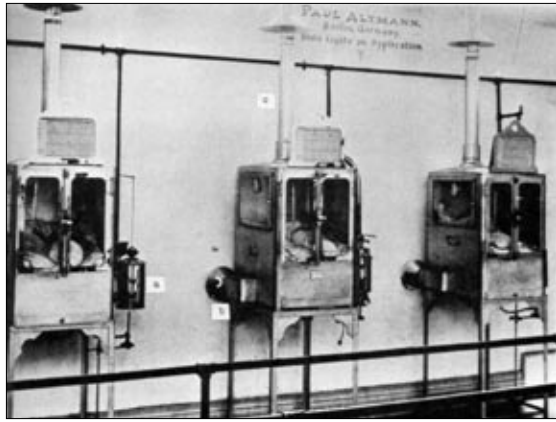


Figure 8. One of the first incubators as shown at an exposition in the early 1900s (above; from <http://www.neonatology.org/classics/silverman/silverman1.html#Fig3>) vs the modern “giraffe” incubator used at Baylor.

newborn nursery and during interhospital transports. NNPs with a master’s degree in neonatal nursing not only assist in maintaining the medical plan of care but also assist in optimizing the nursing plan of care. Employment of NNPs is a model of care that enhances quality and reduces risk. With the dedication and expertise of NNPs partnering with nurses and physicians, BHCS is able to achieve the outcomes of which we are so proud.

THE FUTURE

Clearly, the future of neonatology is very bright. Nevertheless, there are numerous challenges. The continued search for more effective and efficient care must continue. We must remain engaged at a local and national level with our colleagues so that the best processes of care are incorporated at Baylor. To ensure this, we are actively involved in several projects including a new Dallas–Fort Worth quality initiative among 4 local NICUs as well as our participation in the national Vermont Oxford quality improvement project, known as NICQ. Cody Arnold, MD, MPH, MSc, a physician/scholar working with Dr. David Ballard, has been hired to conduct quality of care and effectiveness research in neonatology.

Truly, at Baylor we can say that babies in the NICU have indeed come a long way.

Figure 9. Staffing for neonatal care: in the beginning, a nurse took care of an infant (right, circa 1904; from <http://www.neonatology.org/classics/silverman/silverman1.html#Fig9>); now, a team of professionals, including neonatologists, neonatal nurse practitioners, and registered nurses, work together.



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