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Abstract

This brief summarizes evidence of nursing's effects on NICU outcomes and recommends policies to bolster and support nursing practice in NICUs. Adequate staffing and a supportive work environment are associated with better outcomes for very low birth weight infants.

Keywords

organization of healthcare delivery, hospitals, nursing, disparities and health equity

Disciplines

Maternal, Child Health and Neonatal Nursing

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Improving the Lives of Fragile Newborns: What Does Nursing Have to Offer?

Eileen Lake, PhD, RN, FAAN, Jeannette Rogowski, PhD, and Janet Weiner, MPH

This brief summarizes evidence of nursing’s effects on NICU outcomes and recommends policies to bolster and support nursing practice in NICUs. Adequate staffing and a supportive work environment are associated with better outcomes for very low birth weight infants.

Babies born weighing less than 1500 grams (three pounds, five ounces) are among the highest risk pediatric patients in hospitals. These very low birth weight (VLBW) babies account for only 1.5% of births but over half of infant deaths. One in four dies in the first year of life and 87% of those deaths occur within the first month when they are in the neonatal intensive care unit (NICU). Critically ill infants have some of the highest health care costs of any population. They are at high risk for nosocomial infections, readmissions, and lasting disabilities. NICU infants require an intense level of nursing care and nurses caring for these babies must make complex assessments, implement highly intensive therapies and make adjustments in care based on the patient’s response. Despite this fact, very little evidence existed to understand precisely how nursing relates to infant outcomes. This Issue Brief summarizes the evidence of nursing’s effects on NICU outcomes, and recommends policies to bolster and support nursing practice in NICUs. To build the evidence base, this research team worked with the Vermont Oxford Network, a collaborative group of NICUs dedicated to improving the quality and safety of care for newborns and their families.

VLBW Babies Are Particularly Sensitive to Nursing Care

While all NICU infants are fragile, some are much more critically ill than others. Some infants need more nursing care than others. Guidelines developed in the early 1980s by the American Academy of Pediatrics, and affirmed by the Association of Women’s Health, Obstetric and Neonatal Nurses, recommended nurse-to-patient ratios based on five

levels of severity of the infant’s condition (acuity). The guidelines recommended one nurse for every three to four infants for the lowest risk babies and a ratio of more than one nurse per baby for the most complex cases. However, the guidelines did not include detailed definitions of acuity levels that were operational. This team collaborated with the National Association of Neonatal Nurses to develop and publish definitions (2015) that can be used in practice. Having the right definition permits us to identify the high acuity infants and assure the proper staffing.

Knowing Infant Acuity Helps to Staff Units Properly

The acuity definitions were instrumental to determining that infant acuity is the primary driver of nurses’ assignments. In a national sample of 104 NICUs, with data from 6,038 nurses and the 15,191 infants assigned to them, Rogowski, Staiger, Patrick et al. (2015) reported the acuity distribution of NICU infants, the nurse/infant ratio at each acuity level, and examined other factors that could influence staffing ratios. They found that most NICU infants (62%) were low-acuity (levels 1 and 2), and 12% of infants were high-acuity (levels 4 and 5).

Acuity Level	% of NICU Infants
1. Continuing Care	33%
2. Intermediate Care	29%
3. Intensive Care	26%
4. Multi-Symptom support	8%
5. Unstable/Complex Critical Care	4%

The researchers also found that nurses with professional characteristics such as a bachelor’s degree or a nursing

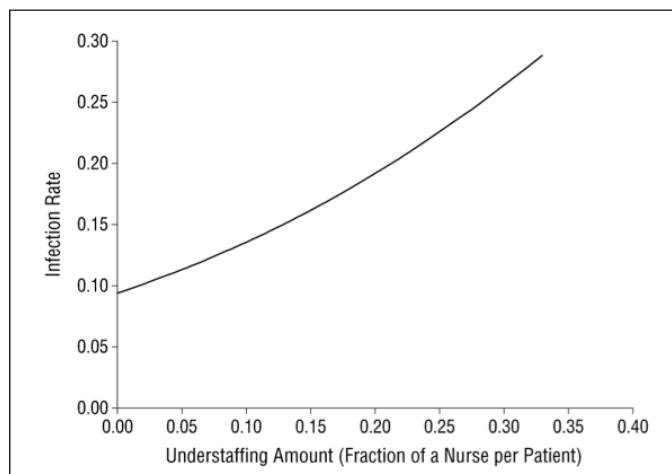
specialty certification were not assigned more complex patients. Even the presence of other NICU health providers did not affect the nurse's assignment. These results suggest that infant care could be improved by optimizing nurse assignments.

NICUs are Understaffed

In *JAMA Pediatrics*, Rogowski, Staiger, Patrick, et al. (2013), the team reported pervasive nurse understaffing of U.S. NICUs and demonstrated its significant association with increased rates of infection. In VLBW babies, infection doubles the mortality rate, increases the length of stay, and is linked to poor developmental outcomes. Using nurse surveys and patient registry data from 67 NICUs in the Vermont Oxford Network, the researchers examined nurse staffing and nosocomial infections among more than 5,600 very low birth weight (VLBW) infants in 2008 and 2009. They compared actual nurse staffing levels to those suggested by professional society guidelines.

Surprisingly, one third of all NICU infants were understaffed. Even more concerning was that the majority of high-acuity infants (68%) were staffed below recommended levels. To meet the staffing guidelines overall and among high acuity infants, a unit would need to add for each baby one-tenth of a nurse more, and one-third of a nurse more for high acuity infants.

Infection rates for VLBW infants are high: about 14% of infants developed a hospital-acquired infection. The nursing unit understaffing was a key factor in whether an infant developed an infection, as illustrated in the graph below, where we see that unit understaffing by a tenth of a nurse (per infant) was associated with 40% higher odds of infection.



Predicted infection rate for VLBW infants

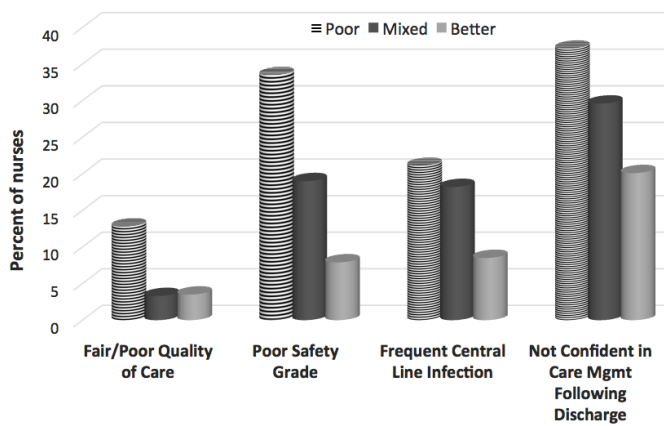
Infants in Understaffed NICUs Have Poor Outcomes

For over two decades, hospitals have been able to seek recognition for meeting standards of nursing excellence. Very few hospitals (7%) achieve this “Magnet”® recognition. Lake, Staiger, Horbar, et al. (2012) showed that VLBW infants born in Magnet® hospitals had significantly lower chances of death, infection and severe brain hemorrhage. The rates of these adverse outcomes in this population are high. Overall, 12.9% of infants died, 7.6% suffered a severe brain hemorrhage, and 17.9% had a nosocomial infection. This study included 70,000 infants in 558 hospitals, 20% of which had the Magnet® designation.

Infants in NICUs with Poor Work Environment Have Worse Outcomes

One aspect of Magnet® hospitals' success is having a better work environment. A good work environment is one in which the registered nurse has relationships with physicians that are collegial and respectful, where the nurse manager is supportive of the staff nurses, and where the nurse can have input into clinical care decisions in the institution. This study measured the work environment through the Practice Environment Scale of the Nursing Work Index, a measure developed by Dr. Lake (2002). The importance of this measure is that it has been endorsed since 2004 by the National Quality Forum as a nursing care performance measure.

In fact, Lake, Hollowell, Kutney-Lee, et al. (2016) found that a better work environment was associated with better NICU quality and safety. Here the researchers utilized multi-state nurse survey data from Penn's Center for Health Outcomes and Policy Research. A unique aspect of this study focused on parents, who are often present with their hospitalized newborn. Nurses reported their confidence that parents would be able to manage their infants care following discharge. From a survey of 1,247 NICU nurses in 171 hospitals in four states, they found that nurses in NICUs classified as having better work environments reported higher quality, and better safety and patient outcomes. This study is showcased in a [video](#) on the *Journal of Nursing Care Quality's* website. As shown in the bar graph on page 3, consistently across all four outcomes, in the poor work environments (striped bars) the percent of nurses reporting poorer quality, safety, and outcomes was significantly higher.



Nurse-reported quality and safety outcomes by work environment category

Notably, one third of nurses in the NICUs with the poor work environments were not confident that parents could manage their infants' care. This is consistent with an earlier study by this team that [breastfeeding support](#) is provided to more infants in NICUs with better staffing and adequate resources. The nurse is responsible to support the mother in developing and maintaining a milk supply, which provides optimal nutrition and immunologic protection for critically ill newborns. In 2014, the U.S. Surgeon General issued a [call to action](#) to support breastfeeding for all newborns.

In a related study, Hallowell, Rogowski, Spatz, et al. (2016) looked at whether infants actually received breastmilk, and how the nurse work environment influenced the chance an infant was receiving breastmilk at the point of discharge to home. Breastmilk feeding is a National Quality Forum neonatal quality indicator. They studied a national sample of 97 NICUs, 5,614 nurses, and 6,996 VLBW infants in 2008. Fewer than half of the infants were receiving breastmilk at discharge. The remainder were discharged on formula only. Higher rates of breastmilk feeding were associated with better nurse work environments, higher nurse staffing, better educated nurses (bachelor's degree), and more breastfeeding support.

Nursing Factors Can Reduce Racial Disparities in VLBW Infant Outcomes

Seven out of ten black infants are born in hospitals that serve disproportionately black infants. This is important because VLBW infants are disproportionately black; 16% of total births, and 33% of VLBW infants, are black. While previous studies have documented that infants born in "high-black" hospitals have worse outcomes, the study team sought to

understand whether nursing factors could account for part of this difference. The team found that nurse staffing and work environments were worse in these hospitals.

Lake, Staiger, Horbar, et al. (2015) studied disparities in two perinatal outcomes: nosocomial infections and discharge on breast milk. The study linked the results of surveys of 5,773 NICU nurses at 98 hospitals nationwide with outcomes data for 8,252 VLBW infants treated at those hospitals. Hospitals were divided into three terciles based on the percentage of their patient populations that were black: <11%, 11%-31%, and >31%. Data showed that 70% of VLBW infants were born in high black tercile hospitals, 25% in the middle tercile, and just 5% in the low tercile.

The study found significant outcome disparities between the three terciles of hospitals. High-black hospitals had higher levels of understaffing and lower ratings of the nurse work environment. These NICU nursing features accounted for one-third to one-half of the hospital-level disparities. When understaffing and practice environment were controlled for, the differences between high-black and low-black hospitals were negligible, suggesting that improving nurse-to-infant ratios and work environment would reduce the disparity in these perinatal outcomes.

What should NICU managers do? What can be done from a policy perspective?

The studies show that nurse staffing and the nurse work environment have a significant effect on NICU outcomes. They document substantial NICU nurse understaffing relative to national guidelines and the poor outcomes associated with understaffing.

- To improve the health and lives of VLBW infants, hospitals should improve nurse staffing and work environments in the NICU.
- There is increasing pressure to standardize nurse-to-patient ratios across institutions that may take the form of legislated ratios, mandated or voluntary public reporting of ratios, or industry standards. The acuity definitions developed by this team offer a basis for determining satisfactory staffing.

- Nurse staffing and work environment may account for one-third to one-half of racial disparities in the quality of care for VLBW infants. Because nearly three-fourths of VLBW black infants are born in these lower-quality hospitals, improving staffing and the nurse environment could be an effective way to reduce the substantial burden of low birth weight in the black community.
- Nursing factors should be considered in provider payment systems that reward outcomes.
- Understaffing is associated with an increased risk for two perinatal outcome measures (nosocomial infection and breastmilk feeding) in VLBW infants. Hospital administrators and NICU managers should reassess their staffing decisions to devote needed nursing care to critically ill infants and to educate parents about post-discharge care.
- Nurse staffing requirements should take into account factors not often included in acuity measures, such as the need for nurses to provide lactation assistance or to educate parents about post-discharge care.

- A supportive nurse work environment, as measured by nurse reports, or as indicated by hospital Magnet® designation, is associated with better NICU outcomes and is a promising strategy to reduce complications and achieve better outcomes for VLBW infants.

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