

Staffing Matters— Every Shift

Data from the Military Nursing Outcomes Database can be used to demonstrate that the right number and mix of nurses prevent errors.

OVERVIEW: Data from the Military Nursing Outcomes Database (MilNOD) project demonstrate that inadequately staffed shifts can increase the likelihood of adverse events, such as falls with injury, medication errors, and needlestick injuries to nurses. Such evidence can be used to show that it takes not only the right number of nursing staff on every shift to ensure safe patient care, but also the right mix of expertise and experience. Based on findings from the MilNOD project, the authors present realistic scenarios of common dilemmas hospitals face in nurse staffing, illustrating the potential hazards for patients and nurses alike.

Keywords: adverse events, care quality, nurse staffing, patient safety

Imagine you're the new charge nurse on a 50-bed medical-surgical unit in a tertiary-care medical center, with a census of 45 patients. As you make assignments for the next shift, one of your six scheduled RNs calls in sick, and three patients are waiting in the ED for admission to the unit. It's the weekend, and you don't want to bother your nurse manager at home or appear incompetent by asking for help from the nursing supervisor. You still have five other RNs, three LPNs, and two patient care technicians on the unit. Even though the RNs are all novices, three of them have completed orientation. If everyone works hard enough, you can make it through the shift.

And yet you can't help but wonder: Is that the best decision for patient safety?

Such situations aren't unusual. Hospital nurses are often forced to work short staffed, providing care in environments that place patients and even nurses themselves at risk. In fact, despite the flurry of activity following the 2000 Institute of Medicine (IOM) report, *To Err is Human: Building a Safer Health System*,¹ the U.S. health care system made little significant progress toward safer patient care in the decade

after its publication.² In 2004, the IOM released *Keeping Patients Safe: Transforming the Work Environment of Nurses*, which advocated "work processes, workspaces, work hours, staffing, and organizational cultures that better defend against the commission of errors."³ But according to the 2010 National Healthcare Quality Report, the median rate of change in care quality (as measured by 179 different indicators) was only 2.3% per year within that decade, and one-third of the quality indicators either showed no change or worsened.⁴

The 2010 IOM report, *The Future of Nursing: Leading Change, Advancing Health*, highlights the need for nurses to continue to advance their education and be vocal members of health care teams to ensure the provision of seamless care.⁵ There's a greater need for nurses to understand workforce requirements by role and skill level, among other factors—information that can inform and guide changes in nursing practice and education.

We know that staffing matters. Studies have shown that hospitals with lower proportions of RNs have higher rates of death overall, death following complications (that is, failure to rescue), and other adverse



events.⁶⁻¹⁰ But how do such data on staffing translate into what the average hospital nurse experiences on a shift?

In this article we aim to answer that question by using findings from the Military Nursing Outcomes Database (MilNOD), a research project that has investigated the effects of staffing levels and skill mix on the probability of patient falls, medication errors, and needlestick injuries to nursing staff.^{11,12} We review the findings and present realistic scenarios so that nurses can better understand how staffing affects the care they give and be better advocates for the patients they serve.

NURSE STAFFING AND CARE QUALITY

With recent initiatives such as pay for performance and public reporting on the quality and safety of hospital care, we've entered a new era of accountability. And despite differences in how data are collected across and even within hospitals, "nursing sensitive" quality measures are becoming more central to the public reporting of clinical outcomes. Evidence linking nurse staffing and patient outcomes has grown over the years, but gaps remain in our understanding

of precisely how nurse staffing affects care quality.¹³ Furthermore, mandated nurse staffing levels don't always account for factors that can detract from a nurse's work during a shift. Patient turnover rates and interruptions, for example, can affect staffing requirements and the care a nurse has anticipated providing over a shift.¹⁴

Fortunately, the measurement of nurse staffing has evolved. Early health services researchers used a nurse-to-hospital-bed ratio or a nurse-to-patient ratio (based on average daily census) to explain differences in mortality rates.^{15,16} These studies used data primarily from the American Hospital Association, which did not distinguish direct care nursing staff from nurse managers and did not account for the different skill and licensure levels of nursing staff. Currently, nurse staffing is defined in many ways—as the "presence" of staff, as total nursing care hours per patient per day, or as nurses' expertise level (the skill mix on a unit) or educational level (which usually looks at the percentage of nurses on a unit with a bachelor's degree or higher).

Two comprehensive literature reviews highlight the connection between nurse staffing and rates of

Table 1. Increased Probabilities of Adverse Patient Outcomes Associated with Shift-Level Changes in Staffing on Medical–Surgical Units^a

Unit of Change	Increased Probability of Falls (%)	Increased Probability of Falls with Injury (%)	Increased Probability of Medication Errors (%)
10% decrease in RN skill mix	11	30	13
1-hour decrease in nursing care hours per patient per shift	7	15	13
10% decrease in civilian staff	48	48	NS

NS = not significant.

^aThe increased probabilities were calculated using the following base rates: 1.4 falls, 0.3 falls with injury, and 1.86 medication errors.

death and failure to rescue, but they also note the inconclusive associations between staffing and adverse events such as pressure ulcers, medication errors, and hospital-acquired infections.^{17,18} Among the reasons the connection hasn't been more firmly established are inconsistent definitions of staffing (such as aggregate numbers of nurses in hospitals per 1,000 beds) and inconsistent methods of analysis (such as studying staffing at the hospital or unit level).¹³ A recent report on patient safety claims that “sparse” progress has been made in understanding the connections between nurse staffing and patient safety.²

It's important to note that most staffing studies are conducted at the hospital and unit levels, obscuring the variation that occurs across shifts on a unit. Measuring staffing at the hospital or unit level may not be adequate, because at that level staffing is far removed from the point of care. And when nursing care is delivered with too few staff, even on a single shift within a month of otherwise good staffing levels, the potential for errors rises, compromising the quality of nursing care.¹⁹

One recent shift-level study found that in hospitals with shifts staffed below targeted levels (still another definition of “staffing”), patient mortality rates were significantly higher.¹⁰ The researchers studied 197,961 patients, 68% of whom had been in hospital units in which one or more shifts were staffed at least eight hours below target levels. Over a third (34%) had been in units where three or more shifts were staffed below target levels. The study results showed a 2% higher mortality rate for each shift in which staffing fell below target levels and a 4% higher mortality rate for each high-turnover shift to which a patient was exposed. (“High-turnover” shifts were those with admissions, transfers, and discharge rates “greater than or equal to the mean plus one standard deviation for the day shift turnover for that unit.”)

The MilNOD was a four-phase quality improvement and research project begun in 1996 and completed in 2009, encompassing data from 111,500 shifts on 56 inpatient units in 13 U.S. Army, Navy, and Air Force hospitals.^{20,21} Prospective data collected

on each shift included direct staffing hours according to nursing licensure level (RN or other licensed or unlicensed nursing staff) and military category (military, civilian, contract, or reservist), as well as patient factors (census, acuity, admissions, discharges, and transfers). Retrospective adverse-event data (falls, medication errors, and needlestick injuries to nursing staff) were collected quarterly over the period from existing incident reports. Annual surveys on patient and nurse satisfaction, nurse work environment, and pressure ulcer and restraint-use prevalence were conducted as well.

Quarterly performance reports comparing similar hospitals and units were provided to the nursing leaders at participating hospitals, and best practices were shared. Descriptions of the data collection methods and the reliability and validity of the data are published elsewhere.²¹

Nurses who have never worked in a military facility might presume that military and civilian hospitals are so different that these findings do not apply to their work environments. But all military hospitals are accredited by the Joint Commission and follow the same standards of care as civilian hospitals. Military RNs must hold a bachelor of science in nursing degree to be commissioned. New graduates can make up half or more of the RN staff on military medical–surgical units.

THE MILNOD DATA: STAFFING SCENARIOS

The data from the MilNOD demonstrated that the number, mix, and experience of nursing personnel on a shift are associated with adverse events for patients²¹ and needlestick injuries to nurses.¹² The MilNOD researchers found extreme variability in staffing numbers and skill mix on shifts within the same units, more so in medical and surgical units than in critical care units. Critical care units, because of the higher-acuity patients they serve, typically have a higher percentage of RNs on each shift. Medical and surgical units, however, generally have more patients, more staff, and a wider nursing skill mix.

To determine whether staffing affects adverse events, the MilNOD researchers calculated the odds

ratios for specific adverse events according to staffing levels and then converted them into the probabilities for each type of error. (According to Grimes and Schulz's explanation of odds ratios, probabilities, and relative risk, "odds ratios are the output of logistic regression,"²² which was the methodology used by the MilNOD researchers.) For instance, a decrease in the number of RNs working on a shift resulted in a decrease in the total nursing care hours per patient per shift, which in turn was associated with an increased probability that a fall would occur on the shift (see Tables 1, 2, and 3). Here is a more specific example: for every one-hour decrease in nursing care hours on a shift on a critical care unit, the probability of a fall with injury for a patient increased by 51% and the probability of a needlestick injury for a nurse increased by 52%.

The percentages are calculated from the odds ratios the researchers determined from Bayesian hierarchical logistic regression models developed in a previous study.¹¹ For example, the odds ratio of 1.51 for falls with injury for each one-hour decrease in total nursing care hours per patient per shift on a critical care unit calculates to a 51% increased probability of a fall.

To put this information into perspective, consider the following scenarios, which are descriptive only and therefore cannot imply cause-and-effect relationship. Also, the probability of adverse events such as falls may be influenced by factors such as patient confusion and wet floors,²³ which were not accounted for in the MilNOD analysis.

Scenario 1. A medical–surgical unit starts with 10 staff nurses on the night shift caring for 20 patients. (This can be expressed as four nursing care hours per patient per shift and is calculated like this: 10 staff on the shift, each working an eight-hour shift, provides 80 nursing care hours. Divide 80 hours by 20 patients to get four nursing care hours per patient per shift.) The postanesthesia care unit transfers two patients to the unit, the family medicine and neurology clinics admit one patient each, and the ED admits

two patients. Now there are six more patients on the unit and none have been discharged, since the surgeons are late in discharging their patients. So 10 nursing staff are caring for 26 patients. As a result of this increase in workload, one of the nurses overlooks a new order for a postoperative antibiotic, and this delay in administration causes the patient to remain on the unit an extra day.

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The MilNOD model indicates that there's a 13% increased probability (odds ratio, 1.13) of a medication error occurring on that shift because the nursing care hours per patient per shift have decreased by one hour (see Table 1).

Scenario 2. Your next shift in the ICU is scheduled to have 10 nursing staff; seven are RNs and three are not, for a proportion of 70% RNs. One RN calls in sick and is replaced by an LPN, changing the skill mix to 60% RNs. The nursing supervisor "floats" an LPN from the stepdown unit to the ICU. This LPN has limited ICU experience and is caring for a postoperative patient the same day of surgery. Unaware of the danger, the LPN encourages the patient to transfer to the bedside commode; the patient is not strong enough to do this and when trying to comply falls and is bruised on the back of her leg.

The MilNOD model indicates that there's a 36% increased probability (odds ratio, 1.36) of a fall with injury because of this 10% decrease in RNs on the shift (see Table 2).

Table 2. Increased Probabilities of Adverse Patient Outcomes Associated with Shift-Level Changes in Staffing on Critical Care Units^a

Unit of Change	Increased Probability of Falls (%)	Increased Probability of Falls with Injury (%)	Increased Probability of Medication Errors (%)
10% decrease in RN skill mix	20	36	17
1-hour decrease in nursing care hours per patient per shift	11	51	5
10% decrease in civilian staff	36	NS	47

NS = not significant.

^aThe increased probabilities were calculated using the following base rates: 0.24 falls, 0.05 falls with injury, and 0.67 medication errors.

Table 3. Increased Probabilities of Adverse Patient Outcomes Associated with Shift-Level Changes in Staffing on Stepdown Units^a

Unit of Change	Increased Probability of Falls (%)	Increased Probability of Falls with Injury (%)	Increased Probability of Medication Errors (%)
10% decrease in RN skill mix	NS	NS	NS
1-hour decrease in nursing care hours per patient per shift	14	25	NS
10% decrease in civilian staff	33	50	67

NS = not significant.

^aThe increased probabilities were calculated using the following base rates: 1.1 falls, 0.27 falls with injury, and 1.53 medication errors.

Scenario 3. On your shift on the stepdown unit, you have 10 nursing staff; five are active military nurses (with an average of five years of experience) and five are federally employed civilian nurses (with an average of 14 years of experience), for a proportion of 50% civilian RNs. Five patients are transferred or discharged; and because the census is so low, one of the more experienced civilian nurses is pulled to work on another unit. Now the proportion is 40% civilian RNs. (Most military hospitals do not have a float pool or use contract nurses to fill in when needed.)

The MilNOD model indicates that there's a 67% increased probability (odds ratio, 1.67) of a nurse-administered medication error occurring on this shift (see Table 3).

APPLYING DATA TO DAILY DECISIONS

The above scenarios illustrate how various factors such as staff calling in sick or an unanticipated increase in patient volume can affect patient safety. The MilNOD data and its statistical models suggest that adapting to such situations by just working through them may have the potential to increase the probability of adverse events on a shift.

More and more states are exploring mandatory nurse staffing ratios, designated most often as numbers of patients to licensed nursing providers (which includes both RNs and LPNs). Although research to date has not demonstrated a direct impact of improved staffing on the quality of care, early research on this topic is promising. Aiken and colleagues have demonstrated decreases in nursing burnout and nursing job dissatisfaction in hospitals in three different states that meet California's minimum nurse-staffing requirements.⁶ This same study also shows that, when asked, nurses rate their care quality higher when they work in a hospital that meets the California staffing requirements. Future research will, we hope, take off from these findings to compare quality indicators such as patient falls and medication errors in hospitals that meet the California requirements with those that do not.

We are unaware of any staffing mandates that take into account the skill or experience level of the nursing staff. Data from the MilNOD suggest that skill and experience levels are related to, and have the potential to impact, care quality in ways that traditional mandatory staffing ratios do not often address. Also, regardless of what staffing may look like at the hospital level, poorly staffed shifts are likely to see adverse outcomes. We recommend future studies that establish an evidence base for not merely minimum but also *optimal* staffing guidelines.

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Our scenarios illustrate how analysis and interpretation of data on staffing can be applied to daily decision making. If a nurse manager knows that the probability of a fall is increased when the number, type, and experience of nursing personnel are limited, that manager can make informed decisions on staffing for each shift. Charge nurses making assignments in situations with changing patient census and fluctuating nursing staff numbers and experience levels need to be aware of the potential implications for each shift. Nursing leaders must also support shift-level staffing decisions and understand the potential impact of failing to ensure an adequate number and mix of nurses on each shift. And nurses must articulate the shift-level staffing requirements in a way that garners support within their hospitals. Too often nurses request additional staff, yet can't speak to the value more staff would have for the unit or the institution.

The MilNOD findings are supported by other recent research. Needleman and colleagues lend

credibility to studying staffing and outcomes at the shift level.¹⁰ More of these types of studies are needed to build the evidence on how to staff shifts. Such findings may be useful for nurses faced with workload spikes or unplanned staff decrements.

Because these data were collected from military hospitals, their generalizability to civilian hospitals is limited. But because the database used includes 56 units in 13 military hospitals, a sample representing a wide range of nationwide facilities that provide the same types of care as civilian hospitals, the findings may be applicable to nonmilitary settings. While data were collected on a number of nursing and patient measures, there are factors that are difficult to capture and were not included. For example, data on collective bargaining agreements that give shift and vacation preference to senior (experienced) nurses are not included, yet these agreements make a well-balanced skill mix difficult to achieve. Further studies are needed that track nursing expertise levels for every shift in order to determine whether nurses' experience level affects patient and nurse outcomes. Also, it's important to bear in mind that staffing is a function of more than just the number of nurses working on a shift. Other variables, such as work environment, nurse experience and education level, or the physician–nurse relationship, may have to be addressed when staffing is adjusted but outcomes don't improve.

Nurses strive to deliver the best care possible. But we must pay more attention to nurse staffing if we are to remedy the quality crisis in U.S. hospital care. Understanding the factors that cause adverse outcomes will help to turn the tide on patient safety. Let's not allow another decade to go by without effecting dramatic improvements. ▼

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REFERENCES

1. Kohn LT, et al., editors. *To err is human: building a safer health system*. Washington, DC: National Academy Press; 2000.
2. Wachter RM. Patient safety at ten: unmistakable progress, troubling gaps. *Health Aff (Millwood)* 2010;29(1):165-73.
3. Page A. Committee on the Work Environment for Nurses and Patient Safety, Board on Health Care Services. *Keeping patients safe: transforming the work environment of nurses*. Washington, DC: Institute of Medicine, National Academies Press; 2004. http://www.nap.edu/catalog.php?record_id=10851.
4. Agency for Healthcare Research and Quality. *National health care quality report, 2010*. Rockville, MD: U.S. Department of Health and Human Services; 2011 Mar. AHRQ Publication No. 11-0004. <http://www.ahrq.gov/qual/nhq10/nhq10.pdf>.
5. Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine. *The future of nursing: leading change, advancing health*. Washington, DC: National Academies Press; 2011. http://www.nap.edu/catalog.php?record_id=12956.
6. Aiken LH, et al. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA* 2002;288(16):1987-93.
7. Kovner C, et al. Nurse staffing and postsurgical adverse events: an analysis of administrative data from a sample of U.S. hospitals, 1990-1996. *Health Serv Res* 2002;37(3):611-29.
8. Mark BA, et al. A longitudinal examination of hospital registered nurse staffing and quality of care. *Health Serv Res* 2004;39(2):279-300.
9. Needleman J, et al. Nurse-staffing levels and the quality of care in hospitals. *N Engl J Med* 2002;346(22):1715-22.
10. Needleman J, et al. Nurse staffing and inpatient hospital mortality. *N Engl J Med* 2011;364(11):1037-45.
11. Patrician PA, et al. The association of shift-level nurse staffing with adverse patient events. *J Nurs Adm* 2011;41(2):64-70.
12. Patrician PA, et al. Needlestick injuries among nursing staff: association with shift-level staffing. *Am J Infect Control* 2011;39(6):477-82.
13. Clarke SP, Donaldson NE. Chapter 25. Nurse staffing and patient care quality and safety. In: Hughes RG, editor. *Patient safety and quality: an evidence-based handbook for nurses*. Rockville, MD: Agency for Healthcare Research and Quality; 2008. <http://www.ncbi.nlm.nih.gov/books/NBK2676>.
14. Myny D, et al. Determining a set of measurable and relevant factors affecting nursing workload in the acute care hospital setting: a cross-sectional study. *Int J Nurs Stud* 2012;49(4):427-36.
15. Hartz AJ, et al. Hospital characteristics and mortality rates. *N Engl J Med* 1989;321(25):1720-5.
16. Silber JH, et al. Comparing the contributions of groups of predictors: which outcomes vary with hospital rather than patient characteristics? *J Am Stat Assoc* 1995;90(429):7-18.
17. Kane RL, et al. The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. *Med Care* 2007;45(12):1195-204.
18. Lang TA, et al. Nurse-patient ratios: a systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. *J Nurs Adm* 2004;34(7-8):326-37.
19. Lucero RJ, et al. Variations in nursing care quality across hospitals. *J Adv Nurs* 2009;65(11):2299-310.
20. Loan LA, et al. Participation in a national nursing outcomes database: monitoring outcomes over time. *Nurs Adm Q* 2011;35(1):72-81.
21. Patrician PA, et al. Towards evidence-based management: creating an informative database of nursing-sensitive indicators. *J Nurs Scholarsh* 2010;42(4):358-66.
22. Grimes DA, Schulz KF. Making sense of odds and odds ratios. *Obstet Gynecol* 2008;111(2 Pt 1):423-6.
23. Lake ET, Cheung RB. Are patient falls and pressure ulcers sensitive to nurse staffing? *West J Nurs Res* 2006;28(6):654-77.