

OPEN

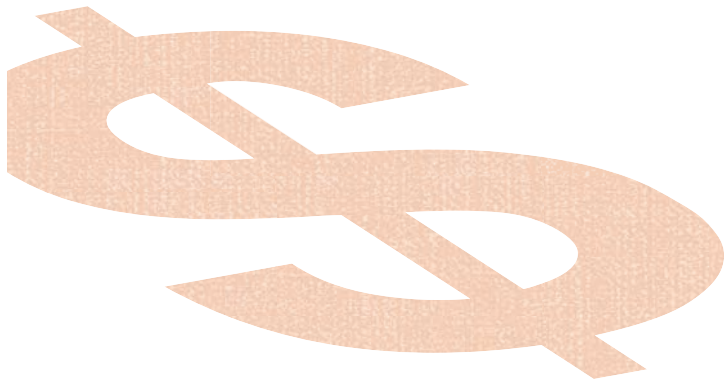
Taking nurse staffing

By Rebecca A. Paulsen, PhD(c), MS, RN, CPN

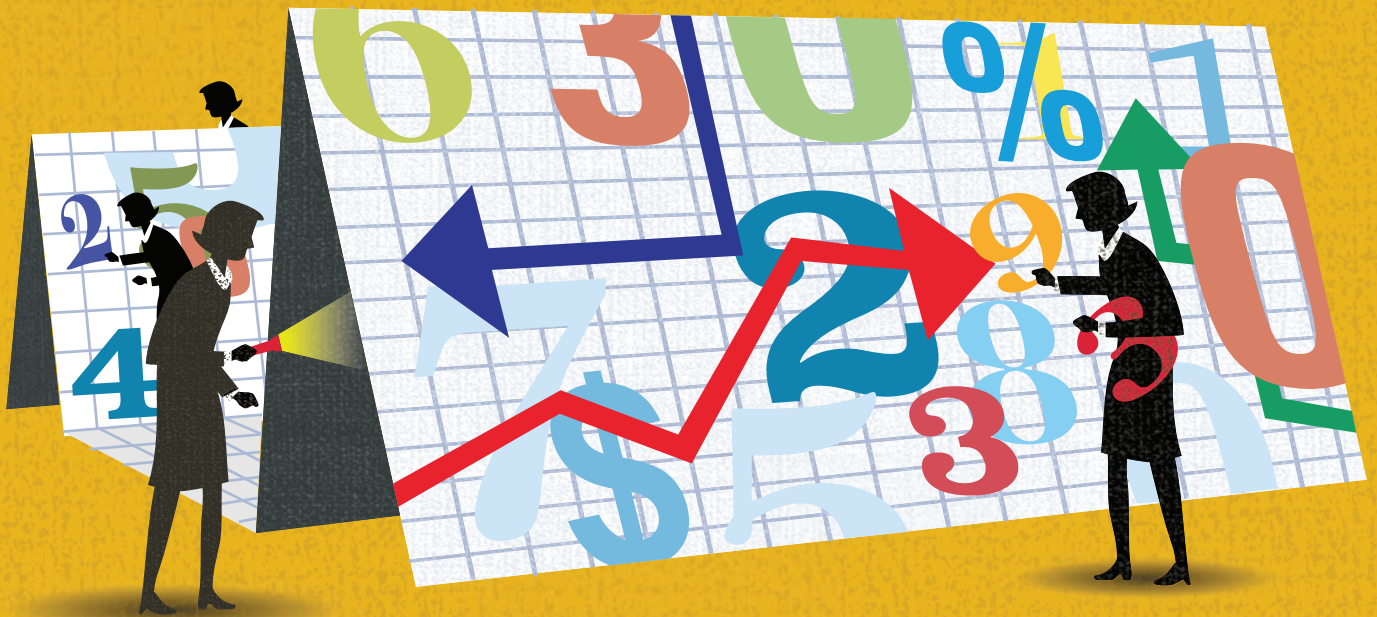
Over the past 2 decades, a significant body of research has substantiated the link between

nurse staffing factors and patient outcomes. For instance, the number of nurses available to care for patients, measured by full-time equivalents and hours per patient day (HPPD), was found to be inversely correlated with patient mortality and failure to rescue.^{1,2} Likewise, lower HPPD correlated with longer length of stay.³ And when staffing targets weren't met, mortality increased.⁴ Higher levels of education for nurses, especially BSN preparation, correlated with decreased mortality and failure to rescue, and higher RN skill mix was associated with decreased pneumonia and decreased mortality.^{5,6}

These sentinel studies led to significant policy changes. Legislation mandating specific nurse-patient ratios passed in California, with the federal government and other states also considering legislation.⁷ In addition, the National Academy of Medicine (formerly the Institute of Medicine) recommended increased educational levels for nurses in all areas of practice, with a target of 80% of the American RN workforce being BSN-prepared by 2020.⁸



research to the unit level



Despite progress in the health-care industry toward achieving these goals, nurse managers and administrators working on hospital units continue to struggle with knowing what constitutes the right number and quality of nurses matched to patients' needs to achieve clinical outcome targets. (See *Historical context*.) This knowledge is critical in a climate of reimbursement uncertainty given that achieving the right balance of nurses to meet patient care needs defines fiscally responsible staffing.

Consider that in 2016, 62.2% of the country's 2.6 million nurses worked in hospitals with a median pay of \$68,450 per year.⁹ With salaries making up nearly half of U.S. hospitals' expenses and nursing comprising about 30% of salaries, effective management of nursing resources, including staffing, is imperative for meeting financial outcomes.¹⁰

Likewise, managing the safety and quality of patient care is paramount, and failure to do so is expensive. The average cost of a single central line-associated bloodstream infection (CLABSI) is over \$45,000, and a patient fall with injury costs \$14,000

on average.^{11,12} Additionally, under the Affordable Care Act, the Centers for Medicare and Medicaid Services (CMS) will withhold payment to hospitals if quality care targets aren't met.¹³ With studies showing that these patient outcomes are sensitive to nurse staffing variables, continued development of the evidence base for nurse staffing is vital. The goal must be providing unit-level evidence-based data for frontline managers to predict and monitor staffing factors related to patient care.

This article provides a summary of the current body of published nurse staffing research, explores gaps in the literature that explain why translation into clinical practice has been difficult, and suggests ways that hospital nurse managers and administrators can help move the science forward. It's important to realize the role hospitals must play in advancing unit-level nurse staffing research. It can't be accomplished without strong collaboration between clinical nurse experts and researchers.

Nurse characteristics

The experience and skills of the nurses on any given unit vary in

terms of education level; years of experience; the amount of experience working on a specific unit or with a specific patient population; and the knowledge, or competency, to perform certain skills. This variation impacts individual nurse workload, as well as overall unit workload, and is weighed into staffing decisions and patient assignments. Nursing workload has been defined as a combination of factors, including nursing time spent in direct patient care and other work, competency, physical exertion, and complexity of care.¹⁵

Several studies have highlighted the importance of an educated, experienced nursing workforce for producing desirable patient outcomes. A workforce with proportionately more BSN preparation was associated with decreased mortality and failure to rescue.^{5,16,17} Higher levels of specialty certification in a group of nurses correlated with lower patient mortality and fewer failures to rescue if the nurses were baccalaureate-prepared or higher.¹⁷ Odds of patient death on CCUs were highest when 20% or more of the nurses had fewer than 2 years' experience.¹⁸

Collectively, the results of these studies support having a nursing workforce with higher levels of experience, education, and certification to produce safer patient care, but they don't tell us how much is the right amount or allow for causal conclusions, leaving plenty of room for future research.

Patient acuity, nursing workload, and unit workflow

Patient acuity and nursing workload are entwined in clinical practice and in the literature because

Historical context

Hospitals began incorporating nursing care into the per diem room accommodation charge in the 1960s in an attempt to balance budgets in response to concerns about rising healthcare costs.¹⁴ In 1983, Medicare changed to a prospective payment system based on diagnosis-related groups (DRGs). This change motivated hospitals to control costs by paying them a fixed amount for a patient's care based on the DRG.¹⁴

With nursing care bundled in the per diem charge along with patient supplies and services, such as housekeeping, the value of nursing expertise in the patient care process was hidden. As such, the nursing department was seen as nonrevenue-generating and vulnerable to cost-cutting.¹⁴ This view of the value of nursing on hospital units didn't take into consideration the complexity of the nursing work environment, nurses' knowledge and skills, and how these factors align with meeting the individual needs of patients and their families.

patient care needs demand nurses' time and attention. Patient acuity, also called patient classification, is defined as assessing the nursing care requirements of patients to determine the amount of nursing time needed to meet those requirements.^{14,19,20,21} Patient classification tools have been used since the 1960s, yet there's no consensus on the best methods for measuring nursing workload or determining the optimal amount of time for completion of specific nursing activities.^{14,21,22} Confounding variables are numerous and complex, including individual patient characteristics and nursing unit environmental factors.²³

There's essentially a tug-of-war in the practice of measuring patient acuity between the desire to objectively determine required nursing work and the need to rely on the professional judgment of nurses to know which patients need more or less of their time. The goal of both strategies is to predict the amount of nursing care, or time, patients will require and use this information to determine staffing levels. Although not perfect, factoring patient acuity into staffing decisions is a better approach than relying solely on nurse-patient ratios or financial targets, such as budgeted HPPD, to determine unit-level nurse staffing needs.²¹ This approach is supported by the results of a study that examined nurses' workloads on a unit where patients were assigned to maintain mandated nurse-patient ratios without regard to differences in patient needs. The workloads of the individual nurses were significantly different even though the numbers of patients in their care were similar.²⁴

Unit workflow also impacts nursing workload. Admissions, discharges, and transfers of patients, often called patient turnover, take additional nursing time, which may not be accounted for in prescribed nurse-patient ratios or average budgeted HPPD that doesn't recognize shift-by-shift variability.²⁵⁻²⁷ An ethnographic study of patient turnover found that workflow disruptions, such as admissions and discharges, led to increased workload for nurses, noting that dispersed patient turnover was less disruptive to workflow than clustered turnover.²⁶ Another study found that understaffed shifts with high patient turnover were correlated with increased patient mortality risk, linking the combined effect of staffing levels and workload to clinical outcomes.²⁸

Unit and hospital characteristics

Unit-level hospital staffing decisions occur within a nested framework of unit, hospital, and external factors, yet the body of literature examining the impact of unit and organizational characteristics on nurse staffing is limited. Aiken and colleagues found that a better patient care environment, as measured using the National Quality Forum's Practice Environment Scale of the Nursing Work Index (PES-NWI), was associated with lower patient mortality and better nurse outcomes.²⁹ The PES-NWI captures nursing foundations for quality of care, nurse manager characteristics, and nurse-physician relations, and is widely administered as part of the National Database of Nursing

Quality Indicators® (NDNQI®) nurse satisfaction survey.

Other work in this area has focused on staff scheduling factors. Longer shift lengths and shorter time periods away from work for nurses correlated with increased patient mortality in adults and poorer quality outcomes for pediatric patients.^{30,31} Increased overtime correlated with more catheter-associated urinary tract infections and pressure injuries, but also a slightly lower CLABSI rate.³²

Although supportive of the overall theme that nurse staffing factors are tied to patient outcomes, these studies, like many others, used a cross-sectional design. Therefore, conclusions about cause and effect can't be made.

Limitations of current knowledge

Translating nurse staffing research findings into practice at the unit level, where staffing decisions are made, is hampered by three major limitations. The most outstanding problem is the use of aggregated hospital-level data, rather than unit-level data, making it nearly impossible to replicate results at the unit level.³³ Many nurse staffing studies used data from large national databases, such as the CMS and NDNQI. Databases like these offer the convenience of accessibility and the statistical power that comes from using large data sets. The downside, however, is that researchers are limited to the preexisting definitions and quality of variables in the database, and aren't necessarily able to define and choose measures based on theoretical constructs

that may be more meaningful to those in clinical practice.

Although we can conclude that certain factors, such as increased BSN preparation and lower nurse-patient ratios, are important enough to change workforce and staffing resources, this information isn't helpful to a nurse manager challenged to determine what risk the unit's current skill mix and available staff levels pose to achieving patient outcome targets. Without knowing the risk a priori, it's impossible to identify possible solutions. Furthermore, the lack of unit-level data for use by researchers is reflective of the lack of real-time data for decision support on units where staffing decisions are taking place.

The use of large databases also presents a second challenge: Preexisting, aggregated data are generally limited to cross-sectional research designs. The large dataset studies indicate that nurse staffing factors correlate with patient outcomes, which allows us to conclude that nurse staffing plays a role in producing those outcomes, yet causal claims can't be drawn from correlational studies.³⁴ Future research needs to study unit-level data using more complex statistical operations.

For example, studies could control for moderator and mediator variables, such as Magnet[®] recognition or turnover rate, or use hierarchical linear modeling to study nested data.³⁵ Even better would be using experimental or quasi-experimental study designs to determine which staffing factors or decisions are best for producing target outcomes.³⁴ Different acuity systems could be studied on the same unit or similar units using a quasi-

experimental design. Another example is testing which skill mix and staff-patient ratio combinations produce the best patient results over a period of time.

A third problem is that the best ways to measure unit-level nurse staffing aren't yet known through research. Few studies have tried to determine the best measure of nurse staffing, whereas measures have been selected more for convenience or availability than from any underlying construct supporting their use.^{35,36} A construct is the abstract theme that a researcher is attempting to measure by using variables that are indicators of that theme.³⁷ For example, nursing HPPD is commonly used as a variable indicative of the level or adequacy of nurse staffing. Although nursing HPPD was found to be a reliable measure in three studies, the studies' small sample sizes limited generalization of the reliability findings to other populations, thus falling short of supporting a claim that nursing HPPD is the best measure.³⁸⁻⁴¹

A systematic review of 29 nurse staffing literature reviews and systematic reviews further highlighted the extent of this problem: It found that the three most common variables used as measures of nurse staffing levels were HPPD, skill mix, and nurse-patient ratio, and that they were calculated 82 different ways across multiple studies.³⁵ For example, HPPD was calculated using midnight census and average census over 24 hours, and using RN-HPPD and total HPPD, which includes RNs, LPNs, and unlicensed assistive personnel (UAP). Skill mix was also calculated in a variety of ways, including combining LPNs with RNs or LPNs with UAP.

Two studies stand out as offering possible paths forward through the cluttered field of nurse staffing measures. One study sought to discover which staffing measure was best for determining the effect on patient quality outcomes by correlating HPPD, RN-HPPD, perceived adequacy of nurse staffing as gathered from nurses via the PES-NWI, having enough assistive personnel, and case mix index (CMI)—a DRG-related weight indicative of the hospital resources a patient required that's often used as a proxy for acuity.^{42,43} Both HPPD and perceived adequacy of staffing correlated with CMI, but perceived adequacy wasn't correlated with HPPD; rather, it was strongly associated with whether enough assistive personnel were available, which isn't included in RN-HPPD. The author concluded that HPPD was likely a better measure than RN-HPPD, but also recommended that researchers conducting quality-of-care studies choose nurse staffing measures based on a conceptual framework and not by availability.⁴²

Another group of researchers proposed two composite staffing measures seated within a conceptual framework called "nurse dose."⁴⁴ Years of direct nursing experience, levels of nursing education, and skill mix were combined to create a composite measure of nurse qualities called "active ingredient," whereas total nursing HPPD, RN-HPPD, and average nurse-patient ratio were combined to represent the intensity of nursing applied to patients.⁴⁴ Both of the composite nurse dose measures were found to be significant predictors of

hospital-acquired methicillin-resistant *Staphylococcus aureus* infections and patient falls.⁴⁵ Use of composite measures or other means of considering the interactions of multiple staffing variables at once holds merit for use in future research to improve our understanding of how variables combine to affect outcomes.

Overcoming limitations: Data are key

To conduct the types of studies needed to advance nurse staffing research and allow for its effective use by nurse managers at the unit level, researchers need access to unit-level staffing and patient outcomes data. Given the wide use of technology in today's hospitals, data capture should be widely achievable. These data must be accessible and reliable within and among organizations. Consideration should be given to the value of preserving raw data as opposed to data derived from calculations. For example, consider the potential benefits to the study design if researchers can calculate HPPD from raw data as opposed to using precalculated HPPD measured different ways by different hospitals.

Improving data collection and access is something nurse managers and nursing administrators can work on now and benefit from during their work, even before starting research. Our goal should be to capture data in a way that doesn't require unit leaders to spend time putting data together; rather, their time should be spent analyzing results. Nursing informatics research has primarily focused on the development of electronic tools within the health technology industry to assess nurse staffing.^{20,46} Development of

passive, accurate data capture and accessibility of unit-level staffing and outcomes data seems like a plausible next step for informatics research. Engagement with hospital-based nursing informaticists may be helpful.

Staffing research at the unit level needs to be an iterative process, inviting clinical nurses to engage in vetting and validating research findings, and using their input to establish the validity of staffing constructs and strengthen study designs. Just as researchers need access to data, nurse managers need access to timely patient outcomes data to compare with staffing measures, watching for trends that can become research questions. Once measures or combinations of measures are determined through research to produce desired outcomes, technology can again be leveraged to predict and justify staffing levels to achieve outcome targets. A cyclic process should emerge in which new knowledge is applied, producing new data to analyze and leading to new research questions that propel the science of nurse staffing forward.

Next steps

The desire to understand, explain, and, ultimately, predict how nurse staffing factors and decisions impact patient care on hospital units remains as important today as ever, given the need to achieve fiscally responsible staffing. A robust body of nurse staffing knowledge exists, but its translation from research to unit-level practice has been hampered by the limitations posed by hospital-level data, cross-sectional study designs, and poor nurse staffing measures. These limitations share

a common root cause: Unit-level data are lacking. Nurse managers, administrators, and researchers should focus efforts on developing ways to capture, access, and analyze unit-level nurse staffing and patient outcomes data. **NM**

REFERENCES

1. Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002;288(16):1987-1993.
2. Needleman J, Buerhaus P, Mattke S, Stewart M, Zelevinsky K. Nurse-staffing levels and the quality of care in hospitals. *N Engl J Med*. 2002;346(22):1715-1722.
3. Murphy GT, Birch S, O'Brien-Pallas L, Kephart G, MacKenzie A. Nursing inputs and outcomes of hospital care: an empirical analysis of Ontario's acute-care hospitals. *Can J Nurs Res*. 2011;43(1):126-146.
4. Needleman J, Buerhaus P, Pankratz VS, Leibson CL, Stevens SR, Harris M. Nurse staffing and inpatient hospital mortality. *N Engl J Med*. 2011;364(11):1037-1045.
5. Aiken LH, Clarke SP, Cheung RB, Sloane DM, Silber JH. Educational levels of hospital nurses and surgical patient mortality. *JAMA*. 2003;290(12):1617-1623.
6. Mark BA, Harless DW, McCue M, Xu Y. A longitudinal examination of hospital registered nurse staffing and quality of care. *Health Serv Res*. 2004;39(2):279-300.
7. Douglas K. Ratios—if it were only that easy. *Nurs Econ*. 2010;28(2):119-125.
8. Institute of Medicine. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: National Academies Press; 2010.
9. U.S. Bureau of Labor Statistics. Occupational outlook handbook: registered nurses. www.bls.gov/ooh/healthcare/registered-nurses.htm.
10. Market Realist. Analyzing hospital expenses: breaking down the important costs. <https://marketrealist.com/2014/11/analyzing-hospital-expenses>.
11. Zimlichman E, Henderson D, Tamir O, et al. Health care-associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA Intern Med*. 2013;173(22):2039-2046.

12. Centers for Disease Control and Prevention. Home and recreational safety: costs of falls among older adults. www.cdc.gov/homeandrecreational/safety/falls/fallcost.html.
13. Centers for Medicare and Medicaid Services. Provider preventable conditions. www.medicare.gov/medicaid/financing-and-reimbursement/provider-preventable-conditions/index.html.
14. Lineweaver L. *Nurse Staffing 101: A Decision-Making Guide for the RN*. Silver Spring, MD: American Nurses Association; 2013.
15. Alghamdi MG. Nursing workload: a concept analysis. *J Nurs Manag*. 2016;24(4):449-457.
16. Friese CR, Lake ET, Aiken LH, Silber JH, Sochalski J. Hospital nurse practice environments and outcomes for surgical oncology patients. *Health Serv Res*. 2008;43(4):1145-1163.
17. Kendall-Gallagher D, Aiken LH, Sloane DM, Cimioti JP. Nurse specialty certification, inpatient mortality, and failure to rescue. *J Nurs Scholarsh*. 2011;43(2):188-194.
18. Hickey PA, Gauvreau K, Jenkins K, Fawcett J, Hayman L. Statewide and national impact of California's staffing law on pediatric cardiac surgery outcomes. *J Nurs Adm*. 2011;41(5):218-225.
19. Seago JA. A comparison of two patient classification instruments in an acute care hospital. *J Nurs Adm*. 2002;32(5):243-249.
20. Harper K, McCully C. Acuity systems dialogue and patient classification system essentials. *Nurs Adm Q*. 2007;31(4):284-299.
21. Mensik JS. *The Nurse Manager's Guide to Innovative Staffing*. Indianapolis, IN: Sigma Theta Tau International; 2013.
22. Malloch K, Conovaloff A. Patient classification systems, part 1: the third generation. *J Nurs Adm*. 1999;29(7-8):49-56.
23. Tourangeau AE, Doran DM, McGillis Hall L, et al. Impact of hospital nursing care on 30-day mortality for acute medical patients. *J Adv Nurs*. 2007;57(1):32-44.
24. Upenieks VV, Kotlerman J, Akhavan J, Esser J, Ngo MJ. Assessing nursing staffing ratios: variability in workload intensity. *Policy Polit Nurs Pract*. 2007;8(1):7-19.
25. Hughes RG, Bobay KL, Jolly NA, Suby C. Comparison of nurse staffing based on changes in unit-level workload associated with patient churn. *J Nurs Manag*. 2015;23(3):390-400.
26. Jennings BM, Sandelowski M, Higgins MK. Turning over patient turnover: an ethnographic study of admissions, discharges, and transfers. *Res Nurs Health*. 2013;36(6):554-566.
27. Wagner C, Budreau G, Everett LQ. Analyzing fluctuating unit census for timely staffing intervention. *Nurs Econ*. 2005;23(2):85-90,55.
28. Meyer RM, Clarke SP. Shifts with nurse understaffing and high patient churn linked to heightened inpatient mortality risk in a single site study. *Evid Based Nurs*. 2011;14(4):122-123.
29. Aiken LH, Clarke SP, Sloane DM, Lake ET, Cheney T. Effects of hospital care environment on patient mortality and nurse outcomes. *J Nurs Adm*. 2008;38(5):223-229.
30. Trinkoff AM, Johantgen M, Storr CL, Gurses AP, Liang Y, Han K. Nurses' work schedule characteristics, nurse staffing, and patient mortality. *Nurs Res*. 2011;60(1):1-8.
31. Stimpfel AW, Lake ET, Barton S, Gorman KC, Aiken LH. How differing shift lengths relate to quality outcomes in pediatrics. *J Nurs Adm*. 2013;43(2):95-100.
32. Stone PW, Mooney-Kane C, Larson EL, Pastor DK, Zwanziger J, Dick AW. Nurse working conditions, organizational climate, and intent to leave in ICUs: an instrumental variable approach. *Health Serv Res*. 2007;42(3 Pt 1):1085-1104.
33. Welton JM. Mandatory hospital nurse to patient staffing ratios: time to take a different approach. *OJIN Online J Issues Nurs*. 2007;12(3).
34. Polit DF, Beck CT. *Nursing Research: Generating and Assessing Evidence for Nursing Practice*. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2011.
35. Brennan CW, Daly BJ, Jones KR. State of the science: the relationship between nurse staffing and patient outcomes. *West J Nurs Res*. 2013;35(6):760-794.
36. Park SH, Blegen MA, Spetz J, Chapman SA, De Groot HA. Comparison of nurse staffing measurements in staffing-outcomes research. *Med Care*. 2015;53(1):e1-e8.
37. Chinn PL, Kramer MK. *Integrated Theory and Knowledge Development in Nursing*. 8th ed. St. Louis, MO: Elsevier Mosby; 2010.
38. Simon M, Yankovskyy E, Klaus S, Gajewski B, Dunton N. Midnight census revisited: reliability of patient day measurements in US hospital units. *Int J Nurs Stud*. 2011;48(1):56-61.
39. Klaus SF, Dunton N, Gajewski B, Potter C. Reliability of the nursing care hour measure: a descriptive study. *Int J Nurs Stud*. 2013;50(7):924-932.
40. Choi J, Staggs VS. Comparability of nurse staffing measures in examining the relationship between RN staffing and unit-acquired pressure ulcers: a unit-level descriptive, correlational study. *Int J Nurs Stud*. 2014;51(10):1344-1352.
41. Min A, Scott LD. Evaluating nursing hours per patient day as a nurse staffing measure. *J Nurs Manag*. 2016;24(4):439-448.
42. Kalisch BJ. The impact of RN-UAP relationships on quality and safety. *Nurs Manage*. 2011;42(9):16-22.
43. Centers for Medicare and Medicaid Services. Case mix index. www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Acute-Inpatient-Files-for-Download-Items/CMS022630.html.
44. Manojlovich M, Sidani S. Nurse dose: what's in a concept? *Res Nurs Health*. 2008;31(4):310-319.
45. Manojlovich M, Sidani S, Covell CL, Antonakos CL. Nurse dose: linking staffing variables to adverse patient outcomes. *Nurs Res*. 2011;60(4):214-220.
46. Baggett M, Batcheller J, Blouin AS, et al. Excellence and evidence in staffing: a data-driven model for excellence in staffing (2nd edition). *Nurs Econ*. 2014;32(3 suppl):3-35.

Rebecca A. Paulsen is a PhD student at the University of Missouri and senior director of medical-surgical services at Children's Mercy Hospital in Kansas City, Mo.

The author has disclosed no financial relationships related to this article.

Copyright © 2018 The Author. Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI-10.1097/01.NUMA.0000538915.53159.b5