Published in final edited form as:

ANS Adv Nurs Sci. 2015 ; 38(3): 241–251. doi:10.1097/ANS.0000000000000081.

Proposing a New Conceptual Model and an Exemplar Measure Using Health Information: Technology to Examine the Impact of Relational Nurse Continuity on Hospital-Acquired Pressure Ulcers

Janet STIFTER, PhD, RN¹ [Postdoctoral Scholar], Yingwei YAO, PhD¹ [Research Associate Professor], Karen Dunn LOPEZ, PhD, MPH, RN¹ [Assistant Professor], Ashfaq KHOKHAR, PhD² [Professor], Diana J. WILKIE, PhD, RN, FAAN¹ [Professor and Harriet H. Werley Endowed Chair for Nursing Research], and Gail M. KEENAN, PhD, RN, FAAN³ [Professor]

¹University of Illinois at Chicago, College of Nursing, Chicago, IL

²Illinois Institute of Technology, Chicago, IL

³University of Florida, College of Nursing, Gainesville, FL

Abstract

The influence of the staffing variable nurse continuity on patient outcomes has been rarely studied and with inconclusive results. Multiple definitions and an absence of systematic methods for measuring the influence of continuity have resulted in its exclusion from nurse-staffing studies and conceptual models. We present a new conceptual model and an innovative use of health information technology to measure nurse continuity and to demonstrate the potential for bringing the results of big data science back to the bedside. Understanding the power of big data to address critical clinical issues may foster a new direction for nursing administration theory development.

Keywords

conceptual model; health information technology; nurse continuity; nurse staffing; adverse patient outcomes; big data science

Introduction

A major challenge faced by contemporary Chief Nursing Officers (CNOs) is addressing increasing healthcare costs while providing safe, high quality patient care.¹ Healthcare is costly with expenditures of 2.6 trillion dollars in 2010, a 10-fold increase since 1980.² As the largest hospital operating expense,³ nurses are viewed as valued but costly resources for safeguarding patients from harm and improving outcomes.⁴ Nursing services reorganization

Corresponding Author: Janet Stifter, PhD, RN, University of Illinois at Chicago, College of Nursing, Department of Health Systems Sciences, 845 S. Damen St. (MC 802), Chicago, IL 60612, 773-616-4500, FAX 312-996-7725, Jstift2@uic.edu.

Conflict of interest: The HANDS software, which includes the NANDA-I, NIC, and NOC standardized nursing terminologies, is owned and distributed by HealthTeam IQ, LLC. Dr. Gail Keenan is currently the President and CEO of this company and has a current conflict of interest statement of explanation and management plan in place with the University of Illinois at Chicago.

efforts (e.g., lower nurse-to-patient ratios, decreasing registered nurse [RN] care hours)⁵ have been undertaken in response to cost overruns. Reorganization strategies have become a focus of research as concerns mount over their potential to compromise one of healthcare's most important functions – protecting patients from harm when hospitalized.⁶

Reorganization strategies have been implemented in part because nurse leaders have been ineffectual in demonstrating the connection between nursing care delivery and positive care outcomes. The use of one early care model, primary nursing, has eroded as a result of this reorganization, resulting most significantly in the loss of nurse continuity. Nurse continuity or the presence of consistent RN caregivers is a rarely studied nurse-staffing variable, potentially due to difficulty in measuring this concept. This challenge has led many CNOs who value the use of consistent caregivers to none-the-less ignore this facet of nurse staffing when directing resources toward improving patient outcomes. The purpose of this article is to present literature support for a new conceptual model of nurse continuity and an innovative approach for research using health information technology to measure the influence of nurse continuity on hospital-acquired pressure ulcers (HAPUs).

Literature Review

One important nurse-staffing variable affected by reorganization strategies is nurse continuity, once a critical feature of the primary nursing model. Primary nursing is a care delivery system that makes an RN responsible and accountable 24 hours a day for all nursing care provided to a select group of patients. The goal of primary nursing is to foster both continuity of care and comprehensive patient care management.⁷ The primary nursing model contrasts with the current care delivery model in which patients may see many different nurses due to varied shift lengths, nurse schedules, and diverse care providers (e.g., part-time staff, agency or float nurses).⁵ Past research studies on primary nursing have been inconsistent in supporting improved patient outcomes.^{8–9} Thus, the link between nurse continuity and improved patient outcomes remains unsubstantiated.

Definition of Nurse Continuity

An examination of the literature evidence of care continuity reveals a focus on two main topics: (1) definitions and types of continuity, and (2) measures of continuity. Continuity definitions include continuity of information,^{6,10} relationships (relational)^{10–11} or management.^{10,12} *Information continuity* relates to use of the medical record to coordinate care delivery. *Relational continuity* speaks to the unique therapeutic relationship that develops between a patient and a consistent care provider. *Management continuity* describes the management of a health condition over time typically found with chronic conditions.

The original relational definition of nurse continuity described in the primary nursing model appears to have ceded ground to two additional definitions of care continuity. The first definition relates to use of the medical record and the second reflects the transition of the patient from one unit or care setting to the next.¹³ The latter definitions focus more on communication, information transfer, and coordination of care over time¹⁴ versus the nurse-patient relationship at the bedside.

A number of continuity measures were found in the literature. These measures include assignment patterns,¹⁵ chronological calculations or indices,^{16–18} and self-report surveys and questionnaires.^{19–20} Assignment pattern instruments such as Munson and Clinton's¹⁵ are used to collect data on the nursing care activities provided for a cross section of patients on a unit. These data are then used to determine the nursing assignments that will best ensure integration, continuity, and coordination of care for those patients. Limitations of the assignment pattern instruments include complexity (number of activities being studied), high completion time, and subjective nature of the nurse continuity assessments.

The primary care literature reports a number of indices (e.g., SECON [Sequential Continuity Index], the UPC [Usual Provider Index], the COC [Continuity of Care Index], and the K Index)¹⁶ that have been used to measure the patient's ambulatory care experience chronologically. These indices are calculated by aggregating the pattern of patient visits over time with primary care providers. Chronological measures are also used in nursing studies, including the Continuity of Care Index,¹⁸ the Consecutive Care Days Index,¹⁷ and the Consistency Index.¹⁷ Though these indices calculate a measure of continuity for patients they do not measure the independent influence of nurses' consistent or continuous care on subsequent patient outcomes. These chronological measures must be combined with another data source to allow an examination of nurse continuity on patient outcomes.

Finally, several nursing studies^{19–20} used a single question to measure perceptions about continuity (i.e., do nurse midwives perceive that the majority of their clients receive continuity of care)¹⁹ as part of a larger self-report survey or questionnaire. These questions provide valuable insights about nurse perceptions or beliefs about care continuity. However, these questions do not attempt to quantify nurse continuity nor are they able to measure the link between care continuity and potential patient outcomes.

Conceptual Models for Nurse Continuity

A number of conceptual models in the literature depict management continuity or the effect of discharge planning and care coordination^{21–22} on patient outcomes. Models were also found depicting information continuity in the form of patient handoffs²³ and the use of clinical guidelines, workflows, and pathways.²⁴ However, none of these conceptual models examined nurse continuity as a nurse-staffing variable that influences patient outcomes. Similarly, Aiken *et al.* defined a theoretical model that examined the link between hospital organizational attributes and patient outcomes but the model was focused on RN-MD relationships, RN autonomy and control and did not include nurse continuity. Tourangeau *et al.* created a model to describe the influence of hospital care structures and processes that influence mortality in acute medical patients and identified 15 practice environment, staffing, and nurse characteristic variables but not nurse continuity. Two nurse-staffing models were found that included nurse continuity as a nurse-staffing variable^{25–26} but neither were sufficient to describe the direct and moderating role of nurse continuity as my proposed model. The Irvine *et al.*²⁵ model incorporates nurse continuity as a variable but within the context of management not relational continuity. Coordination of Care and Continuity of Monitoring and Reporting are two characteristics in the model that describe Nursing's Interdependent role with other health professionals in achieving patient and health outcomes.

Continuity is not used as a nurse-staffing variable in this model but in reference to how nurses communicate and coordinate care with other health providers. The O'Brien-Pallas *et al.*²⁶ model was the only model found that includes a relational nurse continuity variable within a depiction of 27 other patient, nurse, and system characteristics, and system behaviors that influence patient, nurse, and system outcomes. Continuity of care/shift change is included on a list of "Input" Systems Behavior that effect the Patient Care Delivery system ("throughput") leading to patient, nurse and system outcomes. However, though the continuity variable is listed in the model, the authors do not define either the direct influence of nurse continuity on the patient outcomes or the combined influence of nursing continuity and other potentially relevant nurse-staffing variables on patient outcomes as is depicted in my model. Thus, based on the limitations we found with the current models available in the literature, we developed a new conceptual model to include variables identified through the literature that we believe are important to measure when examining the influence of nurse continuity on hospital-acquired pressure ulcer outcomes.

New Conceptual Model for Nurse Continuity

Our proposed conceptual model (Figure 1) depicts the relationships: (1) of nurse continuity on patient outcomes, (2) among nurse continuity, nurse characteristics (i.e., RN education, RN experience, RN work pattern [full versus part-time status]), and patient outcomes, (3) among nurse continuity, unit environment characteristics (i.e., worked hours per patient day [whppd], nurse-to-patient ratio, and shift length), and patient outcomes, and (4) of patient characteristics on patient outcomes relationships that we believe are not clearly defined in existing nurse staffing models. The first three relationships are based on our hypothesis that nurse continuity is an integral nurse-staffing variable that can either directly influence patient outcomes or moderate other nurse-staffing or unit environment variables to influence patient outcomes, such as fewer hospital-acquired pressure ulcers (HAPUs). We believe that providing patients with consistent nurse caregivers will lead to improved assessments, monitoring, and decision making resulting in more timely interventions and improved patient outcomes. This hypothesis has support from Van Walraven *et al.*'s²⁷ systematic review of 18 studies that described the association between care continuity with primary care providers and patient outcomes. Findings included improved patient satisfaction and decreased hospitalizations and emergency room visits for patients with consistent primary care providers.

Similarly, our examination of the nursing literature revealed three studies with findings that support the first relationship proposed in our new model. Bostrom¹⁷ reported improved patient satisfaction with increased nursing continuity; Russell *et al.*²⁸ found a decline in hospitalizations and use of emergent care with continuous home care nurses; and Siow²⁹ noted a safer environment with more continuous experienced nurses. These study findings support our belief about a positive association between nurse continuity and patient outcomes. No studies located examined our proposed second and third relationships suggesting an interactive or moderating effect of nurse continuity as a means to strengthen the known influence of other nurse-staffing and unit environment characteristics on patient outcomes.

Extensive research documents the influence of individual nurse-staffing variables on patient outcomes including a recent state of the science review³⁰ of 29 systematic or literature reviews. The evidence currently supports the premise that an increased level of RN education is associated with decreased mortality and odds of failure to rescue.³¹ Similarly, mortality rates were found to decline with each additional year of nurse experience in studies conducted in Canadian hospitals.⁵ Finally, staff ‘churn’ or changes in staffing due to use of part-time, float, or agency staff interfered with team functioning and care continuity in a study of 80 medical-surgical units.³² These three nurse-staffing variables (i.e., RN education, RN experience, RN work pattern [full versus part-time status]) appear as nurse characteristics in our new model.

In addition there are a variety of unit environment characteristics commonly depicted in the patient outcomes literature included in our model (i.e., worked hours per patient day [whppd], nurse-to-patient ratio, and shift length.) Study results indicate significant associations between additional nursing care hours/higher proportion of RN care and reductions in mortality,^{33–34} falls,³⁵ and pressure ulcers.^{33,35} A richer RN skill mix (i.e., a higher RN-to-ancillary personnel ratio) also increased satisfaction.³⁶ Kane *et al.*³⁴ noted that decreasing the number of patients each RN cared for reduced the odds of nosocomial sepsis, cardiac arrest, and medical complications. Aiken *et al.*³⁷ learned that the improved nurse-to-patient ratios in Magnet hospitals reduced the odds of dying by one half. There are fewer studies examining the impact of shift length on actual outcomes, with some negative study findings including increased errors,³⁸ performance lags,³⁹ and less time spent in direct patient care as the shift lengthens.⁴⁰

Studies examining nurse-staffing and unit environment characteristics typically examine the direct influence of a single variable on patient outcomes but not the potential interactions between two or more variables with their subsequent influence on patient outcomes. Our proposed model depicts the direct influence of nurse-staffing and unit environment variables on patient outcomes such as HAPUs but also the interactive or moderating effect of nurse continuity. We propose to examine how nurse continuity may positively influence patient outcomes such as HAPU prevention by strengthening the capabilities of a workforce limited by nurses with lesser education, experience, or operating under lesser nurse-to-patient ratios.

The final relationship included in this new model, specific to our plan to examine HAPUs, depicts the influence of patient characteristics on patient outcomes. Pressure ulcers are a prevalent never event (5–10%)⁴¹ and a major nurse-sensitive quality outcome. The literature is replete with factors that contribute to pressure ulcers including impairments of mobility, nutrition, cognition, and continence^{41–42} all of which are effected by the quality of nursing assessment, monitoring, decision making, and interventions. Our new model includes patient characteristics as important variables when examining influences on patient outcomes.

Exemplar Measure to Study Nurse Continuity

As stated above, one barrier to understanding the influence of nurse continuity on patient outcomes has been the absence of robust methods that measure all relevant variables. To support testing of our nurse continuity model, our team of investigators at the University of

Illinois at Chicago developed an innovative documentation tool. This tool, the Hands on Automated Nursing Data System (HANDS)⁴³ is an electronic plan of care (POC) documentation system that can be used to gather the variables in the proposed conceptual model, making it possible to comprehensively examine the relationship between nurse continuity and HAPUs. The HANDS was successfully deployed in clinical practice and used by 787 nurses on nine units in four hospitals for 12 or 24 months to routinely document nursing plans of care on their patients. This period of use resulted in the collection of nursing POC data for 42,403 hospitalizations. The valid and reliable HANDS database^{44–45} has been shown to generate standardized nursing care big data that has been statistically analyzed and mined for best practices⁴⁴ as well as translated into evidence based decision support for end-of-life pain management in a prior study.⁴⁵ The HANDS plan of care data and the demographic information collected about each nurse user upon entering data into the HANDS system will serve as the data used to evaluate the impact of nurse continuity on HAPU patient outcomes in my proposed study.

The HANDS is used each shift by nurses to enter data that tracks and links a patient's diagnoses (North American Nursing Diagnosis Association International [NANDA-I]),⁴⁶ outcomes (Nursing Outcomes Classification [NOC]),⁴⁷ and interventions (Nursing Interventions Classification [NIC]),⁴⁸ (NNN) with patient demographics and a variety of nurse characteristics.⁴³ In HANDS information about patient outcomes and the nurse caregivers are automatically captured, linked, and stored through the documentation on each shift. As a result, the relationship of nurse characteristics (e.g., RN education, RN experience, RN work pattern) to the care provided and the outcomes achieved can be analyzed down to the shift level. This level of analysis allows us to examine the characteristics of the nurses directly caring for an individual patient with his/her subsequent outcomes rather than stopping at the unit or hospital level as is found with other databases.

Historically, there has been no other data collection system with linked data that has captured nurse continuity or other factors thought to be moderated by nurse continuity. This measurement gap prevented researchers from comprehensively evaluating the combined impact of patient characteristics and nurse-staffing variables on patient outcomes. The content and structure of the HANDS database allows us to use the standardized data to perform big data analysis to: (1) identify and control for potentially influential patient-level characteristics, (2) examine the influence of a single variable such as nurse continuity on patient outcomes, and (3) examine the influence of nurse continuity on other key nurse-staffing or unit environment variables that may influence patient outcomes.

Operational definitions of our selected study variables can be translated into terms that are captured through the raw data available in HANDS (Table I). For example, the nurse continuity variable consecutive days of care by the same/single RN(s), is determined using the total number of consecutive care days worked by each RN with the patient during a care episode. Nurse continuity is then operationalized as the percentage of consecutive care days by the same/single RN(s) per patient episode. Similarly, nurse experience is determined by the number of years of experience an RN possesses and operationalized as the percent of time cared for by RNs with greater than or equal to 2 years of experience per patient episode. Finally our patient outcomes variables (i.e., continence, mobility, nutrition) are

operationalized using NNN labels (Table II) and then measured based on their occurrence in POC documentation in the HANDS.

Implications for Nursing and Conclusions

Nursing services reorganization remains a challenge for CNOs. Financial constraints from declining patient volumes, nurse call-ins (absences), fluctuations in census, retention of experienced bedside staff, and recruitment of nurses with a baccalaureate education are ongoing challenges for CNOs seeking to provide safe staffing for hospitalized patients. Efforts to promote nurse continuity in scheduling and assigning patients may be a nurse-staffing variable that CNOs can influence with positive repercussions for patient outcomes.

Our literature review revealed many definitions, types, and measures of continuity but only three studies that attempted to measure nurse continuity and patient outcomes. A limitation of these studies was the use of separate, unlinked data sources for the nurse-staffing and patient outcomes data. No studies addressed the interaction of nurse continuity and other nurse-staffing variables on an important patient outcome such as HAPUs. To guide research that may affect future nurse administrator decisions we developed a new conceptual model and an information technology big data tool (HANDS) to measure variables in this model. We believe that understanding the power of big data science to address critical clinical issues may foster a new direction for nursing administration theory development and may be a critical strategy for CNOs seeking to achieve safe, high quality patient outcomes amid the challenge of ongoing reorganization of nursing services.

Acknowledgments

The authors thank Kevin Grandfield, Publication Manager of the Department of Biobehavioral Health Science at the University of Illinois at Chicago College of Nursing, for editorial assistance.

Funding: This research was made possible by an R01 NR012949 grant from the National Institutes of Health, National Institute of Nursing Research and a 1R36HS023072-01 grant from the Agency for Healthcare Research and Quality (AHRQ). Its contents are solely the responsibility of the authors and do not necessarily reflect the official views of the National Institute for Nursing Research or the Agency for Healthcare Research and Quality.

References

1. Sherman, RO. Major challenges in executive nurse leader roles today. *EmergingRNLeader*. 2012. <http://www.emergingrnleader.com>
2. Kaiser, EDU. [Accessed January 27, 2013] US Health Care Costs. <http://www.kaiseredu.org/Issues-Modules>
3. McCue M, Mark BA, Harless DW. Nurse staffing, quality, and financial performance. *Journal of Healthcare Finance*. 2003; 29:54–76. <http://web.ebscohost.com.proxy.cc.uic.edu>.
4. Hughes, Ronda G., editor. U. S. Department of Health and Human Services, Agency for Healthcare Research and Quality. Patient safety and quality: An evidence-based handbook for nurses. Maryland: AHRQ; 2008. AHRQ Publication No. 08-0043 www.ahrq.gov/qual/nursesfdbk/
5. Tourangeau AE, Giovannetti P, Tu JV, et al. Nursing-related determinants of 30-day mortality for hospitalized patients. *Canadian Journal of Nursing Research*. 2002; 33:71–88. <http://digitallibrary.mcgill.ca>. [PubMed: 11998198]
6. Anthony MK, Preuss G. Models of care: The influence of nurse communication on patient safety. *Nursing Economics*. 2002; 20:209–215. 248. <http://web.ebscohost.com>. [PubMed: 12382537]

7. Ferguson, V. The National League for Nursing (NLN). Primary nursing: One nurse - one client planning care together. New York: NLN; 1977. Primary nursing - A modality of care for today. NIH Publication No. 52-1695
8. Shukla RK. All RN model nursing care delivery: A cost-benefit evaluation. *Inquiry*. 1983; 20:173–184. [PubMed: 6222987]
9. Chavigny K, Lewis A. Team or primary nursing care? *Nursing Outlook*. 1984; 32:322–327. [PubMed: 6567848]
10. Reid, R.; Haggerty, J.; McKendry, R. Defusing the confusion: Concepts and measures of continuity of healthcare. Canada: Canadian Health Services Research Foundation; 2002. www.chsrf.ca
11. Saultz JW. Defining and measuring interpersonal continuity of care. *Annals of Family Medicine*. 2003; 19:134–143. DOI: 10.1370/afm.23 [PubMed: 15043374]
12. Brown S. Continuity of care: A concept analysis. *Vision*. 1997; 3:3–6.
13. Procter S. Planning for continuity of carer in nursing. *Journal of Nursing Management*. 1995; 3:169–175. [PubMed: 7620657]
14. Haggerty JL, Reid RJ, Freeman GK, et al. Continuity of care: A multidisciplinary review. *British Medical Journal*. 2003; 327:219–1221. DOI: 10.1136/bmj.327.7425.1219
15. Munson F, Clinton J. Defining nursing assignment patterns. *Nursing Research*. 1979; 28:243–249. [PubMed: 255923]
16. Ejlertsson G, Berg S. Continuity-of-care measures: An analytic and empirical comparison. *Medical Care*. 1984; 22:231–239. [PubMed: 6700286]
17. Bostrom J, Tisnado J, Zimmerman J, et al. The impact of continuity of nursing care personnel on patient satisfaction. *Journal of Nursing Administration*. 1994; 24:64–68. [PubMed: 7931690]
18. Curley MAQ, Hickey PA. The Nightingale metrics. *American Journal of Nursing*. 2006; 106:66–70. <http://ovidsp.tx.ovid.com.proxy.cc.uic.edu>. [PubMed: 17016098]
19. Fleissig A, Kroll D. Achieving continuity of care and carer. *Modern Midwife*. 1997; 7:15–19. [PubMed: 9348860]
20. Goode D, Rowe K. Perceptions and experiences of primary nursing in an ICU: A combined methods approach. *Intensive and Critical Care Nursing*. 2001; 17:294–303. DOI: 10.1054/iccn.2001.1600 [PubMed: 11866421]
21. McDonald, KM.; Schultz, E.; Albin, L., et al. Agency for Healthcare Research and Quality. Care Coordination Measures Atlas. Vol. Chapter 3. Maryland: AHRQ; 2011. Care Coordination Measurement Framework. AHRQ Publication No. 11-0023-EF www.ahrq.gov/professionals/systems/long-term-care
22. Tomura H, Yamamoto-Mitani N, Nagata S, et al. Creating an agreed discharge: Discharge planning for clients with high care needs. *Journal of Clinical Nursing*. 2011; 20:444–453. DOI: 10.1111/j.1365-2702.2010.03556.x [PubMed: 21219523]
23. Jeffcott SA, Evans SM, Cameron PA, et al. Improving measurement in clinical handover. *Quality and Safety in Health Care*. 2009; 18:272–277. DOI: 10.1136/qshc.2007.024570 [PubMed: 19651930]
24. Gooch P, Roudsari A. Computerization of workflows, guidelines, and care pathways: A review of implementation challenges for process-oriented health information systems. *Journal of the American Medical Informatics Association*. 2011; 18:738–748. DOI: 10.1136/amiajnl-2010-000033 [PubMed: 21724740]
25. Irvine D, Sidani S, Hall LM. Linking outcomes to nurses' roles in health care. *Nursing Economic\$*. 1998; 16:58–64. 87. [PubMed: 9592519]
26. O'Brien-Pallas L, Meyer RM, Hayes LJ, et al. The patient care delivery model – An open system framework: Conceptualization, literature review and analytic strategy. *Journal of Clinical Nursing*. 2010; 20:1640–1650. DOI: 10.1111/j.1365-2702.2010.03391.x [PubMed: 21118325]
27. Van Walraven C, Oake N, Jennings A, et al. The association between continuity of care and outcomes: A systematic and critical review. *Journal of Evaluation in Clinical Practice*. 2010; 16:947–956. DOI: 10.1111/j.1365-2753.2009.01235.x [PubMed: 20553366]
28. Russell D, Rosati RJ, Rosenfeld P, et al. Continuity in home health care: Is consistency in nursing personnel associated with better patient outcomes? *Journal for Healthcare Quality: Promoting Excellence in Healthcare*. 2011; 33:33–39. DOI: 10.1111/j.1945-1474

29. Siow, KCE. Impact of continuity in nursing care on patient outcomes in the pediatric intensive care unit. Doctoral dissertation. 2012. <http://repository.upenn.edu/dissertations/AAI3509486>
30. Brennan CW, Daly BJ, Jones KR. State of the science: The relationship between nurse staffing and patient outcomes. *The Western Journal of Nursing Research*. 2013; 35:760–794. DOI: 10.1177/0193945913476577 [PubMed: 23444060]
31. Aiken LH, Clarke SP, Cheung RB, et al. Educational levels of hospital nurses and surgical patient mortality. *Journal of the American Medical Association*. 2003; 290:1617–1623. DOI: 10.1001/jama.290.12.1617 [PubMed: 14506121]
32. Duffield C, Roche M, O'Brien-Pallas L, et al. The implications of staff 'churn' for nurse managers, staff, and patients. *Nursing Economic\$*. 2009; 27:103–110. <http://web.ebscohost.com.proxy.cc.uic.edu>. [PubMed: 19492774]
33. Blegen MA, Goode CJ, Spetz J, et al. Nurse staffing effects on patient outcomes: Safety-net and non-safety-net hospitals. *Medical Care*. 2011; 49:406–414. DOI: 10.1097/MLR.0b013e318202e129 [PubMed: 21407034]
34. Kane RL, Shamliyan TA, Mueller C, et al. The association of registered nurse staffing levels and patient outcomes: Systematic review and meta-analysis. *Medical Care*. 2007; 45:1195–1204. <http://www.jstor.org.proxy.cc.uic.edu>. [PubMed: 18007170]
35. Sovie MD, Jawad AF. Hospital restructuring and its impact on outcomes. *Journal of Nursing Administration*. 2001; 31:588–600. <http://ovidsp.txovid.com.proxy.cc.uic.edu>. [PubMed: 11771464]
36. Seago JA, Williamson A, Atwood C. Longitudinal analyses of nurse staffing and patient outcomes. *The Journal of Nursing Administration*. 2006; 36:13–21. <http://web.ebscohost.com.proxy.cc.uic.edu>. [PubMed: 16404195]
37. Aiken LH, Sloane DM, Lake ET, et al. Organization and outcomes of inpatient AIDS care. *Medical Care*. 1999; 37:771–787.
38. Scott LD, Rogers AE, Shwant WT, et al. Effects of critical care nurses' work hours on vigilance and patients' safety. *American Journal of Critical Care*. 2006; 15:30–37. <http://web.ebscohost.com.proxy.cc.uic.edu>. [PubMed: 16391312]
39. Fitzpatrick JM, While AE, Roberts JD. Shift work and its impact upon nurse performance: Current knowledge and research issues. *Journal of Advanced Nursing*. 1999; 29:18–27. <http://web.ebscohost.com.proxy.cc.uic.edu>. [PubMed: 10064278]
40. Reid N, Robinson G, Todd C. The quantity of nursing care on wards working 8- and 12- hour shifts. *International Journal of Nursing Studies*. 1993; 30:403–413. www.sciencedirect.com.proxy.cc.uic.edu. [PubMed: 8225806]
41. Anders J, Heinemann A, Leffmann C, et al. Decubitus ulcers – Pathophysiology and primary prevention. *Deutsches Arzteblatt International*. 2010; 107:371–382. DOI: 10.3238/arztebl.2010.0371 [PubMed: 20539816]
42. Coleman S, Gorecki C, Nelson EA, et al. Patient risk factors for pressure ulcer development: Systematic review. *International Journal of Nursing Studies*. 2013; 50:974–1003. DOI: 10.1016/j.ijnurstu.2012.11.019 [PubMed: 23375662]
43. Keenan GM, Tschannen D, Wesley ML. Standardized nursing terminologies can transform practice. *Journal of Nursing Administration*. 2008; 38:103–106. DOI: 10.1097/01.NNA.0000310728.50913.de [PubMed: 18327054]
44. Keenan GM, Yakel E, Yao Y, et al. Maintaining a consistent big picture: Meaningful use of a web based POC EHR system. *International Journal of Nursing Knowledge*. 2012; 23:119–123. DOI: 10.1111/j.2047-3095.2012.01215.x [PubMed: 23043651]
45. Yao Y, Keenan G, Al-Masalha F, et al. Current state of pain care for hospitalized patients at end of life. *The American Journal of Hospice and Patient Care*. 2013; 30:128–136. DOI: 10.1177/1049909112444458
46. NANDA International. *Nursing diagnoses: Definition and classification 2003–2004*. Philadelphia: NANDA International; 2003.
47. Moorhead, S.; Johnson, M.; Maas, M. *Nursing outcomes classification (NOC)*. St. Louis: Mosby; 2004. Iowa outcomes project.

48. McCloskey Dochterman, JC.; Bulechek, GM. Nursing interventions classification (NIC). St. Louis: Mosby; 2004.
49. Aiken LH, Sochalski J, Lake ET. Studying Outcomes of Organizational Change in Health Services. Medical Care. 1997; 35:NS6–NS18. [PubMed: 9366875]
50. Tourangeau AE, Doran DM, McGillis-Hall L, et al. Impact of hospital nursing care on 30-day mortality for acute medical patients. Journal of Advanced Nursing. 2007; 57:32–44. DOI: 10.1111/j.1365-2648.2006.04084.x [PubMed: 17184372]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
Conceptual Model for Studying the Effect of Nurse Continuity on Patient Outcomes

Table I

Raw Data in HANDS and Operationalized Definitions for Patient Predictors, Nursing Staffing, and Continuity Variables

Variable	Raw Data Found in HANDS	Operationalized Definition
Nurse Staffing		
Shift Length	Number of consecutive hours worked by each RN during a care episode.	% of 8-hour RN care shifts in a patient episode.
RN Work Pattern (Shifts of Care by Part [PT]/Full- Time [FT] vs. Very Part-Time [VPT] Status Workers)	Fraction of time status (FT, PT, VPT) for each RN who cared for the patient during a care episode.	% of care shifts by very part-time status (0.3 [24 hours] or less) in a patient episode.
Nurse Experience	Years of experience as a RN.	% of time cared for by RNs with to 2 years of experience in a patient episode.
Nurse Education	Diploma, ADN, ^a BSN, ^b BSN and some additional coursework, Master's degree in nursing, or Doctoral degree in nursing.	% of time cared for by a RN with a BSN or greater in a patient episode.
Patient-to-Nurse Ratio	Actual number of patients cared for by a single RN during a shift.	The average patient-to-nurse ratio over the course of the patient care episode.
Worked hours per patient day (whppd)	The total number of RN hours on a unit in a 24-hour period divided by the number of patients on that unit at the midnight census.	The average whppd over the course of the patient care episode.
Nurse Continuity		
Number of consecutive days cared for by the same/single RN(s)	The total number of consecutive care days worked by each RN with the patient during a care episode.	% of consecutive care days by the same/single RN(s) in a patient episode.
Patient Predictors		
Nutrition	1 NANDA-I, ^c 5 NOC, ^d 5 NIC ^e Nutrition labels	NNN ^f Nutrition label appearing on the admission POC ^g in the patient's episode
Continence	3 NANDA-I, 4 NOC, 6 NIC Continence labels	NNN Continence label appearing on the admission POC in the patient's episode
Hydration	3 NANDA-I, 3 NOC, 9 NIC Hydration labels	NNN Hydration label appearing on the admission POC in the patient's episode
Mobility	2 NANDA- I, 4 NOC, 5 NIC Mobility labels	NNN Mobility label appearing on the admission POC in the patient's episode
Perfusion	2 NANDA- I, 4 NOC, 5 NIC Perfusion labels	NNN Perfusion label appearing on the admission POC in the patient's episode
Cognition	4 NANDA- I, 9 NOC, 6 NIC Cognition labels	NNN Cognition label appearing on the admission POC in the patient's episode
Skin	3 NANDA-I, 2 NIC Skin labels	NNN Skin label appearing on the admission POC in the patient's episode
Age	Age in years	Age in years

^aADN = Associate Degree in Nursing

^bBSN = Bachelor of Science in Nursing

^cNANDA-I = North American Nursing Diagnosis Association – International

^dNOC = Nursing Outcomes Classification

^eNIC = Nursing Interventions Classification

^fNANDA-I NOC NIC = NNN

^gPOC = Plan of Care

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table IINANDA-I,^a NOC,^b and NIC^c (NNN) Labels for Mobility

NANDA-Is
1. NANDA-I: Impaired Bed Mobility
2. NANDA-I: Risk for Peripheral Neurovascular Dysfunction
3. NANDA-I: Impaired Physical Mobility
NOCs
1. NOC: Mobility
2. NOC: Body Positioning
3. NOC: Neurological Status: Cranial Sensory/Motor Function
4. NOC: Immobility Consequences: Physiological
NICs
1. NIC: Positioning
2. NIC: Positioning: Wheelchair
3. NIC: Pressure Management
4. NIC: Bed Rest Care
5. NIC: Positioning: Neurologic

^aNANDA-I = North American Nursing Diagnosis Association – International^bNOC = Nursing Outcomes Classification^cNIC = Nursing Interventions Classification