RN assessments of excellent quality of care and patient safety are associated with significantly lower odds of 30-day inpatient mortality: A national cross-sectional study of acute-care hospitals

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Abstract

Background—Quality and safety in health care has been increasingly in focus during the past 10–15 years. Stakeholders actively discuss ways to measure safety and quality of care to improve the health care system as a whole. Defining and measuring quality and safety, however, is complicated. One underutilized resource worthy of further exploration is the use of registered nurses (RNs) as informants of overall quality of care and patient safety. However, research is still scarce or lacking regarding RN assessments of patient safety and quality of care and their relationship to objective patient outcomes.

Objective—To investigate relationships between RN assessed quality of care and patient safety and 30-day inpatient mortality post-surgery in acute-care hospitals.

Design—This is a national cross-sectional study.

Data sources—A survey (*n* = >10,000 RNs); hospital organizational data (*n* = 67); hospital discharge registry data (*n* > 200,000 surgical patients).

Data collection and analysis—RN data derives from a national sample of RNs working directly with inpatient care in surgical/medical wards in acute-care hospitals in Sweden in 2010. Patient data are from the same hospitals in 2009–2010. Adjusted multivariate logistic regression models were used to estimate relationships between RN assessments and 30-day inpatient mortality.

Results—Patients cared for in hospitals where a high proportion of RNs reported excellent quality of care (the highest third of hospitals) had 23% lower odds of 30-day inpatient mortality

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compared to patients cared for in hospitals in the lowest third (OR 0.77, CI 0.65–0.91). Similarly, patients in hospitals where a high proportion of RNs reported excellent patient safety (highest third) had is 26% lower odds of death (OR 0.74, CI 0.60–0.91).

Conclusions—RN assessed excellent patient safety and quality of care are related to significant reductions in odds of 30-day inpatient mortality, suggesting that positive RN reports of quality and safety can be valid indicators of these key variables.

Keywords

Hospitals; Mortality; Patient safety; Quality of health care; Registered nurses

1. Introduction

Registered nurses (RNs) hold a central position in inpatient hospital care. In addition to providing direct patient care, RNs contribute to safe and high quality patient care by supervising other nursing staff, monitoring the health status of patients, coordinating and collaborating with multi-professional health care teams, and providing education and support for both patients and patients' families. This allows RNs to have a unique perspective of the patient care experience, putting them at the "sharp end" of patient safety (Hughes, 2008; Reason, 1995), and influencing their ability to make well-informed assessments of care quality and patient safety in their workplace (Page, 2004).

Quality and safety in health care have been increasingly in focus in recent years. Within a variety of health care (Sveriges Kommuner och Landsting; SKL, 2013), research (Agency for Healthcare Research and Quality; AHRQ, 2013), and policy-making organizations (Ministry of Health and Social Affairs, 2010) ways to measure quality of care and patient safety to improve reimbursement systems and the health care system as a whole are perpetual topics for active discussion. Defining and measuring quality and safety is, however, complicated (Loeb, 2004; Pronovost et al., 2005). Agencies such as the World Health Organization (Sherman et al., 2009; World Health Organisation, 2008) and the AHRQ (Farquhar, 2008) both acknowledge that there is a plethora of classifications and definitions of patient safety and quality of care. Definitions vary by context and purpose and descriptions of the relationships between patient safety and quality of care also vary. Campbell et al. (2000) and the Institute of Medicine (2001), for example, both describe safety as an integrated dimension of quality whereas in contrast, Runciman et al. (2009) describe quality as a part of the patient safety classification. Others describe patient safety as being a discipline in its own right (Emanuel et al., 2008; Leape and Berwick, 2005). However, we have found little direct discussion of RNs' conceptualization of patient safety and quality of care or the links between them (see Mitchell, 2008). One underutilized resource worthy of further exploration is the use of RNs as informants of overall quality of care and patient safety in acute care hospital settings (McHugh and Stimpfel, 2012).

Research verifying RN assessments of quality of care and patient safety remains scarce. While a few studies have shown a direct relationship between RN assessments of care quality and patient outcomes including 30-day mortality (Kutney-Lee et al., 2009; McHugh and Stimpfel, 2012; Tourangeau et al., 2007), research is still lacking about the relationship

between RN assessments of patient safety and 30-day inpatient mortality. Additionally, most of the published research in this area derives from North America, which leaves open the question of whether similar relationships are found in other countries with different health care systems. In their seminal paper on this topic, McHugh and Stimpfel noted (2012) that an important next step in evaluating the relationship between RN reported quality of care and outcomes was to examine this relationship in international samples and contexts. In previous research from Sweden, a number of nursing work environment factors were found to be significantly related to RNs' assessments of patient safety, although the relationship with objective patient outcomes was not examined (Smeds Alenius et al., 2014). The use of inpatient mortality as a measure of timeliness and effectiveness in hospital care has been under debate for many years (Barker et al., 2011; Mitchell and Shortell, 1997; Thomas and Hofer, 1999), as it has been criticized for lacking sensitivity as an outcome measure. Using risk-adjusted inpatient mortality is one well-established method to increase sensitivity. A number of researchers, such as Silber et al. (2007) and Tourangeau (2005) argue that investigating residual variance in patient mortality, i.e. that is not explained by patient characteristics, may allow hypotheses that organizational characteristics including nursing care could contribute to some of the variance.

The study presented below has been in part inspired by McHugh and Stimpfel (2012) but was conducted in Sweden, which has a health care system different from those in North America in several ways. The Swedish health care system is based on principles of equal access to care, and primarily tax-financed with minimal out-of-pocket costs for patients with in-hospital health care provision, the responsibility of regional authorities with hospitals providing specialized services for their catchment area. While specific health care financing mechanisms vary between different levels of government and individual hospitals, the overwhelming majority of acute care hospitals are owned and operated by the public sector, with patients generally referred to hospital via primary care, except in case of emergency.

2. Objectives

In this study, we continue efforts to step-wise add data to contribute to a systematic development of a context-relevant and empirically-based conceptual framework, to generate hypotheses that may be locally relevant, but more broadly generalizable. The primary aim of this study is to investigate the relationship between RN assessments of quality of care and patient safety on their unit and the objective patient outcome measure of 30-day inpatient mortality in acute-care hospitals in Sweden.

The following hypotheses are examined:

1. RN assessments of better patient safety, aggregated to the hospital level, are related to lower 30-day inpatient mortality.

2. RN assessments of better quality of care, aggregated to the hospital level, are related to lower 30-day inpatient mortality.

3. Methods

This cross-sectional study combines three different types of data: patient data from the national hospital discharge register, data on Swedish acute care hospitals, and a RN survey of working conditions. These data derive from the Swedish RN4CAST database, part of an EU 7th framework project (Sermeus et al., 2011).

3.1. Patient discharge data

The patient data were extracted from the national hospital discharge register (Swedish: Patientregistret). The register includes information on all inpatient care discharges from all hospitals in Sweden. The following information was extracted: patient characteristics (gender and age), administrative data (hospital/clinic, department, date of admission, date of discharge, length of stay, where patients were admitted from, where patients were discharged to), and medical information (main diagnosis, secondary diagnosis, procedures, and diagnosis related groups [DRGs]), and if the hospital stay was planned or not.

We focused on patients who had undergone general, orthopaedic, or vascular surgery. This patient group can be found in most general acute care hospitals, there are established risk-adjustment procedures for administrative data regarding this population (Silber et al., 2007, 2009), and this group has been the subject of other recent research in this area, thus allowing comparison (Aiken et al., 2014). Data from adult surgical patients, aged 19–99, with general, orthopaedic, and vascular surgical DRGs with more than five deaths per DRG were included in these analyses. The most common diagnoses and procedures in this patient group are presented in Table 1.

3.2. Hospital data

Data on the organizational characteristics of the hospitals derive from each hospital administration complemented by data available in the public domain. These data supplied information on the organizational characteristics used in the analysis including: hospital size (number of beds), teaching status, and presence of high-technology procedures (defined as open-heart and/or transplantation surgery). Hospitals that did not perform the surgical procedures included in the analyses were omitted in the final dataset, with analysis thus based on a 67 of the approximately 80 existing acute-care hospital organizations from all Swedish health care regions. Hospital characteristics are shown in Table 2.

3.3. RN sample and survey

All RNs working in inpatient medical/surgical units in acute-care hospitals in Sweden were recruited via the member register of the Swedish Association of Health Care Professionals, which represents >80% of clinically active RNs. The member register contains workplace information (hospital and department), but no information pertaining to the specific function or duties of the RN or his/her involvement in inpatient versus outpatient care. The RN survey was therefore distributed with deliberate over-recruitment. The survey was sent, by Statistics Sweden, to the home addresses of all RNs registered as working in medical/surgical departments ($N = 33,083$), with the option of responding by paper or electronically. After three reminders, the return rate was 69.8% ($n = 23,087$). After excluding RNs who did

not meet the inclusion criteria, the study database contained 10,174 respondents (see Lindqvist et al., 2015, for further detail). In this study, those who worked in hospitals which did not perform the surgical procedures included in the study were omitted; analysis is thus based on responses from the 10,107 RN respondents who worked in the 67 included hospital organizations. The Ethical Review Board in Stockholm (Dnr 2009/1587-31/5) approved the study prior to initiation.

The RN survey included items about the RN work environment, latest work shift, quality, and safety. It was based on 118 items from validated and well-known instruments (Aiken and Patrician, 2000; Lake, 2002; Li et al., 2007; Maslach and Jackson, 1981) with questions developed and tested in prior research, which were translated for the study (Aiken et al., 2002, 2008). Two global items measuring RN reported quality of care and patient safety from the survey were used in the analyses presented here.

The participating RNs had a mean age of 39.7 years (median 38, range 21–67), and were primarily women (93%). A majority of the RNs had a bachelor's degree in nursing (59%), with almost all educated in Sweden (97.8%). The RNs had worked in the profession for a mean of 11.4 years (range 0–48) and at their current workplace for a mean of 9.6 years (range 0–48).

4. Variables

4.1. Outcome variable

The primary outcome variable, derived from the patient discharge data from 2009 and 2010, was *inpatient death within 30 days of admission*. Analyses were based on the first admission for patients with several admissions.

4.2. Explanatory variables

Two global items from the RN survey were used as explanatory variables. Quality of care was measured by a single item (*In general, how would you describe the quality of nursing care delivered to patients on your unit/ward?*) with responses on a 4-point Likert scale ranging from 1 = poor to 4 = excellent. Patient safety was measured by a single item (*Please give your unit/ward an overall grade on patient safety*) with responses on a 5-point Likert scale ranging from 1 = failing to 5 = excellent. To facilitate comparison with previous research (McHugh and Stimpfel, 2012), quality of care was dichotomized into exceptionally positive responses (4 = excellent) compared to all other responses. The patient safety measure was also dichotomized into the most positive response (5 = excellent) versus all others (responses 1, 2, 3, 4).

For analysis, we used hospital-level measures representing the percentage of RNs that reported that the quality of care was excellent and the percentage of RNs that gave an overall patient safety grade of excellent. Hospitals were categorized based on being in the lower, middle, or upper tertile for these measures (separately).

To assess the reliability of RN reported quality of care and patient safety, we calculated the intraclass correlation coefficient (Sloan et al., 2002) for patient safety and quality of care

using a one-way analysis of variance. The ICCs for quality of care (0.75) and patient safety (0.8) indicate that there was adequate agreement among the individual RNs to aggregate their responses to the hospital level (Glick, 1985).

4.3. Control variables

A number of variables were used to control for patient and hospital characteristics. For patients, adjustments were made for gender, age, comorbidities (according to Charlson et al., 1987, 1994), and whether the hospital stay was planned or unplanned. We also included dummy variables indicating the surgical DRG to account for type of surgery. The C-statistic for the risk-adjusted mortality model was 0.89, which is considered strong (Hosmer et al., 2013). Adjustments were also made for hospital char-acteristics including size, teaching status, and if high-technology procedures could be carried out, these hospital variables, with the exception of size, were dichotomized as yes/no for analysis.

4.4. Statistical methods

Descriptive statistics, cross-tabulations, frequencies, and graphs depicting distributions and correlations, were used to check for anomalies, such as outliers or extreme values. The ICC was investigated by using a one-way analysis of variance. Goodness of fit in the form of C-statistics was performed on the mortality model to investigate the extent to which the model can predict the outcome better than chance.

We used separate adjusted multivariate logistic regression models to estimate the relationship of RN assessed quality of care and RN assessed patient safety to 30-day inpatient mortality (LaValley, 2008). In all regression analyses, a mixed model approach with random intercept was used to correct for the dependency of observations within a hospital. Confidence intervals were set at 95%. Data were analyzed using SAS 9.4.

5. Results

5.1. Descriptive data

The 201,674 surgical patients included in analyses had a mean age of 64.5 years (median 67 years, std 17.7). There were more women (57.6%) than men (42.4%), with patients having a mean length of stay of 7 days (median 5 days, std 7.4). A total of 2341 patients (1.2%) died while in hospital within 30 days of admission. The most common surgical DRGs, comorbidities, and primary diagnoses among these patients are shown in Table 1.

The 67 acute-care hospital organizations included ranged from 40 to 2072 beds in size, with a mean of 333 beds. Ten of the hospital organizations performed high technology procedures, and eight were teaching hospitals. All but two hospitals were publicly run, and one of these two was non-profit. The 30-day inpatient mortality in the study sample ranged from 0 to 2.7% between hospitals. The mean number of RN responses per hospital was 150, with a range of 13–805 responses. On the hospital level, the proportion of RNs reporting that quality of care was excellent ranged from 0 to 30.9% (mean 11.6%), while the proportion of RNs assessing patient safety as excellent ranged from 0 to 9.8% (mean 3.4%). Hospital characteristics are shown in Table 2.

5.2. Quality of care, patient safety, and 30-day inpatient mortality

The results of both the unadjusted and the adjusted multivariate analyses of hospital level RN assessments of quality of care and patient safety and their relationship with the outcome variable 30-day inpatient mortality are shown in Table 3.

For quality of care, a hospital in the highest tertile of the proportion of RNs reporting excellent quality of care is associated with 23% lower odds for 30-day inpatient mortality compared with a hospital in the lowest tertile for this item (OR 0.77, CI 0.65–0.91).

Similarly, for patient safety, comparison between a hospital in the lowest tertile with one in the highest tertile in regard to the proportion of RNs assessing patient safety as excellent shows a statistically significant association with a 26% reduction in the odds of 30-day inpatient mortality (OR 0.74, CI 0.60–0.91).

6. Discussion

In this national cross-sectional study, we combine data derived from over 2 million hospital admissions with over 200,000 surgical procedures performed in 67 acute-care hospital organizations throughout Sweden, and survey data from over 10,000 RNs working in inpatient care in the same hospitals. We found that RN assessments of excellent patient safety and quality of care were related to significantly reduced odds of patients dying in hospital within 30 days of admission after general, vascular, or orthopaedic surgery.

One interesting finding is what appears to be a wide range in 30-day inpatient mortality among the 67 hospital organizations analyzed here. Sweden is a country which aims at equal access to quality care regardless of place of residence, and as these hospitals were almost exclusively publicly run with low direct patient costs, differences noted here should not reflect socio-economic variation to the extent found in many countries. The patients in this study had undergone surgical procedures which are carried out in most general acute care hospitals in Sweden with a low expected mortality rate in this patient group. In spite of this, the range of 0–2.7% 30-day inpatient mortality in this group among the 67 hospital organizations, in a country with the lowest average patient mortality rates among the RN4CAST-countries (Aiken et al., 2014), seems to suggest that the goal of equal quality care across the country is not being met.

Since 2010, when the RN survey was distributed, Sweden has launched the Patient Safety Act (Ministry of Health and Social Affairs, 2010) with the aim of increasing focus on patient safety and quality of care to better regulate the responsibilities of hospital organizations to make systematic efforts to avoid hospital-related injuries. This study suggests that RN's positive assessments of quality of care and patient safety might be used as an indicator of overall hospital quality and safety. Admittedly, inpatient mortality is a rather crude measure of both safety and quality. On the other hand, this study demonstrates that RN assessments of excellent quality and safety are strongly related to substantially lower odds of patient mortality, in a country with notably low mortality in this patient group. Since patient characteristics do not account for the total residual variation of inpatient mortality between hospitals it would be reasonable to hypothesize that there is potentially preventable mortality

associated with, among other factors, the quality and safety of patient care (Nolte and McKee, 2012; Tourangeau, 2005).

An intrinsic feature of the work of a professional RN in hospitals is the assessment of quality and safety to improve patient care, prevent unnecessary harm to patients, and ultimately prevent avoidable deaths. This involves not only assessment of nursing-specific aspects of care, but also having an overview of care provided by multiple professionals during a patient's hospital stay (Mitchell, 2008). The fact that extremely positive RN assessments of patient safety and quality of care are associated with significant reductions in the odds of patient mortality raises new research questions about how RNs distinguish and define excellent care in their hospital/workplace. One might hypothesize that a "good" or "very good" grade involves room for improvement, whereas an "excellent" grade related to the quality and safety of patient care assumes exceptionally positive circumstances, although this issue demands further empirical study.

A relatively recent shift in patient safety research is the idea of not defining patient safety only as having as little as possible of something (e.g. medical errors, avoidable deaths, hospital acquired infections, etc.) but rather as having as much as possible of whatever makes it not happen more often, what Hollnagel (Hollnagel et al., 2013) among others refer to as "resilience in health care". By investigating what makes health care safer rather than solely focusing on errors, we might understand and learn more about the complexities of modern health care and the challenges that health care professionals deal with on a daily basis in efforts to keep patients out of harm's way.

One limitation of our data is that it provides little insight into what underlies the RN assessments of patient safety and quality of care. Continuing to use RNs as informants of the practice environment can give us an "inside" look at the acute care hospital environment where most medical errors occur and where most health care professionals interact with the patients during their hospital stay. The work environment can be seen as the context which enables or undermines the provision of high quality and safe care by health care professionals (Aiken et al., 2011, 2012; Page, 2004). Thus, investigating further work environment characteristics which might underlie RNs rating their unit as exceptionally positive for patient safety and quality of care could allow us to complement focus on minimizing error with efforts to support factors with the most positive impacts and where the most positive results for both patients and staff are to be gained.

By building further on the work of McHugh and Stimpfel (2012) in evaluating relationships between RN reported quality of care and patient outcomes, we have been able to strengthen generalizability. An important element of establishing the robustness of associations is to evaluate stability and universality in decidedly different contexts. Conducting these analyses in a Swedish context also eliminates many of the potential confounding factors from US studies, which are challenged by extensive variation in insurance status and correlated health status differences.

Our study, which extends the work of McHugh and Stimpfel (2012), but also investigates associations not previously examined, e.g. between RN assessments of patient safety and 30-

day inpatient mortality, has several strengths but there also are a number of factors which should be considered when interpreting our results. It derives from the larger multi-national project, RN4CAST, which means that the methods used have been validated in previous research (Sermeus et al., 2011). It is a national Swedish study limited to a particular context and health care system; however our recruitment strategy through the Swedish Association of Health Care Professionals with their high rate of organizing clinically active RNs, along with a nearly 70% return-rate, indicates that this study has good coverage of clinically active RNs working in inpatient acute care hospitals in Sweden. In this study, the 67 hospital organizations had an average of 150 RN survey responses per hospital, with only two hospitals with less than 20 respondents. The study includes a national non-random sample of RNs, acute care hospitals, and surgical patient discharges, which minimizes bias in recruitment, although the selection bias related to who chooses to respond remains a potential limitation. The uniqueness of this study is not only due to its scope and generalizability but also because of the lack of prior research in this area.

Although we had no access to unit level data in this study, it would be beneficial to include this in future research to be able to account for unit size and differences in response levels within hospitals. Also, having established a relationship between RN assessments of patient safety and quality of care and 30-day inpatient mortality, determining the predictive power of RN assessments on patient outcomes is another area for future investigation.

The research presented here is aimed at contributing to the growing body of research knowledge about associations between the work/care environment and outcomes for patients. Efforts to improve patient outcomes need to focus on the patient care environment where the RN is a central actor although not the only active professional. The use of RNs as informants about the organization of patient care in hospitals can give us further clues as to what in the work/care environment facilitates or hinders the provision of safe, high quality care. Our continued research will entail observations and interviews from "exceptionally positive environments" and will thus include involvement of patients and other health care professionals' perspectives.

7. Conclusions

In this national study we have found that positive RN assessments of patient safety and quality of care are related to a decrease in the odds of 30-day inpatient mortality, although the wide variation in patient mortality among the included hospitals does not mesh with the political aim of equal access to quality care across Sweden.

Our results are consistent with work in other health care contexts (McHugh and Stimpfel, 2012) adding to the study's generalizability and providing further validation that positive RN reports pertaining to quality and safety can be valid indicators of overall hospital quality and patient safety. This has important implications, suggesting that hospital RNs are an underused resource in informing policy decisions regarding quality and safety.

Acknowledgments

References

Agency for Healthcare Research Quality (AHRQ). Quality & Patient Safety. 2013

Aiken LH, Cimiotti JP, Sloane DM, Smith HL, Flynn L, Neff DF. Effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environments. Med. Care. 2011; 49(12):1047–1053. [PubMed: 21945978]

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. [PubMed: 18469615]

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. [PubMed: 12387650]

Aiken LH, Patrician PA. Measuring organizational traits of hospitals: the Revised Nursing Work Index. Nurs. Res. 2000; 49(3):146–153. [PubMed: 10882319]

Aiken LH, Sermeus W, Van den Heede K, Sloane DM, Busse R, McKee M, Bruyneel L, Rafferty AM, Griffiths P, Moreno-Casbas MT, Tishelman C, Scott A, Brzostek T, Kinnunen J, Schwendimann R, Heinen M, Zikos D, Sjetne IS, Smith HL, Kutney-Lee A. Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and the United States. BMJ. 2012; 344:e1717. [PubMed: 22434089]

Aiken LH, Sloane DM, Bruyneel L, Van den Heede K, Griffiths P, Busse R, Diomidous M, Kinnunen J, Kozka M, Lesaffre E, McHugh MD, Moreno-Casbas MT, Rafferty AM, Schwendimann R, Scott PA, Tishelman C, van Achterberg T, Sermeus W. Rn4Cast Consortium. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. Lancet. 2014; 383(9931):1824–1830. [PubMed: 24581683]

Barker AL, Brand CA, Evans SM, Cameron PA, Jolley DJ. "Death in low-mortality diagnosis-related groups": frequency, and the impact of patient and hospital characteristics. Med. J. Aust. 2011; 195(2):89–94. [PubMed: 21770881]

Campbell SM, Roland MO, Buetow SA. Defining quality of care. Soc. Sci. Med. 2000; 51(11):1611–1625. [PubMed: 11072882]

Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J. Clin. Epidemiol. 1994; 47(11):1245–1251. [PubMed: 7722560]

Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J. Chronic Dis. 1987; 40(5):373–383. [PubMed: 3558716]

Emanuel, L.; Berwick, D.; Conway, J.; Combes, J.; Hatlie, M.; Leape, L.; Reason, J.; Schyve, P.; Vincent, C.; Walton, M. What exactly is patient safety?. In: Henriksen, K.; Battles, JB.; Keyes, MA.; Grady, ML., editors. Advances in Patient Safety: New Directions and Alternative Approaches (Vol.1 Assessment). Rockville, MD: Agency for Healthcare Research and Quality; 2008.

Farquhar, M. AHRQ quality indicators. In: Hughes, RG., editor. Patient Safety and Quality: An Evidence-based Handbook for Nurses. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

Glick WH. Conceptualizing and measuring organizational and psychological climate: pitfalls in multilevel research. Acad. Manag. Rev. 1985; 10(3):601–616.

Hollnagel, E.; Braithwaite, J.; Wears, RL. Resilience in Health Care. Ashgate Publishing Ltd.; 2013.

Hosmer, DW., Jr; Lemeshow, S.; Sturdivant, RX. Applied Logistic Regression. John Wiley & Sons.; 2013.

Hughes, RG. Chapter 2 – Nurses at the "sharp end" of patient care. In: Hughes, RG., editor. Patient Safety and Quality: An Evidence-based Handbook for Nurses. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

Institute of Medicine (IOM). Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: Institute of Medicine (IOM); 2001.

Kutney-Lee A, Lake ET, Aiken LH. Development of the hospital nurse surveillance capacity profile. Res. Nurs. Health. 2009; 32(2):217–228. [PubMed: 19161172]

Lake ET. Development of the practice environment scale of the Nursing Work Index. Res. Nurs. Health. 2002; 25(3):176–188. [PubMed: 12015780]

LaValley MP. Logistic regression. Circulation. 2008; 117(18):2395–2399. [PubMed: 18458181]

Leape LL, Berwick DM. Five years after To Err Is Human: what have we learned? JAMA. 2005; 293(19):2384–2390. [PubMed: 15900009]

Li YF, Lake ET, Sales AE, Sharp ND, Greiner GT, Lowy E, Liu CF, Mitchell PH, Sochalski JA. Measuring nurses' practice environments with the revised nursing work index: evidence from registered nurses in the Veterans Health Administration. Res. Nurs. Health. 2007; 30(1):31–44. [PubMed: 17243106]

Lindqvist R, Smeds Alenius L, Griffiths P, Runesdotter S, Tishelman C. Structural characteristics of hospitals and nurse-reported care quality, work environment, burnout and leaving intentions. J. Nurs. Manag. 2015; 23(2):263–274. [PubMed: 24047463]

Loeb JM. The current state of performance measurement in health care. Int. J. Qual. Health Care. 2004; 16(Suppl. 1):i5–i9. [PubMed: 15059982]

Maslach C, Jackson SE. The measurement of experienced burn-out. J. Occup. Behav. 1981; 2(2):99–113.

McHugh MD, Stimpfel AW. Nurse reported quality of care: a measure of hospital quality. Res. Nurs. Health. 2012; 35(6):566–575. [PubMed: 22911102]

Ministry of Health Social Affairs, 2010. Patientsäkerhetslag. 2010; 2010:659. (*Patient Safety Act*).

Mitchell, PH. Patient Safety and Quality: An Evidence-based Handbook for NursesAgency for Healthcare Research and Quality. Rockville, MD: 2008. Chapter 1 – Defining patient safety and quality care.

Mitchell PH, Shortell SM. Adverse outcomes and variations in organization of care delivery. Med. Care. 1997; 35(11 Suppl):NS19–NS32. [PubMed: 9366876]

Nolte E, McKee CM. In amenable mortality – deaths avoidable through health care – progress in the US lags that of three European countries. Health Aff. (Millwood). 2012; 31(9):2114–2122. [PubMed: 22933419]

Page, A. Institute of Medicine Quality Chasm Series. Washington, DC: The National Academies Press; 2004. Keeping patients safe: transforming the work environment of nurses; p. 488

Pronovost PJ, Thompson DA, Holzmueller CG, Lubomski LH, Morlock LL. Defining and measuring patient safety. Crit. Care Clin. 2005; 21(1):1–19. vii. [PubMed: 15579349]

Reason J. Understanding adverse events: human factors. Qual. Health Care. 1995; 4(2):80–89. [PubMed: 10151618]

Runciman W, Hibbert P, Thomson R, Van Der Schaaf T, Sherman H, Lewalle P. Towards an International Classification for Patient Safety: key concepts and terms. Int. J. Qual. Health Care. 2009; 21(1):18–26. [PubMed: 19147597]

Sermeus W, Aiken LH, Van den Heede K, Rafferty AM, Griffiths P, Moreno-Casbas MT, Busse R, Lindqvist R, Scott AP, Bruyneel L, Brzostek T, Kinnunen J, Schubert M, Schoonhoven L, Zikos D. Rn4Cast Consortium. Nurse forecasting in Europe (RN4CAST): rationale, design and methodology. BMC Nurs. 2011; 10:6. [PubMed: 21501487]

Sherman H, Castro G, Fletcher M, Hatlie M, Hibbert P, Jakob R, Koss R, Lewalle P, Loeb J, Perneger T, Runciman W, Thomson R, Van Der Schaaf T, Virtanen M. World Alliance For Patient Safety Drafting Group. Towards an international classification for patient safety: the conceptual framework. Int. J. Qual. Health Care. 2009; 21(1):2–8. [PubMed: 19147595]

Silber JH, Romano PS, Rosen AK, Wang Y, Even-Shoshan O, Volpp KG. Failure-to-rescue: comparing definitions to measure quality of care. Med. Care. 2007; 45(10):918–925. [PubMed: 17890988]

Silber JH, Rosenbaum PR, Romano PS, Rosen AK, Wang Y, Teng Y, Halenar MJ, Even-Shoshan O, Volpp KG. Hospital teaching intensity, patient race, and surgical outcomes. Arch. Surg. 2009; 144(2):113–120. discussion 121. [PubMed: 19221321]

Sloan JA, Aaronson N, Cappelleri JC, Fairclough DL, Varricchio C. Clinical Significance Consensus Meeting Group. Assessing the clinical significance of single items relative to summated scores. Mayo Clin Proc. 2002; 77(5):479–487. [PubMed: 12004998]

Smeds Alenius L, Tishelman C, Runesdotter S, Lindqvist R. Staffing and resource adequacy strongly related to RNs' assessment of patient safety: a national study of RNs working in acute-care hospitals in Sweden. BMJ Qual. Saf. 2014; 23(3):242–249.

Sveriges Kommuner och Landsting (SKL). Nationell satsning för attöka patientsäkerheten och minska vårdskadorna. 2013

Thomas JW, Hofer TP. Accuracy of risk-adjusted mortality rate as a measure of hospital quality of care. Med. Care. 1999; 37(1):83–92. [PubMed: 10413396]

Tourangeau AE. A theoretical model of the determinants of mortality. ANS Adv. Nurs. Sci. 2005; 28(1):58–69. [PubMed: 15718939]

Tourangeau AE, Doran DM, McGillis Hall L, O'Brien Pallas L, Pringle D, Tu JV, Cranley LA. Impact of hospital nursing care on 30-day mortality for acute medical patients. J. Adv. Nurs. 2007; 57(1): 32–44. [PubMed: 17184372]

World Health Organisation. World Alliance for Patient Safety Progress Report 2006–2007. Geneva: World Health Organisation; 2008.

What is already known about the topic?

- A few studies have shown a direct relationship between RN assessments of care quality and patient outcomes including 30-day mortality.

- The use of RNs as informants of overall quality of care and patient safety in acute care hospital settings is an underutilized resource in measuring quality and safety.

What this paper adds

- Previous studies have not addressed the relationship between RN assessments of patient safety and 30-day inpatient mortality.

- RN-assessed excellent patient safety and quality of care are related to reductions in odds of inpatient 30-day mortality, suggesting that positive RN reports of quality and safety can be valid indicators of these key variables.

- The results of the study add evidence that positive RN reports of quality and safety can be valid indicators of overall hospital quality and patient safety.

- The findings on RN assessed quality of care and mortality in this study are consistent with previous US research findings, and extends them to the Swedish context, which adds to its generalizability.

Table 1

Common primary diagnosis, comorbidities and surgical DRGs.

		%
5 most common surgical DRGs		
1	Major joint and limb reattachment procedures of lower extremity	26.0
2	Hip and femur procedures except major joint age > 17	10.9
3	Rectal resection/major small and large bowel procedure	8.8
4	Lower extremity and Humer procedure except hip, foot, femur age > 17	8.2
5	Combined anterior/posterior spinal fusion/spinal fusion/back and neck procedure, except spinal fusion	5.9
5 most common primary diagnosis		
1	Other primary coxarthrosis	8.5
2	Other primary gonarthrosis	7.7
3	Fracture of neck of femur, closed	5.8
4	Pertrochanteric fracture, closed	4.5
5	Acute appendicitis, other and unspecified	2.6
5 most common comorbidities		
1	Diabetes without chronic complication	7.5
2	Chronic pulmonary disease	5.1
3	Myocardial infarction	3.9
4	Congestive heart failure	3.5
5	Any malignancy	3.1
Mortality rate in this patient group		1.3

Table 2

Hospital characteristics and distribution of excellent quality and safety assessments.

Mean no. of beds (range)	324 (40–2072)
Teaching status	**N (%)**
Non-teaching	59 (88%)
Teaching	8 (12%)
Technology status	**N (%)**
Low	57 (85%)
High	10 (15%)

	Mean % (std)	Range %
Mortality rate on hospital level	1.04 (0.6)	0–2.7
RN assessments aggregated on hospital level		
Excellent quality of care	11.6 (5.7)	0–30.8
Excellent patient safety	3.4 (2.5)	0–9.8

Table 3

Relationships between RNs who report excellent quality of care and/or patient safety and the outcome of 30-day inpatient mortality.

	Unadjusted model			Adjusted model[a]		
	OR	95% CI	Pr > ChiSq	OR	95% CI	Pr > ChiSq
Quality of care						
Middle tertile hospitals compared to the lowest tertile hospitals	0.82	0.66–1.00	0.055	0.86	0.72–1.04	0.112
Highest tertile hospitals compared to the lowest tertile hospitals	0.79	0.61–1.02	0.067	0.77	0.65–0.91	0.002
Patient safety						
Middle tertile hospitals compared to the lowest tertile hospitals	0.92	0.75–0.13	0.450	0.82	0.68–1.00	0.048
Highest tertile hospitals compared to the lowest tertile hospitals	0.68	0.52–0.90	0.006	0.74	0.60–0.91	0.004

[a] Adjustments were made for patient characteristics (gender, age, comorbidities, surgical DRGs, emergency room admittance) and hospital characteristics (size, level of specialization, teaching status)