

Relationship between the number of nurses on staff and the outcomes of nurse-sensitive patients in acute specialized units: A systematic review

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Abstract

Background: The relationship between hospital acquired infections, patient outcomes, adverse events and death, and nursing workloads has been shown in several research. In order to examine the relationship between patient outcomes and the number of nurses on an acute specialty unit, we conducted this systematic review.

Method: To enhance the quality of the systematic review, we followed the PRISMA declaration. We searched electronic sources; Pubmed, Google Scholar, and CINAHL to find research publications that looked into the relationship between patient outcomes and the number of nurses on acute specialty units. The search was limited to the English language and published between 2014 and 2023.

Result: Six cross-sectional studies were considered in this systematic review. The majority of the research focused on two outcomes: morality and length of ICU hospitalization. Two studies do not include the typical NPR definition. One comprised 69 ICUs, found that a lower bed-to-nurse ratio and a daily plan of care review were both associated with a lower yearly ICU mortality. Instead than focusing on ICU personnel, improving communication is a low-cost, process-specific intervention strategy that may improve clinical outcomes in patients receiving ICU care.

Conclusion: A negative association was seen in the majority of the included studies between hospital mortality, length of stay in the intensive care unit, and a rise of nurses in relation to the number of hospital beds or admitted patients.

Keywords: Nurses Staff; Patients Outcomes; Intensive Care Unit; Nurse to Patients' Ratio

1. Introduction

A minimal number of nurses assigned to a particular number of patients they care for is known as the nurse to patient ratio (NPR) (1). One of the staffing strategies meant to keep nurse workloads reasonable is the implementation of

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minimum NPR in numerous jurisdictions throughout the globe (2). Numerous studies have demonstrated the link between hospital acquired infections (3), patient outcomes such as adverse events and mortality, and nurse workloads and missed care (4).

NPR have been shown to increase patient safety, decrease missed care, decrease readmissions, and decrease mortality (5,6). Additionally, these ratios have been shown to promote staff retention and work satisfaction (5). Nurse-sensitive outcome indicators, first developed by Needleman et al. in 2002 (7) and derived from administrative data, are frequently used to quantify patient outcomes associated with ratios. These markers are not always the same across studies, but they typically include the following: deep vein thrombosis, urinary tract infection, shock/cardiac arrest, length of stay, pressure injury, readmission, pneumonia, sepsis, and surgical wound infection (7). Aside from adverse events like prescription mistakes and falls resulting in injuries, research has also looked at other aspects including aggression, patient satisfaction, restrictive practices like restraint, and other factors (5). In this study we aimed to carry out a systematic review to look at the connection between patient outcomes and the number of nurses on an acute specialty unit.

2. Method

We conducted this systematic review according to PRISMA guidelines (8). Electronic databases; PubMed, Google scholar, and CINAHL were searched for articles examining the connection between patient outcomes and acute specialty unit nurse staffing levels.

The following keywords were combined: wound infection, shock, pulmonary failure, pneumonia, outcome, length of stay, patient safety, high dependency, coronary care, critical care, cardiac ward, intensive care, intensive treatment unit, nurse ratio, nurse staffing, nurse mix, nurse workload, nurse dose. The search was done between 2014 and 2023 and was restricted to the English language. By hand searching the conference abstracts and reference lists of the listed research, further papers were found.

After conducting a literature search, a group of reviewers divided into pairs and independently screened abstracts and titles in accordance with the inclusion criteria. Another reviewer arbitrated any disputes that arose amongst the other reviewers. The following inclusion criteria were fulfilled by the included studies: Individuals hospitalized to acute specialty units; examining how NPR affects patient outcomes

With the help of all writers, the data was extracted collaboratively. To prevent duplicate or missing information, data was extracted into predesigned tables using Google Sheets and Google Documents.

3. Result

In this systematic review we included 6 cross sectional studies. Outcome of interest for most of the studies were morality and ICU stay duration. Two studies doesn't mentioned standard definition for NPR. A daily plan of care review and a lower bed-to-nurse ratio were both linked to a reduced yearly ICU mortality in the Kim et al. study, which included 69 ICUs. Enhancing communication is inexpensive, process-specific intervention method that may enhance clinical outcomes in ICU patients, as opposed to ICU staffing.

For patients hospitalized with an emergency general surgical diagnosis, there are notable variations within Trusts in terms of staffing and other infrastructure resources, according to the Ozdemir et al. study. Relationships between mortality and these variables imply the existence of possibly adjustable variables that affect patient outcomes and call for additional research.

Higher odds of patient survival following a cardiac arrest at a hospital were discovered by McHugh et al. to be connected with improved work conditions and lower patient-to-nurse ratios on medical-surgical units. These findings add to a substantial body of research that indicates improved outcomes occur when nurses work in high-quality hospital facilities and shoulder a more manageable workload. Improving working conditions for nurses may increase the likelihood of patients surviving hospitalized cardiac arrest.

The ICUs in the Chittawatanarat et al. study displayed various administration systems. The ICU workload, human resources, and features all had an effect on the outcome markers of crude mortality, ventilator days, and ICU stay duration.

Table 1 Characteristics of the included studies

Citation	Method	Study setting and sample size	Outcome	Ratio measure
Kim et al. (9)	cross-sectional study	IUC, 129,923 patients	30 days mortality	First Level refers to less than 2.5 Second Level 2 to 2.5 to 3.4, third level to 3.5 to 4.4, and fourth level refers to 4.5 or more bed-to-nurse ratios (BNR).
18 Checkley et al.	Cross-sectional prospective study	USA: An organization structure survey was conducted among 69 ICU. The patient's number was not specified.	Mortality	There was no definition of ratio given. Nonetheless, each location offered the amount of beds and nurses on staff.
19 Chittawatanarat et al.	Cross-sectional retrospective study	Using hospital datasets from participating ICU, 104,046 admissions to 155 ICU	ICU stay duration and mortality	Using hospital datasets from participating ICU, 104,046 admissions to 155 ICU in 87 hospitals were made in Thailand between January and December 2011.
27 Johansen et al.	Cross-sectional retrospective study	Patients presented with symptoms of acute coronary syndrome to 73 emergency departments. Information taken from an ED administrative database.	Performance of percutaneous coronary intervention (PCI) within 90 minutes of emergency department arrival.	NPR determined by allocating an average patients number to each nurse.
29 McHugh et al.	Cross-sectional retrospective study	1,160 adult patients in 75 hospitals	In hospital mortality	The average patient's number that nurses reported during their recent shift divided by the average nurses number working that same shift.
34 Ozdemir et al.	Cross-sectional retrospective study	294,602 admissions for emergencies. ICUs and regular wards admitted patients.	30 and 90 days mortality	No definition

In 69 ICUs, the Checkley et al. study found that a lower bed-to-nurse ratio and a daily care review plan were both linked to a reduced yearly ICU mortality. Enhancing team communication is inexpensive, process-specific intervention method that may enhance clinical outcomes in ICU patients, as opposed to 24-hour ICU staffing.

Table 2 Main findings of included studies

Citation	Main findings
Kim et al. (9)	Hospitals with level 4 staffing had a 30-day mortality rate of 2.5%, which was statistically significant compared to rates of 0.8, 2, and 1.8% in hospitals with level 1, level 2, and level 3 staffing, respectively. Furthermore, using level 4 as a reference, hospitals with a bed-to-nurse ratio of level 1 or level 2 had a considerably reduced death rate.
18 Checkley et al.	Surgical ICUs have a lower yearly ICU death rate than medical ICUs according to multivariable linear regression. ICUs with a daily care review plan and a lower bed-to-nurse ratio had a lower yearly ICU death rate. On the other hand, closed ICU status and 24-hour ICU coverage did not appear to be linked to a decreased annual ICU mortality.
19 Chittawatanarat et al.	The average daily NPR had a median value of 0.5. ICU-LOS and median ventilator days were 5.31 and 5.31, respectively. In groups with closed ICU management or high physician staffing, academic ICUs, regular multidisciplinary rounds, ICU physician staffing availability, and low patient density, a multilevel mixed model showed a benefit in crude mortality. A lower NPR was linked to fewer ventilator days even though it showed no improvement in crude mortality.
27 Johansen et al.	There was a strong correlation found between the patients number added to a nurse's workload and the likelihood of receiving aspirin upon arrival (3.9%) and PCI not exceeding 90 minutes of hospital arrival (1.4%). Within 90 minutes of hospital arrival, there was a substantial 6.3% decrease in PCI and a 7.1% rise in aspirin with every 10% increase in the registered nurses number.
29 McHugh et al.	There was a 5% decrease in the probability of surviving cardiac arrest to discharge for every additional patient per nurse in medical-surgical. Additionally, compared to patients treated in hospitals with better work environments, those in poorer work environments had a 16% lower chance of cardiac arrest survival.
34 Ozdemir et al.	With a 30-day mortality rate of 4.2%, there were 294 602 emergency admissions to 156 NHS Trusts. For this group, trust-level mortality rates varied from 1.6 to 8.0%. Trusts with larger ratios of critical care beds and operating rooms to provider sizes, as well as higher levels of physician and nurse personnel, had the lowest death rates. Patients admitted to hospitals on weekends, in trusts with fewer general surgeons, and in trusts with lower nurse staff ratios all had higher death rates.

4. Discussion

In this study we aimed to conduct a systematic review investigating the relationship between acute specialized unit nurse staffing levels and patient outcomes. According to the majority of included studies, increased nurse number in relation to number of hospital beds or admitted patients was associated with decreased in hospital mortality and ICU stay duration.

Higher nurse staffing levels were linked to significantly lower odds of death for 1355 patients in the Kim et al. trial, who passed away within 30 days after being discharged. To be more precise, 30-day post-discharge death probability were 38% and 37% lower, respectively, for BNR less than 2.5 and 2.5 to 3.4 than for ratios of 4.5 or higher.

NPR in ICU and wards have a comparable correlation with mortality patients with stroke. Furthermore, there was a more noticeable rise in 30-day mortality as nurse staffing declined, in contrast to in-hospital mortality (10). Consequently, a number of mortality indicators have been found to be consistently correlated with nurse staffing. Studies carried out across several countries examining the connection between nurse staffing and in-hospital fatalities have demonstrated a connection between reduced patient mortality rates and increased levels of registered nurse staffing (11,12). Thus, it is reasonable to anticipate a decline in patient mortality if a sufficient number of nurses are employed.

Previous studies have indicated that the variables mediating nurse staffing and patient outcome of mortality association are an increased workload and missing nursing care (10,13). This is based on the observation that missed nursing care increased by 25.6 percent when the patient mean number for each nurse providing direct care was 8.3 percent, and that 1 month mortality increased by 16 percent when nurses' missed care increased by 10 percent (13).

A comprehensive investigation on the relationships between nurse staffing and nursing care omissions found that low nurse staffing was associated with missing nursing care in hospitals, with ensuring patient discharge planning being one of the forms of nursing care that was neglected (14). The delivery of essential knowledge regarding post-discharge care through individualized instruction is facilitated by discharge education that incorporates pertinent content (15,16). Prior worldwide research has suggested a number of initiatives, such as discharge-transfer treatments and nurse-led case management.

A higher nurse staffing level was associated with superior cardiac outcomes, per the Johansen et al. (17) study. A rise of 7.1% in aspirin prescriptions upon admission and a 6.3% reduction in the amount of time needed for a PCI not exceeding 90 minutes of hospital admission were linked to every increase in the number of nurses by 10 percent.

O'Brien et al. looked into the relationship between NPRs and patient outcomes that are relevant to nurses (18). Deep vein thrombosis, falls with injuries, pressure ulcers, medical errors with repercussions, pneumonia, urinary tract infections linked to catheter use, and wound infections were among their effects. O'Brien et al. examined a dataset from 24 cardiac and cardiovascular units across six hospitals (18). The average patients number cared for by a nurse on a day shift throughout the data collecting period was used to compute the NPR. Researchers discovered that patients were 35 percent more likely to have a longer-than-expected stay and 22 percent less likely to receive "excellent or good-quality care" for every added patient per nurse (18).

5. Conclusion

Most of the included studies showed a negative correlation between hospital mortality and duration of stay in the ICU and an increase of nurses relative to the number of hospital beds or admitted patients.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Lesman, B., Aroozoo, M., & Petrie, A. (2019). Safe patient care (nurse to patient and midwife to patient ratios) amendment bill: Bill brief. Department of Parliamentary Services Parliament of Victoria. Available from: <https://apo.org.au/sites/default/files/resource-files/2019-02/apo-nid224936.pdf>
- [2] Australian College of Nursing. (2020). A national minimum dataset for nursing workforce planning and decision making – A White Paper by ACN 2020.
- [3] Assaye AM, Wiechula R, Schultz TJ, Feo R. Missed nursing care, nurse staffing levels and patient safety outcomes in low-income country acute care settings: An observational study. *Int J Nurs Pract* [Internet]. 2022 Feb;28(1):e13031. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/34970817>
- [4] Twigg DE, Whitehead L, Doleman G, El-Zaemey S. The impact of nurse staffing methodologies on nurse and patient outcomes: A systematic review. *J Adv Nurs* [Internet]. 2021 Dec;77(12):4599–611. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/34081369>
- [5] Wynendaele H, Willems R, Trybou J. Systematic review: Association between the patient–nurse ratio and nurse outcomes in acute care hospitals. *J Nurs Manag* [Internet]. 2019 Jul 15;27(5):896–917. Available from: <https://onlinelibrary.wiley.com/doi/10.1111/jonm.12764>
- [6] Aiken LH, Sloane DM, Bruyneel L, Van den Heede K, Griffiths P, Busse R, et al. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* (London, England) [Internet]. 2014 May 24;383(9931):1824–30. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24581683>

- [7] Needleman J, Buerhaus P, Mattke S, Stewart M, Zelevinsky K. Nurse-Staffing Levels and the Quality of Care in Hospitals. *N Engl J Med* [Internet]. 2002 May 30;346(22):1715–22. Available from: <http://www.nejm.org/doi/abs/10.1056/NEJMsa012247>
- [8] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* [Internet]. 2021 Mar 29;372:n71. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/33782057>
- [9] Kim Y, Kim HY, Cho E. Association between the bed-to-nurse ratio and 30-day post-discharge mortality in patients undergoing surgery: a cross-sectional analysis using Korean administrative data. *BMC Nurs* [Internet]. 2020;19:17. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/32189999>
- [10] Cho SH, Yun SC. Bed-to-nurse ratios, provision of basic nursing care, and in-hospital and 30-day mortality among acute stroke patients admitted to an intensive care unit: cross-sectional analysis of survey and administrative data. *Int J Nurs Stud* [Internet]. 2009 Aug;46(8):1092–101. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19268287>
- [11] Griffiths P, Maruotti A, Recio Saucedo A, Redfern OC, Ball JE, Briggs J, et al. Nurse staffing, nursing assistants and hospital mortality: retrospective longitudinal cohort study. *BMJ Qual Saf* [Internet]. 2019 Aug;28(8):609–17. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/30514780>
- [12] Haegdorens F, Van Bogaert P, De Meester K, Monsieurs KG. The impact of nurse staffing levels and nurse's education on patient mortality in medical and surgical wards: an observational multicentre study. *BMC Health Serv Res* [Internet]. 2019 Nov 21;19(1):864. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/31752859>
- [13] Ball JE, Bruyneel L, Aiken LH, Sermeus W, Sloane DM, Rafferty AM, et al. Post-operative mortality, missed care and nurse staffing in nine countries: A cross-sectional study. *Int J Nurs Stud* [Internet]. 2018 Feb;78:10–5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28844649>
- [14] Griffiths P, Recio-Saucedo A, Dall'Ora C, Briggs J, Maruotti A, Meredith P, et al. The association between nurse staffing and omissions in nursing care: A systematic review. *J Adv Nurs* [Internet]. 2018 Jul;74(7):1474–87. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/29517813>
- [15] Polster D. Preventing readmissions with discharge education. *Nurs Manage* [Internet]. 2015 Oct;46(10):30–7; quiz 37–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26359555>
- [16] Jack BW, Chetty VK, Anthony D, Greenwald JL, Sanchez GM, Johnson AE, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med* [Internet]. 2009 Feb 3;150(3):178–87. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19189907>
- [17] Johansen ML, de Cordova PB, Duan W, Martinez ME, Cimiotti JP. The implications of nurse resources on cardiac care in the emergency department. *Appl Nurs Res* [Internet]. 2015 May;28(2):210–2. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25085809>
- [18] O'Brien-Pallas L, Li XM, Wang S, Meyer RM, Thomson D. Evaluation of a patient care delivery model: system outcomes in acute cardiac care. *Can J Nurs Res* [Internet]. 2010 Dec;42(4):98–120. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/21319641>