Impact of nurse staffing on patient and nurse workforce outcomes in acute care settings in low- and middle-income countries: a systematic review protocol

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Review question/objective: The objective of this review is to demonstrate the effect of nurse staffing on patient and nurse workforce outcomes in acute care settings in low- and middle-income countries.

Keywords acute care; low- and middle-income countries; nurse staffing; nurse workforce outcomes; patient outcomes


Introduction

Healthcare systems in developing countries deal with a high proportion of the global burden of disease, which is aggravated by a number of health care constraints.¹ The high burden of both communicable and non-communicable diseases, low numbers in the workforce, poor distribution of qualified professionals, and constraints in medical supplies and resources in low- and middle-income countries (LMICs) make the provision of quality healthcare challenging.¹⁻³ Healthcare systems in LMICs, however, are still expected to address universal healthcare access and provide high quality healthcare.⁴

Patient safety continues to be a major priority in the healthcare sector of developed countries and LMICs.⁵ Annually, it is estimated that 41.7 million adverse events occur in healthcare settings globally. Among these adverse events, two-thirds occur in LMICs.⁶ Research shows that nurse staffing and the number of hours nurses work are among the main factors that influence patient safety outcomes.⁷ Nurse staffing also has an effect on nurse workforce outcomes that reflect nurses’ performance, in turn affecting patient outcomes. The term “nurse workforce outcomes” includes nurses’ turnover rates, burnout, absenteeism and job satisfaction.⁸⁻¹¹ Better staffing is associated with a decrease in staff turnover, whilst long working hours are associated with an increase in negative outcomes for nurses, including burnout, absenteeism and turnover.¹²⁻¹⁴

Nurse staffing includes nurse-to-patient ratios and the skill mix of nurses with different educational qualifications, experience and competencies. Staffing levels might be different according to the acuity level of a hospital unit or ward. For instance, intensive care units typically need higher nurse-to-patient ratios than general medical or surgical units.¹⁵⁻¹⁶ The nurse-to-patient ratio is calculated as the number of patients who receive care from one nurse at a single shift. The higher the number of patients for whom a nurse provides care per shift, the higher the likelihood of adverse patient outcomes occurring. A study in UK hospitals found that there was a 20% higher inpatient mortality in medical units of hospitals where nurses cared for 10 or more patients per shift than in hospitals where nurses cared for six or fewer patients per shift.¹⁷ According to Aiken, hospitals can reduce thousands of deaths each year by improving their nurse staffing levels.¹⁸ However, it is not unusual to see nurses caring for large numbers of patients in LMICs. For instance, a cross-sectional study in South Africa showed that the nurse-to-patient ratio was as high as 32, making it difficult

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for nurses to provide adequate care for each patient.\textsuperscript{19}

Most studies exploring the effect of staffing on patient and nurse workforce outcomes have been conducted in developed countries, where efforts are being made to regulate the nurse-to-patient ratio and skill mix.\textsuperscript{20-23} California was the first state in the US to mandate nurse-to-patient ratios. According to this mandate, the nurse-to-patient ratio in medical and surgical units of a hospital is one to five, and in critical care (e.g. intensive care) it is one to two.\textsuperscript{13} Fourteen states in the US, and the states of Victoria and Queensland in Australia are now deciding on mandatory nurse-to-patient ratios.\textsuperscript{24-26} In South Australia, there are mandatory nurse-to-patient ratios for the public sector. These ratios range from one to one in intensive care units (ICU) to a minimum of one to four in post anesthetic recovery rooms for stable patients or for pediatric patients over five years of age and with a family member or caregiver present.\textsuperscript{27}

In addition to nurse-to-patient ratios, skill mix has been shown to influence patient outcomes. Skill mix, grade mix and qualification mix are all terms used to describe the mix of nurses assigned in a hospital or hospital unit. Skill mix refers to the assignment of licensed and unlicensed nurses or registered and unregistered nurses, or the assignment of nurses with different educational qualifications or clinical experience in a hospital or hospital unit.\textsuperscript{16,28} This mix usually consists of registered nurses (RNs), enrolled nurses (ENs), licensed practical nurses (LPNs) and nurse assistants or aides. Skill mix might be also described as the proportion of RNs among all nurse personnel.\textsuperscript{29} Skill mix configuration can range from entirely RN staffing or a combination of RNs, ENs, LPNs, nurse assistants or other unclassified healthcare workers. Enrolled nurses (common in Australia, UK and New Zealand) and LPNs (common in the US and Canada) work under the direction of RNs.\textsuperscript{30-33}

A skill mix is considered “rich” when the number of RNs and/or nurses with a bachelor’s degree or above is higher than the number of LPNs or ENs. A study in six European hospitals reported that a 10% reduction in professional nurses (RNs) resulted in a 12% increase in the odds of death, and that substituting one professional nurse with one nurse assistant would result in a 21% increase in the risk of patient death.\textsuperscript{34} A higher proportion of RNs with a bachelor’s degree qualification is linked to reduced mortality, failure to rescue, patient falls, pneumonia and urinary tract infection.\textsuperscript{35-37}

Systematic reviews on nurse staffing and its effect on patient and nurse workforce outcomes show that increased nurse staffing results in reduced rates of patient mortality, hospital acquired pneumonia, unplanned extubating and shorter length of hospital stay.\textsuperscript{12,16,38-42} However, these reviews reflect nurse staffing from the perspective of the developed world and there is a need to explore evidence from the context of LMICs. Hence, a systematic review of studies conducted in LMICs that addresses nurse staffing in hospital units and its effect on patient and nurse workforce outcomes is vital to inform policy-makers on how to address the healthcare demands of the population in these countries.

There are studies conducted in LMICs for potential inclusion in this review. For instance, studies from China,\textsuperscript{43} Nigeria,\textsuperscript{2} Malaysia,\textsuperscript{44} Thailand\textsuperscript{45} and Brazil\textsuperscript{46} have addressed nurse staffing and patient outcomes. A study in Chinese hospitals addressed the nurse-to-patient ratio and its effect on patient safety outcomes. A study in Malaysian private hospitals reported that the level of nurses’ education was not significantly associated with patient safety. A study on extended work hours and patient, nurse and organizational outcomes in 90 hospitals in Thailand demonstrated that 80% of nurses worked two consecutive shifts, resulting in negative patient, nurse and organizational outcomes. These studies show there is great variation in nurse staffing in LMICs.\textsuperscript{3,43-46}

Existing reviews on LMICs have focused on the importance of structuring nursing practice through Professional Practice Models (PPM) and have not addressed the impact of nurse staffing on patient and nurse workforce outcomes.\textsuperscript{47} Therefore, this review will synthesize evidence on nurse staffing (nurse-to-patient ratio, skill mix and hours worked) and its effect on patient and nurse workforce outcomes in LMICs. The evidence will help policy-makers to develop better ways of improving patient outcomes through appropriate nurse staffing. It will also help to provide directions for nursing education and capacity development of nursing workforce planning in LMICs. Furthermore, it will help multinational partners who provide development assistance to healthcare systems in LMICs to support nursing
workforce development and improve the quality of patient care.

**Inclusion criteria**

**Participants**

Empirical studies that address nurse-to-patient ratios, qualification of nurses, experience and skill mix, and that measure the influence of these factors on patient safety outcomes will be included in the review. The studies to be included are those conducted in acute care settings in LMICs. The acute care settings include medical, surgical, pediatrics, maternal, oncology, cardiac, emergency, trauma and other hospital units where patients are treated for sudden and often unexpected urgent or emergent episodes of injury and illness that can lead to death or disability unless immediate intervention is made. The review will include studies conducted in any of 140 countries, which are classified as LMICs (31 low-income countries, 53 lower-middle-income countries and 56 upper-middle-income countries).

**Intervention**

This review will consider studies that address nurse staffing, such as nurse-to-patient ratios, qualification of professional nurses, level of nurse staffing, hours worked, years of experience of nurses and skill mix, and their effect on patient safety and nurse workforce outcomes.

**Comparator**

The existing nurse staffing levels or designed nurse staffing strategy will be the comparator. For example, for skill mix, the comparison might be between a high proportion of professional nurses versus a low proportion of professional nurses. Some studies might focus on hospitals with a rich skill mix, where a higher proportion of RNs with a bachelor’s degree qualification provides care or they might focus on hospitals with a poor skill mix, where the proportion of RNs with a bachelor’s degree qualification providing patient care is lower.

**Outcomes**

This review will consider studies that include patient outcomes including, but not limited to: pressure ulcers, medication errors, hospital-acquired infections, mortality, failure to rescue, length of stay, readmission rates, falls and disability-adjusted life years (DALYs), and nurse workforce outcomes including nurses’ turnover rates, staff sick leave rates, absenteeism and burnout. Objective measures of the outcomes using validated tools and/or review of hospital records (for both patient and staff outcomes) will be considered. For instance, studies that measure burnout using the Maslach Burnout Inventory (MBI) will be considered for review. Subjective outcomes reported as the perceptions of patients or nurses, or those based on patients’ or nurses’ recall, will not be included for this review.

**Types of studies**

This review will consider both experimental and quasi-experimental study designs including randomized controlled trials (RCTs), non-RCTs, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies will be considered for inclusion. Case-control and analytic cross-sectional studies will be considered for review if there are no appropriate studies with the previously described study designs.

**Methods**

**Search strategy**

The search strategy will aim to find both published and unpublished studies. An initial limited search of CINAHL and PubMed has been undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms, for retrieved articles. This informed the development of a search strategy that will be tailored for each information source (see information sources below). A second search using all identified keywords and index terms will then be undertaken across all included databases. Finally, the reference list of all identified reports and articles will be searched for additional studies. A sample search strategy for PubMed is illustrated in Appendix I. Search terms for developing countries, available from the University of North Carolina (UNC) Library, has been used to build the search terms. Only articles written in English will be included for review. There will be no lower date limit for this review.

**Information sources**

The full search will include CINAHL, PubMed, Scopus, Embase, PsycINFO, Cochrane Library, Web of Science and Science Direct. ProQuest
Dissertations and Theses Global database will be searched for unpublished studies.

**Study selection**

Following the search, all identified articles will be collated and uploaded into Endnote X8 (Clarivate Analytics, PA, USA) and duplicates will be removed. Titles and abstracts will then be screened by two independent reviewers for assessment against the inclusion criteria for the review. Studies that meet the inclusion criteria will be retrieved in full and their details imported into Joanna Briggs Institute System for the Unified Management, Assessment and Review of Information (JBI SUMARI) (Joanna Briggs Institute, Adelaide, Australia). The full text of selected studies will be retrieved and assessed in detail against the inclusion criteria. Full-text studies that do not meet the inclusion criteria will be excluded and reasons for exclusion will be provided in an appendix in the final systematic review report. Remaining studies will undergo a process of critical appraisal, following which some studies might be excluded. The results of the search will be reported in full in the final report and presented in a PRISMA flow diagram. Any disagreements that arise between the reviewers to include or exclude studies will be resolved through discussion or with a third reviewer.

**Assessment of methodological quality**

Selected studies will be critically appraised by two independent reviewers at the study level for methodological quality using the standardized critical appraisal instruments from the Joanna Briggs Institute for the following study types: RCT, quasi experimental, cohort, case control and analytic cross-sectional studies. Any disagreements regarding quality appraisal that arise will be resolved through discussion or with a third reviewer. Following critical appraisal, studies that do not meet a certain quality threshold will be excluded. The decision to exclude will be based on the discussion between the two reviewers.

**Data extraction**

Data will be extracted from papers included in the review by two independent reviewers using the standardized data extraction tool available in JBI SUMARI. The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Authors of papers will be contacted to request missing or additional data, where required.

**Data synthesis**

Papers will, where possible, be pooled in statistical meta-analysis using JBI SUMARI. Effect sizes will be expressed as either odds ratios (for dichotomous data) or weighted (or standardized) mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard chi-squared and I-squared tests. The choice of model (random or fixed effects) and method for meta-analysis will be based on the guidance by Tufanaru et al.

Subgroup analyses will be conducted where there is sufficient data to investigate variations in settings and units of study hospitals. Sensitivity analyses will be conducted to test decisions made regarding missing data or small sample size. Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

A funnel plot will be generated to assess publication bias if there are 10 or more studies included in a meta-analysis. Statistical tests for funnel plot asymmetry (Egger test, Begg test, Harbord test) will be performed, where appropriate.

**Assessing certainty in the findings**

A Summary of Findings will be created using GRADEPro GDT software (McMaster University, ON, Canada). The GRADE approach for grading the quality of evidence will be followed. The Summary of Findings will present the following information where appropriate: absolute risks for intervention and control, estimates of relative risk, and a ranking of the quality of the evidence based on study limitations (risk of bias), indirectness, inconsistency, imprecision and publication bias.

The following patient and nurse workforce outcomes will be included in the Summary of Findings: pressure ulcer, medication errors, hospital-acquired infections, mortality, failure to rescue, length of stay, falls, readmission rates, DALYs, nurses’ turnover rates, sick leave rates, absenteeism and burnout.

**SYSTEMATIC REVIEW PROTOCOL**

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References
27. Australia GoS. Nursing/Midwifery (South Australian Public Sector) Enterprise Agreement 2016.


Appendix I: Search strategy for PubMed


5. “acute care” OR medical OR Surgical OR “Med-surg” OR “medical surgical” OR paediatrics OR matern” OR oncology OR cardiac OR emergency OR Trauma OR hospital

6. 1 AND 2 AND 3 AND 4 AND 5

7. Limit 6 to English language

N.B. Similar search will be conducted for all identified databases.