Systematic review of the evidence related to mandated nurse staffing ratios in acute hospitals

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Abstract

Objective. The purpose of this systematic review was to evaluate and summarise available research on nurse staffing methods and relate these to outcomes under three overarching themes of: (1) management of clinical risk, quality and safety; (2) development of a new or innovative staffing methodology; and (3) equity of nursing workload.

Methods. The PRISMA method was used. Relevant articles were located by searching via the Griffith University Library electronic catalogue, including articles on PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Medline. Only English language publications published between 1 January 2010 and 30 April 2016 focusing on methodologies in acute hospital in-patient units were included in the present review.

Results. Two of the four staffing methods were found to have evidenced-based articles from empirical studies within the parameters set for inclusion. Of the four staffing methodologies searched, supply and demand returned 10 studies and staffing ratios returned 11.

Conclusions. There is a need to develop an evidence-based nurse-sensitive outcomes measure upon which staffing for safety, quality and workplace equity, as well as an instrument that reliability and validly projects nurse staffing requirements in a variety of clinical settings. Nurse-sensitive indicators reflect elements of patient care that are directly affected by nursing practice In addition, these measures must take into account patient satisfaction, workload and staffing, clinical risks and other measures of the quality and safety of care and nurses' work satisfaction. i.

What is known about the topic? Nurse staffing is a controversial topic that has significant patient safety, quality of care, human resources and financial implications. In acute care services, nursing accounts for approximately 70% of salaries and wages paid by health services budgets, and evidence as to the efficacy and effectiveness of any staffing methodology is required because it has workforce and industrial relations implications. Although there is significant literature available on the topic, there is a paucity of empirical evidence supporting claims of increased patient safety in the acute hospital setting, but some evidence exists relating to equity of workload for nurses.

What does this paper add? This paper provides a contemporary qualitative analysis of empirical evidence using PRISMA methodology to conduct a systematic review of the available literature. It demonstrates a significant research gap to support claims of increased patient safety in the acute hospital setting. The paper calls for greatly improved datasets upon which research can be undertaken to determine any associations between mandated patient to nurse ratios and other staffing methodologies and patient safety and quality of care.

What are the implications for practitioners? There is insufficient contemporary research to support staffing methodologies for appropriate staffing, balanced workloads and quality, safe care. Such research would include the establishment of nurse-sensitive patient outcomes measures, and more robust datasets are needed for empirical analysis to produce such evidence.

Introduction

Unit-based mandatory nurse staffing ratios have again become a topic of discussion relating to safety, costs, efficacy and available evidence. There has been considerable academic discussion relating to the pros and cons of mandatory unit-based staffing ratios. However, questions remain as to what empirical evidence is available to underpin this staffing method, as well as others. For the purpose of the present qualitative analysis of the available literature, we used the definition of 'nurse' adopted by the International Council of Nurses (ICN) in order to be clear about what is meant by the terms 'nursing skill mix' and 'nursing workload'. This defines a nurse as a person who has completed a program of basic, generalised nursing education and is authorised by the appropriate regulatory authority to practice nursing in his/her country. Basic nursing education is a formally recognised program of study providing a broad and sound foundation in the behavioural, life, and nursing sciences for the general practice of nursing, for a leadership role, and for post-basic education for specialty or advanced nursing practice.[1]

Internationally, California (USA) appears to be the first jurisdiction that introduced mandated unit-based minimum licenced nurse-to-patient ratios for acute hospitals via the Assembly Bill 394 in 1999. The implementation of this legislation has not had sufficient inquiry. Burnes-Bolton *et al.*[2] examined the effects of mandated nursing ratios in California on key measures of nursing quality among adults in acute care hospitals, finding that there was an expected increase in the proportion of licenced staff per patient but failing to demonstrate improvement in nursing-sensitive patient outcomes identified for measurement in that study. Since the passing of the Californian law, 14 US states now have regulatory requirements for nurse staffing in hospitals ranging from requirements for staffing committees, generation of a core staffing plan or requiring disclosure by public reporting. However, only California stipulates maintenance of a required mandated nurse to patient ratio at all times at the unit level.[3]

Within Australia, the state government of Victoria made a decision to introduce legislation mandating a minimum staffing level staffing of five nurses to 20 patients in medical and surgical wards in 2001 and this has now been enshrined in legislation known as the *Safe Patient Care (Nurse to Patient and Midwife to Patient Ratios) Act 2015* commenced on 23 December 2015. In their study, Gerdtz and Nelson[4] found that there was an urgent need for further research that specifically examines the relationships between models of staffing, skill mix and quality outcomes.

The Queensland Government amended the *Hospital and Health Boards Act, (Qld) 2011* Division 4, Section 138 so that it now requires minimum ratios in public sector health service facilities. The Queensland Government has mandated minimum nursing staff ratios on a platform of patients receiving higher quality and safety of care, thus setting minimum staffing standards for nursing care in hospitals and that nurses will have more manageable, safer workloads and increased job satisfaction.[5]

The Queensland legislation came into force on 1 July 2016 and requires a minimum staff-to-patient ratio of 1 : 4 for morning and afternoon shifts and a ratio of 1 : 7 on night shifts to be maintained in prescribed medical, surgical and mental health units. Government policy is that these ratios would be introduced in stages across Queensland from 1 July 2016. The Government placed high expectations on the legislation regarding patient safety and quality of service from the patient perspective and the equity of workload for nurses. These expectations, coupled with the considerable opportunity cost associated with increased staffing costs, raises the reasonable question as to the evidence base for mandatory nurse staffing ratios or any method of nurse staffing deployed.

There is significant debate in the literature and professional forums about the benefits and detriments of mandated staff ratios. Searching evidenced-based literature using the Griffith University Library online search engines revealed no records when filtered for peer-reviewed and academic or scholarly materials within the last 5-year period.

Looking at literature older than 5 years, Buchan[6] asserted that the main weaknesses of using nurse : patient ratios is their relative inflexibility and their potential inefficiency if they are wrongly calibrated. However, Buchan[6] perceived that the strength of using such ratios lies in their simplicity and transparency. There was no accompanying empirical evidence provided to support this assertion. Welton[7] claimed that a significant weakness in this type of regulatory approach is that hospitals are often required to increase the number of registered nurses without receiving increased reimbursement for patient care. The response to this lack of funding in hospitals results in a decrease in the number of other staff, such as unlicensed care assistant personnel and housekeepers, to compensate for the increased staffing cost. It is the authors' experience that this puts additional burdens on registered nurses because they are then forced to assume non-nursing care tasks. There was no empirical evidence available to support or refute this.

More recently, Tevington[8] supported mandatory nurse : patient ratios, asserting that increasing the number of registered nurses will increase positive patient outcomes, decrease nursing shortages and increase job satisfaction, and cites several authors in support of this. While the authors of the present paper do not disagree with the statements, the need to support this with evidence remains.

There are clear gaps in the health services and nursing management literature relating to staffing factors and patient safety, and very few well-designed intervention studies have been conducted.[9] Examining the literature for the 13-year period after the Australian Resource Centre for Hospital Innovation study[9] demonstrated that there has been little change. Brennan *et al.*[10] undertook a systematic review of the literature examining the relationship between nurse staffing and patient outcomes and found that, at that time, no evidence-based nurse staffing guidelines existed and the few studies conducted reported variability in methods and measurement approaches, which brought the results into question.

There is little doubt that finding a balance of equitable rosters continues to be a challenge for the nursing workforce and healthcare organisations seeking to leverage evidence-based leadership practices.[11–14] Ratios and supply-and-demand strategies (referred to as 'subjective acuity strategies') for nurse : patient ratios continue to be the dominant approach in healthcare organisations.[12,15–17] In addition to ratio-based assignments and

acuity-based strategies, some models are driven purely by financial targets.[15]

It is clear that there is a need for more emphasis on using evidence-based strategies to promote safety and quality for consumers of health care, and to address workload and time and attendance equity for nurses. Robinson *et al.*[18] found that there is limited information about how staffing policies are interpreted and implemented by hospital leaders in their personnel and budgetary planning practices and that many outcomes of staffing were the result of financial imperatives that took little account of the process of nurse staffing. Previous studies measured outcomes of the processes that hospitals implemented in response to initiatives related to staffing, not the process of implementation itself. This fixed or historical approach to staffing is a common practice in healthcare services.[18]

The literature revealed a further category of nurse staffing relating to the use and risks associated with casual per diem nursing labour from nursing agencies. Adams *et al.*[19] describe this group as nurses who work for agencies outside or external to a healthcare organisation. Although this type of employment practice continues in most countries with a well-developed health system, Adams *et al.*[19] cite recommendations from the Institute of Medicine[20] that healthcare facilities avoid employing nurses working from a temporary external agency because this 'augmenting risks to safety'. The authors have labelled this staffing approach as 'surge staffing' in the present qualitative review of the literature.

Four staffing methods were identified as a result of the search of the literature and used to categorise the studies located during the literature search: supply and demand; ratio; fixed/historical; and surge. Analysis of the findings of the studies included in the present qualitative review revealed three outcome themes. Without reference to importance or numbers of papers included, these themes were: (1) management of clinical risk, quality and safety; (2) development of a new or innovative staffing methodology; and (3) equity of nursing workload.

It was the intention of this study to correlate outcome themes with the staffing method categories that emerged.

Methods

The present study used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement proposed by Moher *et al.*[21] Relevant peer-reviewed and scholarly journal articles were located by searching via the Griffith University Library electronic catalogue the PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Medline databases.

For the search, keywords were formulated with the aid of Boolean operators for combinations of words and, for searches performed in CINAHL and Medline, using MeSH terms.

The keyword combinations used (and the number of articles retrieved) were as follows: nursing staff/staffing AND methodology (3982 articles); nursing staffing AND ratio (5706 articles); nurse staffing AND safe (5796 articles); nurse rostering AND ratio (149 articles); nurse rostering AND methodology (213 articles); and nurse rostering AND safe (131 articles). The keywords used when searching for scholarly articles using Google scholar (and the number of articles retrieved) were: nursing staff/staffing AND methodology (134 articles); nursing staffing AND ratio (16 901 articles); nurse rostering AND ratio (4980 articles); and nurse rostering AND methodology (6480 articles).

Selection of evidence

The initial screening was performed by examining article titles and then the abstracts and conclusions to determine whether the article reflected the objectives of the systematic literature review. Relevant peer-reviewed and scholarly journal articles were located by searching the literature as described above.

Inclusion and exclusion criteria

Only English language articles published between 1 January 2010 and 30 April 2016 were included in the study. The literature reviewed included journal articles, guidelines, case studies and government reports on the topic, focusing on publications in the last 6 years. Publications selected for review included literature and systematic reviews, as well as original research journal articles and reports.

The present review focused on the available methodologies in in-patient wards of acute care hospitals and excluded those methodologies considered relevant for primary and community care, ambulatory care, subacute care, mental health care and aged care services. The screening process applied the inclusion and exclusion criteria to narrow the number of studies identified. Table 1 lists the inclusion and exclusion criteria used in the present study.

Results and discussion

Following the application of the inclusion and exclusion criteria detailed in Table 1, 214 records were identified. After removal of 120 duplicates, the articles underwent an additional screening process based on their title, after which a further 66 records were excluded, leaving 54 records for eligibility assessment. The abstracts of these articles were then screened, with only those articles containing empirical evidence considered eligible for the present study. This process resulted in the exclusion of a further 33 articles, with the qualitative analysis performed on the remaining 21 articles.

Following all exclusions as shown in Fig. 1, only two of the four staffing methods were found to have evidenced-based articles from empirical studies within the parameters set for

Table 1.   Criteria used to include and exclude identified literature in the present analysis

Inclusion criteria (literature studied)	Exclusion criteria (literature disregarded)
Published between 2010 and January 2016	Ambulatory staffing methodologies
Written in English	Subacute care staffing methodologies
Include other systematic reviews, meta-analyses and case reports	Aged care staffing methodologies
Available methodologies in in-patient units of acute care hospitals	Mental health staffing methodologies

inclusion. There were no studies identified for fixed or historically based staffing methods or surge staffing models in the studies included for qualitative analysis. Supply–demand returned 10 studies, and staffing ratio returned 11 studies (Table 2).

A common theme of the studies of supply–demand staffing methodology was the need to collect detailed information about fluctuating patient demand. However, there was little agreement between the studies on what information ought to be collected.

Many of the studies reviewed highlighted the need to collect patient data at the care level for a better understanding of the dynamic interactions between nursing staff and patients.[22–27]

Many of the staffing ratio studies also discussed skill mix with the assumption that higher levels of skill mix resulted in improved patient outcomes. The studies of Cook *et al.*[27] and McHugh *et al.*[28] regarding the consequences of the Californian mandated nursing ratios concluded that there was no evidence that legislation resulted in an improvement in patient safety or
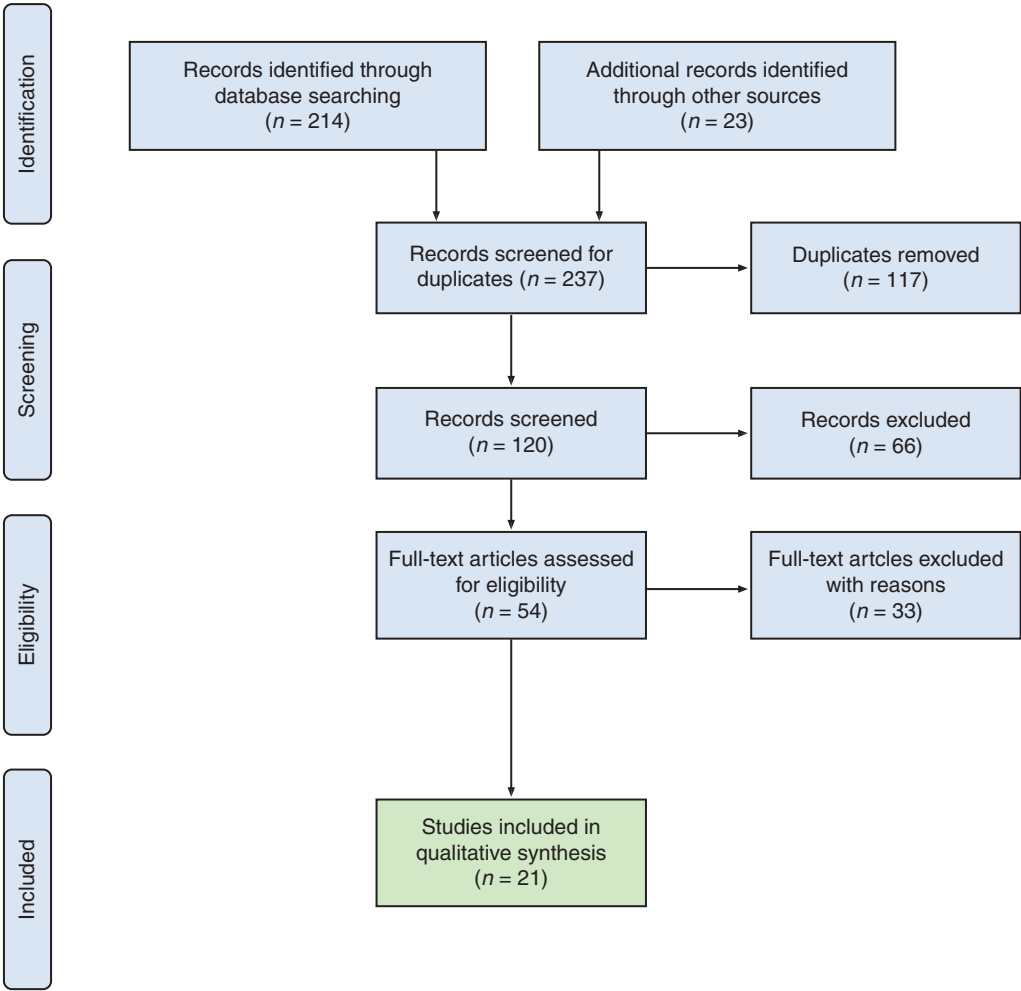

Fig. 1.   Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram showing a summary of findings at the outcome level.

Table 2.   Studies categorised by staffing method type

Staffing method	No. studies	References
Supply and demand	10	Pappas *et al.*,[22] Unruh and Zhang,[23] Smeds Alenius *et al.*,[24] Patrician *et al.*,[29] Graff *et al.*,[31] Braaksma *et al.*,[32] Twigg *et al.*,[33] Diaz *et al.*,[34] McNair,[37] Hoi *et al.*[38]
Staffing ratio	11	Smeds Alenius *et al.*,[24] Rogowski *et al.*,[25] Mefford and Alligood,[26] Cook *et al.*,[27] McHugh *et al.*,[28] Sherenian *et al.*,[30] Jones *et al.*,[35] Harding and Wright,[39] Park *et al.*,[40] Aiken *et al.*,[41] Ball and Catton[42]

Table 3. Outcome themes emerging in the literature included in the present systematic literature review
Some studies addressed more than one theme

Theme	No. studies	References
Management of clinical risk, quality and safety	11	Pappas *et al.*,[22] Unruh and Zhang,[23] Smeds Alenius *et al.*,[24] Rogowski *et al.*,[25] Mefford and Alligood,[26] Cook *et al.*,[27] Patrician *et al.*,[29] Sherenian *et al.*,[30] Park *et al.*,[40] Aiken *et al.*,[41] Dubois *et al.*[43]
Development of a new or innovative staffing methodology	10	Pappas *et al.*,[22] McHugh *et al.*,[28] Graff *et al.*,[31] Braaksma *et al.*,[32] Twigg *et al.*,[33] Diaz *et al.*,[34] Jones *et al.*,[35] Hayes and Ball[36] McNair,[37] Harding and Wright[39]
Equity of nursing workload	7	Pappas *et al.*,[22] Rogowski *et al.*,[25] Jones *et al.*,[35] Hayes and Ball,[36] McNair,[37] Hoi and Ismail,[38] Harding and Wright[39]

Table 4. Observed theme by method matrix
Some studies addressed more than one theme

Method	Theme			
	Quality and safety	Staffing methodology	Equity in staffing	Total
Supply and demand	4	6	3	13
Staffing ratio	7	4	4	15
Total	11	10	7	28

a reduction in skill mix. Several studies were found to address more than one theme. Table 3 lists these studies against each of the outcome themes.

Most outcome themes were related to the management of clinical risk, quality and safety. A number of studies in this area concluded that there appears to be a correlation between skill mix and positive patient outcomes.[22,23,25,29,30] Ten outcome themes discussed new or innovative staffing methodologies (see Table 3). Most studies were concerned with developing a nurse staffing model with limited discussion regarding patient outcomes.[28,31–36] However, like previous studies, a number acknowledged the limitation of the data in undertaking the research.[22,25,33] Six of the studies discussed the outcome theme of equity in staffing,[22,25,35–38] and generally concluded that there is a wide variation in nurse staffing and skill mix.[25,35,37] In their study, Harding and Wright[39] suggest that the quality of patient care may vary between facilities in New South Wales due to staffing variations. Table 4 combines the staffing methods and outcome themes in a matrix format.

Seven staffing ratio studies had quality and safety as part of their outcome themes.[24–27,30,40,41] The findings within these studies were diverse and often discussed the skill level of the nurse in conjunction with staffing ratio methodology. Once again, a common theme mentioned in several of these studies was the need for objective data on which to base research.[22,28,32] Aiken *et al.*[41] undertook a large study in Europe in 2014 regarding hospital mortality and nurses' workload and concluded that increasing a nursing workload by one patient increased the likelihood of an in-patient dying within 30 days of admission by 7%. The same study also concluded that for every 10% increase in the nursing workforce that has a Bachelor's degree, the likelihood of an in-patient dying within 30 days of admission decreases by 7%.[41] That study did not address adverse and sentinel event data during the period of hospitalisation.

Conclusion

There is limited evidence to conclude that either supply and demand models of nurse staffing or a staffing ratios method improves the management of risk or improves quality and safety in patient care. Intuitively, it would be reasonable to assert that if there are more nursing staff at an appropriate skill mix level, then patient care and equity in staffing levels would improve.

Research undertaken in Europe demonstrates a clear relationship between skill mix and patient safety.[41] That study also demonstrated an association between the number of patients per nurse and some measures of patient safety.[41] There is a significant research gap that requires the attention of researchers to provide evidence to underpin assumptions regarding nursing ratios and patient safety.

Much of the research cited in this paper found considerable difficulties with accessing and using reliable data, and thus the validity of the findings of many of these studies is problematic. A common theme identified in many of the studies was the need to develop robust data on which to base future research. There is an urgent need for more research into this important area of the health workforce, including the need for a valid and reliable measure of nursing workload.

Competing interests

The authors declare no competing interests.

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