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# NURSE STAFFING REVISITED



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## **ABSTRACT**

Concerns about safe nurse staffing levels and the possible impact on patient, nurse and hospital outcomes have been challenging the nursing profession for decades, with some of the earliest studies dating back decades. While it makes intuitive sense that insufficient nursing staff could adversely affect patient outcomes, specific recommendations as to what constitutes “safe nurse staffing” continues to elude us. Although the literature is extensive and the relationship between nurse staffing and selected patient, nurse, and hospital outcomes are robust, the translation of this body of literature into evidence-based nurse staffing practices remains sorely lacking. The purpose of this paper is to provide an updated review of the evidence associating nurse staffing with patient, nurse, and hospital outcomes, consider the limitations of the literature including challenges in translating findings into practice, discuss the impact of legislative mandates and more recent efforts to address the gap between what we know, what we still need to know, and promising strategies for delineating essential nurse staffing to assure equality outcomes.

**Keywords:** nurse staffing, outcomes, evidence-based practice

# NURSE STAFFING REVISITED

Concerns about safe nurse staffing levels and the possible impact on patient, nurse, and hospital outcomes have been challenging the nursing profession for decades with some of the earliest studies dating back to the 1950's and 1960s<sup>1</sup>. While it makes intuitive sense that insufficient nursing staff could adversely affect patient outcomes, specific recommendations as to what constitutes "safe nurse staffing" continues to elude us. Within the historical context of diagnosis-related groups (DRGs) in the 1980s and increased influence of managed care in the 1990s, hospital efforts to decrease costs through re-engineering and restructuring efforts often included reductions in total nursing staff. While total RN numbers at the bedside reportedly either increased or remained the same, a concomitant drastic reduction of licensed practical nurses and nursing assistants in acute care stretched the capacity of RN staff to assure quality care as patient acuity increased and length of stay (LOS) decreased.<sup>2</sup> Staff development and clinical expertise further dwindled as staff development and clinical nurse specialist (CNS) positions were often eliminated as additional attempts to control costs while preserving numbers of bedside RN staff. To further compound the situation, this same period coincided with significant decreases in nursing school enrollments and one of the longest and most severe nursing workforce shortages in history lasting well into the 2000's and ending only with the onset of the economic decline of the "great recession." Within less than a decade, new nurses went from graduating with multiple RN position offers in hand in the early 2000s' to severe challenges for new graduates in securing a single job offer; being most difficult for non-BSN new graduates.

In response to the changes in the health care industry and growing concerns about adequate staffing to support patient care, the U.S. Congress issued a legislative mandate in 1994 to address growing reports of inadequate nurse staffing and possible impact on patient care. This resulted in a 1996 IOM report on the adequacy of the nursing workforce in assuring quality patient care. The report titled, "Nursing Staff in Hospitals and Nursing Homes: Is it Adequate?" concluded that there was "a serious paucity of recent research on the definitive effects of structural measures, such as specific staffing ratios, on the quality of patient care in terms of outcomes when controlling for all other likely explanatory or confounding variables."<sup>3</sup> The report issued a series of recommendations including a call for focused research funding by the National Institute of Nursing Research (NINR) and the Agency for Health Care Policy and Research (AHCPR) to address the relationship of staffing and outcomes. Since that call for more scientifically rigorous research on nurse staffing and patient outcomes, a myriad of primary studies as well as systematic reviews have been published addressing this widely debated concern. While the literature is

extensive and the relationship between nurse staffing and selected patient, nurse, and hospital outcomes are robust, the translation of this body of literature into evidence-based nurse staffing practices remains sorely lacking. The purpose of this paper is to provide an updated review of the evidence associating nurse staffing with patient, nurse, and hospital outcomes, consider the limitations of the literature including challenges in translating findings into practice, discuss the impact of legislative mandates and more recent efforts to address the gap between what we know, what we still need to know, and promising strategies for delineating essential nurse staffing to assure equality outcomes.

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1 Blegan, Goode, & Reed, L. (1998)

2 Sovie, 1995; Aiken, Sochalski, & Anderson, 1996; Kane, 1996; Shindul-Rothchild, Berry, & Long-Middleton, 1996; Aiken, Clarke, & Sloane, 2000

3 pp 9-10

# LITERATURE REVIEW

Since the 1996 IOM report called for focused research examining relationships between nurse staffing and outcomes, an explosion of research has been published as both primary studies and secondary reviews. One of the earliest literature reviews on this topic was published in 1993 prior to the IOM release<sup>4</sup> with a stated purpose to “review the literature on nurses’ impact on outcomes and costs of care in hospitals and recommended ways for increasing cost effectiveness of hospitals operating in a managed competition and managed care environment.”<sup>5</sup> Although limited as a narrative review without any documented search approach, it is relevant in that it is frequently cited as one of the earliest such reviews of the literature ranging from 1975 to 1993. It is also relevant as a reminder that discussion of safe nurse staffing has been discussed in the literature for decades and remains an unresolved issue.

Among the earliest and most salient post 1996 IOM report studies of nurse staffing provided evidence of poorer patient outcomes with lower hours of RN care<sup>6</sup> and higher nurse-to-patient ratios.<sup>7</sup> Blegan et al (1998) described higher rates of medication errors, pressure ulcers, mortality and overall patient complaints associated with lower hours of RN care even when patient acuity was controlled for. More frequent failure-to-rescue and 30-day mortality rates among surgical patients have been associated with higher nurse to patient ratios<sup>8</sup> and interestingly, Needleman et al (2002) reported stronger associations among medical patients with higher proportion of RN hours and number of RN hours per patient day than among surgical patients. Greater RN care was reported as being significantly related to lower rates of UTI and failure-to-rescue among surgical patients whereas for medical patients, significant associations between higher RN care were found with shorter length of stay and lower rates of UTI, upper GI bleeding, pneumonia, shock or cardiac arrest and failure-to-rescue.<sup>9</sup> Although much of the earliest research focused on nurse staffing and patient outcomes, Aiken et al (2002) have consistently included nurse outcomes in their analysis reporting increased job dissatisfaction and burnout among nurses carrying heavier patient loads. These three studies<sup>10</sup> warrant specific mentioning because subsequent efforts in large part, have mirrored these findings to a greater or lesser degree with variability in the range of patient outcomes, limitations in methodological approach, and difficulty translating their findings into specific staffing recommendations.

Although the initial intent was to limit the scope of this inquiry to an update and synthesis of most recent primary studies published within the last two to three years, it became clear that the utility of

one more synthesis of the literature would be of limited value given the myriad of previously published reviews dating back as far as 1993.<sup>11</sup> The intent therefore was modified to address key evidence, limitations, and proposed next steps by reviewing selected narrative, and systematic and meta-analyses reviews to highlight the state of the state on nurse staffing and outcomes research.

## Focus on systematic and meta-analyses

A total of 14 secondary review articles were reviewed for this paper including three narrative,<sup>12</sup> eight systematic reviews<sup>13</sup> and three meta-analyses.<sup>14</sup> Five of the reviews were published in this last year.<sup>15</sup> Rather than duplicate yet one more review of recent primary studies, it was decided that a more fruitful approach would be to summarize key lessons learned from some of the more rigorous and recent systematic reviews and meta-analyses in order to highlight the most consistent findings, limitations, and recommendations for the future.

4 Prescott (1993)

5 *Id* at 192

6 Blegan, Goode, & Reed, 1998; Needleman, Buerhaus, Mattke, Steward, & Zelevinsky, 2002

7 Aiken, Clarke, Sloane, Sochalski, & Siber, 2002

8 *Id*

9 Needleman et al, 2002

10 Blegan, et al 1998; Aiken et al, 2002; & Needleman, et al, 2002

11 Prescott, 1992

12 Prescott, 1993; Donaldson & Shapiro, 2010; Griffiths et al, 2016

13 Lang, Hodge, Olson, Romano, & Kravitz, 2004; Lankshear, Sheldon, & Maynard, 2005; Thugjaroenkul, Cummings, & Embleton, 2007; Stone, Pogorzelska, Kunches, & Hirschhorn, 2008; West, Mays, Rafferty, Rowan, & Sanderson, 2009; Griffiths et al, 2016, 2018; Myers, Pugh, & Twigg, 2018; Mitchell, Gardner, Stone, Hall, & Pogorzelska-Maziarz, 2018

14 Kane, Shamilyan, Mueller, Duval, & Wilt, 2007; Shin, Park, & Bae, 2018; Driscoll et al, 2018

15 Driscoll et al, 2018; Griffiths et al, 2018; Mitchell et al, 2018; Myers, et al, 2018; Shin et al, 2018

TABLE 1  
**Summary of included literature reviews**

First author	Type	Search period	Primary studies	Outcomes of interest	Quality of studies	Major conclusions
Prescott, 1993	NROL	1974-1993	13	Mortality & other quality indicators and costs of nursing care	Not assessed	Majority of studies associated higher RN skill mix with lower severity-adjusted hospital mortality. Staffing costs are not the major reason for escalating hospital expenses.
Lang, 2004	SROL	1980-2003	43	Patient, nurse, and hospital outcomes	Only 12/43 were considered strong studies; only 8 were prospective	Evidence of probable association between higher RN skill mix and lower failure to rescue (surgical patients), lower inpatient mortality, and shorter LOS for medical patients. Limited support associating skill mix with needlesticks or nurse burnout. Inconsistent evidence associating nurse staffing and UTI or pneumonia and insufficient evidence to conclude any association between staffing and rates of falls, pressure ulcers, infections, and nurse documentation.
Lankshear, 2005	SROL	1990-2004	20	Patient outcomes	2/20 were longitudinal studies and remaining were all cross-sectional designs	9/20 studies reported significant associations between RN staffing and mortality rates; 4/20 for failure to rescue; 7/8 studies found association between RN staffing and pneumonia; two thirds of the studies addressing specific outcomes found significant associations between RN staffing and UTI, pressure ulcers, falls and wound infections. Impact with outcomes only associated with RN skill mix and not by LPN or NAC staff increases.
Kane, 2007	SRMA	1990-2006	101	Patient outcomes	96/101 reviewed were included in meta-analysis because odds ratios were reported.	Higher RN staffing associated most consistently with mortality rates among medical, surgical, and critical care patients; lower odds of pneumonia among all patients; failure to rescue and infections for surgical patients but no association with UTI or surgical bleeding;
Thungjaroenkul, 2007	SROL	1990-2006	17	Hospital costs and length of stay (LOS)	Initially reviewed 47 papers but selected only 17 assessed as moderately (12) or strong (5)	8/11 studies addressing LOS reported significant associations between higher RN staffing and shorter LOS; 10/13 studies that addressed costs found negative associations; 2 found positive associations between higher staffing and costs.
Stone, 2008	SROL	1990-2007	42	Hospital-acquired infections	38/42 included nurse staffing as predictor	Majority of studies that included measures of RN staffing reported significant associations between RN staffing and HAI; only 7 (18%) did not report significant findings. Significant associations with risk of HAI in ICU with increased use to temporary RN staff.
West, 2009	SROL	1990-2006	15	ICU patient outcomes	Observational or case control/cohort studies	Nursing resources broadly defined at nurse-patient ratios, RN education, training, and experience. Only three studies reported significant associations between "Nursing Resources" and mortality; all of the studies reported at least one adverse outcome associated with less adequate "nursing resources" but since they often examined many different outcomes, the possibility of the significant findings being by chance needs to be considered. Concluded that linkages between ICU nursing resources and adverse outcomes remains inconclusive and consider whether this may be due to less variation in staffing in critical care vs general medical surgical units.
Donaldson, 2010	NROL	2005-2009	12	Cost, quality, and outcomes in acute care hospitals in California	Limited studies to those with pre-and post California minimum staffing ratios or longitudinal design. Didn't formally grade the strength of each study.	Consistent findings demonstrated that RN staffing, hours of RN care increased between pre and post measurements however none of the studies demonstrated significant improvements in outcomes. All but one reported non-significant impact of mandatory ratios on hospital costs. Authors suggest one reason for the non-significant findings on outcomes may be due to the fact that many hospitals were already moving toward minimum ratios even before they were formally mandated thus decreasing pre and post variability in staffing.
Brennan, 2013	SROL	1999-2011	29	Focus was on what authors of prior literature reviews concluded	Eight systematic and 21 narrative reviews of the literature	Compositely, the 29 reviews addressed RN staffing research from 1958-2010. Concluded that in spite of myriad of research that is accumulating, there remain no evidence-based staffing guidelines. Authors attribute much of this to the variability of data sources, hospital vs unit-based data, and inconsistent definitions and measurement of staffing and outcomes data. An example of this was given regarding three typical approaches to conceptualizing RN staffing, e.g. staffing ratios, hours of care per day (or other timeframe), and skill mix. In considering just these three ways of approaching RN staffing, their review found over 80 different ways to measure these three concepts.

First author	Type	Search period	Primary studies	Outcomes of interest	Quality of studies	Major conclusions
Griffiths, 2016	NROL		35	Patient safety and economic outcomes	Only four studies were assessed as being strong in design.	Nine studies reported significant associations between staffing levels and mortality rates; 7 studies for failure to rescue with conclusion that mortality and failure to rescue have credible associations with nurse staffing levels. 3/12 studies reported lower fall rates with higher nurse staff levels; 4/6 studies reported shorter LOS with higher staffing; three out of four studies that addressed missed care reported more missed care with lower staffing levels. Very mixed results for pressure ulcers, medication errors, and nurse outcomes even though the authors acknowledge that job satisfaction and burnout among nurses has been reported as higher associated with lower nurse staffing. Twenty-two studies examined association between skill mix and outcomes with better outcomes with higher RN skill mix for mortality, failure to rescue, falls, ulcers and patient satisfaction. Only one study demonstrated better patient outcomes when staffing numbers were based on specialty area and acuity (Twigg, 2011). No convincing evidence to support improved outcomes with mandatory fixed nurse-patient ratios. Evidence of effective staffing tools has also been reviewed as inadequate which also contributes to lack of translation of this research body into practice. Four studies addressed economic case for increased staffing with inconclusive results.
Shin, 2018	SRMA	2000-2016	13	Nurse outcomes	Twelve assessed as moderately strong; one as weak; and none as strong	7/13 assessed burnout; 7/13 examined job dissatisfaction; 4/13 addressed intent to leave; 3/13 examined needlestick injuries. Meta-analysis resulted in significant associations between lower RN staffing and higher levels of job dissatisfaction, burnout, and intent to leave. Association between nurse staffing and needlesticks was non-significant.
Myers, 2018	SROL	2000-2016	44	Patient outcomes in high acuity units including ICU, step-down, trauma, and ED.	Nine cohort studies, 20 observational, one case control, and 14 cross-sectional studies.	Outcomes included: Meta-analysis was not feasible due to inconsistencies in measurement and large numbers of outcomes across studies. Mortality most frequent outcome with 13 studies reporting significant associations with nurse staffing and 6 reporting no significant association. Mixed results in studies testing a range of infections; Falls showed stronger association with staffing than pressure ulcers; LOS was significantly associated with nurse staffing in over 50% of the studies reviewed; Medication errors and reintubation were significantly associated with staffing measures in the majority of studies.
Mitchell, 2018	SROL	2000-2015	54	Health Care Associated Infections	54% were longitudinal or cohort design; Majority of studies were assessed as being moderately strong	50/54 addressed nursing staffing and 74% reported significant associations with HAI; 5/54 examined non-nursing staff (MD and Infection Control Specialists(ICS) with mixed results. Three studies examined physician staffing with only one reporting significant association with infection rates and 2/3 papers addressing ICS also reported significant associations of lower infection rates with higher levels of staffing
Griffiths, 2018	SROL	2006-2016	18	Omissions in Nursing Care	All cross-sectional; seven assessed as having strong external validity but all had at least moderate risks to internal validity or risk of bias	7/18 studies examined frequency of missed care with findings ranging from 75% to 98% nurses self-reporting at least one aspect of care left undone. 14/18 studies reviewed reported significant associations between lower nurse staffing and higher levels of missed nursing care. Most frequently omitted care pertained to communication, planning and emotional support. No evidence supported increased skill-mix using non-RN staff associated with reductions in reports of missed care
Driscoll, 2018	SRMA	2006-2017	35	Patient Outcomes in acute specialty units (ICU, ED, Step-Down	Discrepancies in tables in terms of accounting for fewer than 35 studies; 31 appear to have been evaluated for quality with 21 rated as high, four moderate, and six low quality (Table 2)	Higher nurse staffing was associated with decreased mortality, medication errors, pressure ulcers, use of restraints, infections, pneumonia, higher aspirin use, and more patients receiving percutaneous coronary interventions within 90 minutes. Strongest and most robust associations with patient mortality. Only six of the high-quality studies were able to be included based on their reporting of OR for in-hospital mortality resulting in reporting of a 14% decreased risk of mortality with each additional nurse added to staffing. Consistent with Kane (2007) meta-analysis.
NROL (narrative review of literature); SROL (systematic review of literature) SRMA (systematic review and meta-analysis)						

Table 1 provides a summary of the 14 literature reviews included in this analysis including type of review, search period for included literature review, outcomes of interest, assessment of quality of studies where included, and major findings/conclusions. Compositely, these reviews address nurse staffing literature ranging over 40 years from 1974 to 2017. Those reviewers who evaluated the quality of the primary studies reviewed reported varied quality of

designs with most being cross-sectional. The fact that only three of the reviews were able to include at least a limited meta-analysis<sup>16</sup> with others reporting that they had hoped to do the same but were limited by the inconsistencies and methodological flaws of many studies.<sup>17</sup>

## Patient outcomes

The majority focused on patient outcomes using an array of variables including mortality, failure to rescue, infections, pneumonia, pressure ulcers, etc. Most robust and consistent findings have been associated between better nurse staffing and mortality and failure-to-rescue.<sup>18</sup> The fact that at least two critical patient outcomes have significant cumulative evidence of being adversely impacted by lower RN staffing provides appropriate grounding for a critical call for appropriate nurse staffing. A recently published and robust analysis of hospital mortality data from 300 hospitals across nine countries from the RN4Cast study (2009-2011) reported significant associations between post-op mortality and both missed care and nurse staffing levels.<sup>19</sup> The authors suggest that missed care due to inadequate staffing mediates the association between staffing and 30-day in-patient mortality of surgical patients.<sup>20</sup>

## Nurse outcomes

Selected reviews included nurse outcomes including nurse burnout<sup>21</sup>, job satisfaction<sup>22</sup>, missed care<sup>23</sup>, intent to leave<sup>24</sup>, needlesticks<sup>25</sup>, and nursing documentation<sup>26</sup>. Although there have been reports of mixed and insufficient evidence to support links with

burnout<sup>27</sup>, needlesticks<sup>28</sup> or documentation<sup>29</sup>, two recent reviews reported significant results linking less optimal nurse staffing levels with higher levels of burnout, job dissatisfaction, intent to leave<sup>30</sup> and missed care<sup>31</sup>.

## Hospital outcomes

Fewer reviews specifically included studies of hospital outcomes including cost, length of stay (LOS) or patient satisfaction. Three reviews included LOS<sup>32</sup> with the majority of primary studies reviewed demonstrating lower LOS with higher nurse staffing levels. Prescott (1993) and Thungjaroenkul (2007) reported evidence to support that higher nurse staffing levels were typically not associated with feared increases in hospital costs however, Griffiths (2016) reviewed four primary studies addressing cost with inconclusive results. Additional attention of future studies to include expand from single outcomes of interest related to nurse staffing levels could be useful in speaking to priorities of various stakeholder groups and garner further support for translating these findings into practice.

Only one review<sup>33</sup> specifically examined primary studies showing improved patient satisfaction reports with higher RN skill mix. However, a recent primary study<sup>34</sup> reported significant associations between patient satisfaction and more optimal nurse staffing. Three measures of nurse staffing indicators included ratio of FTE per patient days, skill mix which included RN and educational levels, and flexible staffing which included use of part-time staff. All three were associated with more optimal patient experiences of care although flexible staffing was found to be the most robust.<sup>35</sup>

## Other skill-mix factors

Interestingly, Lankshear (2005) concluded that the associations between skill mix and patient outcomes were only related to RN numbers and not influenced by increases in non-RN numbers such as nursing assistants or LPNs with similar findings for missed care.<sup>36</sup>

<sup>16</sup> Kane, 2007; Driscoll, 2018, Shin, 2018

<sup>17</sup> Lankshear, 2005; Mitchell, 2018; Myer, 2018

<sup>18</sup> Prescott, 1993; Lange, 2004; Lankshear, 2005; Kane, 2007; West, 2009; Griffiths, 2016; Myers, 2018; Driscoll, 2018

<sup>19</sup> Ball et al, 2018

<sup>20</sup> Id

<sup>21</sup> Lang, 2004; Griffiths 2016; Shin, 2018

<sup>22</sup> Griffiths, 2016; Shin, 2018

<sup>23</sup> Id

<sup>24</sup> Shin, 2018

<sup>25</sup> Lang, 2004; Shin, 2018

<sup>26</sup> Lang, 2004

<sup>27</sup> Lang, 2004; Griffiths, 2016

<sup>28</sup> Id at 25

<sup>29</sup> Id at 26

<sup>30</sup> Id at 24

<sup>31</sup> Griffiths, 2018

<sup>32</sup> Thungjaroenkul, 2007; Griffiths, 2016; Myer, 2018

<sup>33</sup> Griffiths, 2016

<sup>34</sup> Oppel & Young, 2018

<sup>35</sup> Id

<sup>36</sup> Griffiths, 2018

In addition, significant associations between risk of hospital-acquired infections (HAI) have been associated with increased use of temporary staff in critical care<sup>37</sup> and medical<sup>38</sup> units.

While there are mixed results associated between nurse staffing levels and a range of outcomes, the most robust associations remain with respect to mortality and failure to rescue.

This alone elevates the importance of adequate nurse staffing even though not all examined outcomes show consistently associated results. With that said, none of the research provides strong support for mandatory fixed, head count ratios nor do they provide much operational guidance to specify what exactly constitutes adequate staffing across a range of settings and patient populations.

## Literature limitations and recommendations

Table 2 includes a summary of limitations and recommendations offered by authors' of the cited literature reviews including methodological limitations of research to date as well as suggestions for improving the ability to compare and contrast findings across studies. The first challenge is grounded in the limitations of cross-sectional and other descriptive study designs to move from mere association to prediction, explanation, and interventions that higher level research designs can provide. A second area of concern relates to the use of aggregate hospital data which is often easier for researchers to access but limited because it cannot differentiate between types of units or acuity of patients for a more proximal analysis.

Similarly, the presence of a robust association between staffing levels and specific outcomes of interest cannot translate into any specific recommendation of what constitutes optimal staffing. Several reviewer noted primary studies reporting a possible curvilinear relationship between staffing and outcomes which suggests at a certain point, adding additional staff may not result in further improved and may in fact, result in less optimal outcomes<sup>39</sup>. More recently, Oppel & Young (2018) also reported non-linear effects of staffing on patient satisfaction suggesting that there is likely a cut-off point where any further staff increases may in fact result in diminishing returns. Finally, most reviewers highlighted the need for more consistent definitions and measurement of key nurse staffing as well as outcome data to be used across studies<sup>40</sup>. For example, Brennan (2013) notes that while several national organizations have developed measures of quality indicators, very few indicators overlap across these initiatives. It seems imperative that the next phase of research on nurse staffing be predicated on more consistent definitions of both nurse staffing as well as indicators of quality nurse, patient, and hospital outcomes.

Given the methodological challenges to date, the ability to translate this growing body of research into actual staffing best practices remains limited. As a result, a range of initiatives have been implemented motivated by but minimally informed by this growing body of research. These include legislative initiatives, development of staffing guidelines, and organizational-specific quality improvement efforts. The next section will highlight some of these efforts to address the very real need yet non-specific definition of what constitutes adequate nurse staffing levels.

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37 Stone, 2008

38 Driscoll, 2018

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39 Langshear, 2005; Kane, 2007

40 Stone, 2008; West, 2009; Brennan, 2013; Griffiths, 2016; Myers, 2018; Mitchell, 2018; Griffiths, 2018; Driscoll, 2018



TABLE 2

**Summary of included literature reviews: limitations and recommendations**

First author	Type	Study limitations	Recommendations
Prescott, 1993	NROL	Not addressed	Hospital leaders and health care policy makers should consider patient and staff outcomes when considering implementation of cost-saving measures
Lang, 2004	SROL	49% of the studies used aggregate hospital level vs nursing unit data.	Minimal support for specifying specific nurse patient ratios; Fixed minimum ratios likely insufficient in improving outcomes without considering range of other factors including acuity, nurse competence, organizational support for nursing.
Lankshear, 2005	SROL	Limitations of cross-sectional and even longitudinal study designs; Use of hospital aggregate vs nursing unit level data: Couldn't calculate effect sized due to different in measurements as well as possible curvilinear relationship	Highlighted evidence of possible curvilinear relationship between RN staffing and quality outcomes as first identified by Began et al (1998). This suggests that after a certain point, further increases in nurse staffing may have diminishing returns.
Kane, 2007	SRMA	Effect sizes were larger in studies using patient/unit level data in their analysis vs aggregate hospital data.	Identified non-linear decline in hospital mortality rates with increased RN staffing consistent with Lankshear assertion of possible curvilinear relationship. Addressed clinical significance of findings with associations with outcomes of at least 10% but also recognized the challenge of identifying specific minimum ratios to recommend.
Thungjaroenkul, 2007	SROL	Identified challenges in varied measurements used to reflect RN staffing, cost, and LOS; Issue of frequent use of weaker observational/cross-sectional designs.	Future studies need to consider nurse competency in addition to numbers in skill mix. Hospital administrators should consider that reducing RN staffing may result in longer LOS and increased costs thus negating their intent at cost-savings.
Stone, 2008	SROL	Use of aggregate hospital vs unit data and cross-sectional designs; varied measurements of staffing and HAI	Recommend consistent use of CDC definitions of HAIs and standardized measures of RN staffing and skill mix.
West, 2009	SROL	Limitations of observational designs and inconsistent measures;	Recommend standardization of measures used to examine "nurse resources" as well as adverse outcomes for better comparisons across studies. Also recommend examining the relevance of "clinical" vs "statistical" significance in outcome studies.
Donaldson, 2010	NROL	Even though they limited studies to longitudinal and/or having pre and post minimum staffing ratios, they expressed concerns with the variations in data sources, levels of analyses (hospital vs unit level) and inconsistent measurements such as RN hours per patient day vs staffing ratios.	In spite of negative findings, the authors suggest that the fact that adverse outcomes didn't increase between pre- and post- mandated ratios given increasing patient acuity, may be due to the impact of mandated ratios. They also highlight the different legislative approaches taken by Oregon and Washington in terms of unit level staffing committees should be evaluated for impact.
Brennan, 2013	SROL	Strong approach to highlighting the consistent challenges reported by other authors of systematic and narrative literature reviews – particularly related to inconsistency of measurements and use of aggregate hospital data which is easier to access vs unit-level data that could be more informative to practice.	While authors acknowledge the robust findings of research associating nursing staffing with adverse outcomes, efforts to translate these findings into practice have remained elusive. Authors suggest the need to come to consensus on definitions, measurements, and consistent access to data specifically at the unit level. They also highly suggest moving from essentially observational designs examining associations to consensus on a multifactorial systems for predicting patient, staff, and cost outcomes. They highlight the fact that organizations as AHRQ, NQF and NDNQI have all developed measures of quality indicators, only two indicators overlap across all three organizations, e.g. HAPU & HALCLABS1.
Griffiths, 2016	NROL	Potential bias in estimates of causal effects from observational studies; Inconsistent results may be due in part to a myriad of missing variables that can contribute to outcomes including education, competency, and role of other team members and other factors inherent to the practice environment. Additional bias can be introduced when major sources of outcomes and adequate staffing are self-reported by nurses themselves especially in more recent efforts to evaluate "missed care" or "care rationing".	Question the limited value of continue to engage in further observational studies that are flawed at best even if many are a high quality as can be accomplished through non-experimental designs. "The evidence is extensive, overwhelming in its size and complexity, but does not provide clear answers." (Page 223) Recommend future research to consider frequently noted limitations of the literature generated thus far in terms of design, measurement and possible sources of bias.
Shin, 2018	SRMA	Observational nature of study designs and insufficient sampling strategies.	Nurse staffing was most strongly associated with job dissatisfaction and less so with burnout and intent to leave. Authors suggest that findings can inform human resources to consider strategies to improve job satisfaction including increased staffing as a way to decrease turnover.
Myers, 2018	SROL	At least 30 possible outcomes were evaluated across the 44 studies reviewed. An effort to identify key indicators, the authors considered if the indicator was found significantly associated with staffing in at least three studies and 50% of the studies that tested the specific outcome.	Authors suggest the following eight outcome indicators as having the strongest evidence of association with nurse staffing in high acuity areas: mortality, LOS, central line associated blood stream infections (CLABSI), ventilator associated pneumonia (VAP), sepsis, falls with injury, reintubation, and medication errors. Use of standardized definitions based on International Classification of Diseases (ICD) codes to provide greater consistency across studies.

First author	Type	Study limitations	Recommendations
Mitchell, 2018	SROL	Meta-analysis not feasible due to variations in study design, definitions, and measurement issues	Reinforce call for standardized definitions and measurement of staffing and outcomes including hospital-acquired infections are needed to allow for more robust analysis.
Griffiths, 2018	SROL	Use of subjective measure of "missed care" and reliance on nurses' self-reporting. Limitations inherent in largely cross-sectional research designs.	Most frequent missed care related to planning, communication, and psychosocial support and less with actual clinical care. Recommend standardization and more objective measurements of "missed care".  Conclude that consensus on how to measure nurse staffing levels at an international level would help review data across studies to better inform practice decisions.
Driscoll, 2018	SRMA	While associations between higher nurse staffing levels and decreased mortality appears robust, causal conclusion are limited due to cross-sectional nature of most study designs.	Reported several studies associating use of temporary/agency staff with poorer outcomes including sepsis, and HAPUs only on medical units.
Greaves, 2018	NROL	Most of the tools have not been actually evaluated in terms of routine use for staffing decisions.	Conclude that "very little usable information on the practicalities of routine use of formal staffing tools in the clinical setting" (Page 18) Tools that were specifically reviewed included: <b>Acuity Tools including:</b> - Therapeutic Intervention Scoring System (TISS) - Acute Physiological and Chronic Health Evaluation (APACHE II, III) severity of disease classification - Simplified Acute Physiology Score (SAPS II) - Diagnostic Related Groups (DRGs) - Sequential Organ Failure Assessment (SOFA) <b>Workload Tools including:</b> - Nursing Activities Score (NAS) - Dependence Nursing Score (DNS) - Nursing Interventions Classification (NIC) - Nine Equivalents of Nursing Manpower Use (NEMS) - American Association of Critical Care Nurses Synergy Model for Patient Care - Sistema Informativa della Performacne Infermieristica (SIPS) System of Patient Related Activities (SoPRA) Time Oriented Scoring System (TOSS) Valoracion de Carags de Trabajo y Tiempos de Enfereria (VACTE) Evaluation of Workloads and Nursing Time.

# LEGISLATIVE MANDATES FOR SAFE STAFFING

Although there remains no definitive evidence-base for fixed staffing ratios, concerns have continued to be raised and have resulted in a range of subsequent legislative action for over 20 years. Two states have passed mandated staffing ratios, many other states have introduced and some have passed safe staffing legislation short of mandating ratios. As of 2009, 14 states and the District of Columbia had passed additional safe staffing legislations and at least 17 others had pending legislation that had been introduced.<sup>41</sup> More recent updates from the American Nurses' Association reports 12 states having staffing legislation with seven establishing nurse staffing committees and another five with public disclosure requirements. Maine and the District of Columbia had previous legislation requiring fixed nurse-patient ratios that were either waived or subsequently removed prior to implementation.<sup>42</sup> Efforts at the national level include a bipartisan bill<sup>43</sup> that has been introduced to the U.S. Congress multiple times since 2003.

Federal legislation was first introduced in 2003 and reintroduced as recently as 2018. H.R. 5052/S.2446 Safe Staffing for Nurse and Patient Safety has not yet been successfully moved out of committee for full consideration and it is unclear whether or not it will be re-introduced.<sup>44</sup> Among its provisions, it would require hospitals to establish staffing committees with over half being direct care nurses, a recommendation first made in the 1996.<sup>45</sup>

## Mandated staffing ratios

In 1999, California passed Assembly Bill 294 mandating fixed staffing ratios allowing a 5-year preparation period prior to implementation.<sup>46</sup> The California Department of Health was charged with overseeing implementation of this first staffing mandate even though the department acknowledged that "essentially, there was not hard, scientific evidence in the literature indicating the number of patients nurses can safely handle while providing quality patient care."<sup>47</sup> Initial ratios of 1:6 were implemented in 2004 and then further reduced in 2005 to 1:5 in medical surgical units and telemetry units and 1:4 in step down units.

This was followed with multiple studies examining the possible impact of the California legislation that created a somewhat stronger

opportunity to explore this "natural experiment" allowing analysis of outcomes using pre and post mandated ratio time frames<sup>48</sup>.

Bolton et al (2007) and Donaldson, et al (2010) found non-significant trends between staffing and patient outcomes but overall non-significant findings relating improvements in quality patient indicators from implementation of fixed ratio mandates. They argue that the negative findings might be due to the lag time between when the legislation was passed (1999) and finally implemented (2004) during which time many California hospitals were already decreasing their staffing ratios in anticipation of this new law. They suggest that, given that outcomes didn't show further decline while acuity continued to increase, the mandated ratios might be effective in spite of their non-significant empirical findings. Mark et al (2012) also reported no consistently improved outcomes among California hospitals when compared with 12 other states without mandated ratios. In contrast, the Aiken team (2010) did report finding lower staffing ratios in California than in Pennsylvania or New Jersey were associated with lower mortality rates. They also found that nurses' working in hospitals in all three states that were in alignment with California mandated ratios, reported less job dissatisfaction, burnout, and felt more positive about the quality of care they were able to provide.<sup>49</sup> While findings from the California experiment are minimal in terms of reporting improved patient outcomes, there is some evidence to support improvements in nurses' job satisfaction and perceptions of their work environment.

The only other state to implement fixed nurse-to-patient ratios is Massachusetts but limited specifically to critical care units.<sup>50</sup> SB231 was passed in 2014 for implementation in 2016 requiring a maximum ratio of 2:1. It also required that hospitals adopt an acuity tool to be used by ICU nurses and report on four quality outcome measures; central line associated blood stream infections (CLABSI), catheter associated UTIs, hospital acquired pressure ulcers (HAPU), and patient falls with injuries.<sup>51</sup>

Implementation of this mandate provided a second "natural experiment" opportunity to examine outcomes over three periods of time, e.g. pre-implementation; preparation, and post implementation. Law et al (2018) compared results of critical care units from six academic medical centers in Massachusetts with 114 similar units from academic medical centers outside of Massachusetts. Similar to the California experience, non-significant results failed to demonstrate evidence to support that mandated fixed-ratios improve patient outcomes.<sup>52</sup> Interestingly, a recent ballot referendum to extend mandatory nurse staffing ratios beyond critical care was defeated by a significant margin by Massachusetts voters in November 2018.

It is probably not surprising that evidence is weak to support fixed head count ratios given the number of factors that might

41 Aiken, et al, 2010

42 Pearce, Morgan, Matthews, & Martin, 2018

43 H.R. 5052/S.2446 Safe Staffing for Nurse and Patient Safety

44 Livanos, 2018

45 IOM, 1996

46 Bolton, et al, 2007

47 Id at 239

48 Bolton et al, 2007; Donaldson & Shapiro, 2010; Aiken et al, 2010; Mark, Harless, Spetz, Reiter, & Pink 2012

49 Aiken, et al, 2010

50 Law, Stevens, Hohmann, & Walkey, 2018

51 Id

52 Law et al, 2018

influence workload but this in no way negates the importance of safe nurse staffing as a priority. Rather, it reminds us that safe staffing cannot be determined exclusively by midnight patient census and nurse head counts but is influenced by multiple factors including patient acuity, nurse experience, education and competency, workflow of admissions, discharges, and transfers, and even the physical layout of patient care units.

As an alternative to mandated ratios, many states including Washington State have implemented safe staffing legislation requiring unit-based staffing committees and/or public disclosure and/or reporting of staffing plans.

## Washington State safe nurse staffing legislation

Although Washington State nurses initially lobbied for mandated nurse staffing ratios, the Washington State Legislature passed its first nurse staffing bill in 2008. HB 3123 required all hospitals to establish a nurse staffing committee with at least half of the members being bedside RNs providing direct patient care.<sup>53</sup> The legislation outlines the responsibilities of each staffing committee including factors that are required for consideration such as acuity, workflow, skill mix, level of RN experience, and physical layout of units. It also required public posting of staffing plans for each unit. In 2017, a second nurse staffing bill was introduced and passed into legislation that added additional requirements to “promote evidence – based nurse staffing and increase transparency of health care data and decision making based on data.”<sup>54</sup> Revisions include the requirement for hospitals to submit annual staffing plans to the Department of Health (DOH) for implementation beginning January 1, 2019. Furthermore, DOH responsibilities expanded to include review of complaints submitted for violations of the revised statute for nurse staffing committees, *RCW 70. 41.420*.<sup>55</sup>

It is interesting to note the reference to “promote evidence-based nurse staffing” in ESHB1714 given the limitations of the current research evidence in being translated into practice. It may well be that legislative imperatives to develop more proximal unit-based staffing committees and subsequent evaluation of effectiveness in meeting quality patient, nurse, and hospital outcomes, may stimulate the next and much needed phase of nurse staffing research.

During the current 2019 Legislative Session, the senate is considering two additional bills relevant to safe staffing. SB 5190 addresses requirements for meals, rest breaks and mandatory overtime<sup>56</sup> and SB 5344 addresses nursing fatigue by restricting RNs to no more than 60 hours of direct patient care per week.<sup>57</sup> Both bills address issues that can directly and indirectly influence staffing by contributing to the general work environment, sick calls, job satisfaction, and nurse retention.

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53 ESSHB 3123, 2008

54 ESHB1714, 2017, pg. 2

55 <https://apps.leg.wa.gov/rcw/default.aspx?cite=70.41.420>

56 <http://lawfilesex.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Bills/5190.pdf>

57 <http://lawfilesex.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Bills/5344.pdf>

# EVIDENCE-BASED NURSE STAFFING: NEXT STEPS

In light of references to the need for evidence-based nurse staffing and considering next steps, a reminder of the components of evidence-based practice may be useful. While research evidence is a significant component, it must always be balanced with additional factors including expert opinion and context. One paraphrased, slightly modified definition of evidence-based practice is that it is clinical decision-making that takes into account the best available scientific evidence, expert opinion, as well as the more proximal context in which care is delivered, client preferences, and the professional judgement of the care provider.<sup>58</sup> Therefore, nurse staffing decision-making can also be informed by expert opinion generated by our professional nursing organizations.

## Professional organizations

Several professional nursing organizations have released recommendations for moving forward in developing evidence-based nurse staffing guidelines including the International Council of Nurses (ICN), American Nurses Association (ANA), and the American Association of Critical Care Nurses (AACN).

The International Council of Nurses released a position statement on Evidence-Based Safe Nurse Staffing in 2018 including the key message that “Determining optimal staffing requirements is a complex issue” that must take into account “a range of competencies which can be deployed to meet changing and fluctuating patient acuity.”<sup>59</sup> Among the 12 recommendations, ICN highlights the need for real-time data that can allow for real-time analysis of staffing needs and that staffing thresholds for safety across a range of settings must be based on actual, agreed upon, quality indicators.<sup>60</sup> Meeting these recommendations will require not only the proximal use of local nurse staffing committees, but also committed nurse leadership with the authority to flexibly monitor and modify staffing requirements through improvements in hospital IT systems that allow for real-time assessment of staffing needs.

Similarly, the American Nurses Association has undertaken the task of revising their Principles of Nurse Staffing that were initially developed in 1999 and last updated in 2012.<sup>61</sup> The current revision process began in 2017 and an initial draft was open for public comment over the summer of 2018. It is uncertain when this final revision will be released but it is expected to include recommendations related to information management as well as areas for future research. The release and review of this upcoming revision

will be a welcomed addition to moving us forward in advancing our understanding of evidence-based nurse staffing practices.

The American Association of Critical Care Nurses (AACN) has taken a unique and forward-thinking approach by taking on the issue of nurse staffing as a high stakes collaborative initiative (2019). Christine Shulman (2018), immediate past AACN president, highlighted the commitment that AACN is taking as an organization to move safe staffing beyond nurse-patient ratios and operational expense debate to a new vision of investment in safety and quality. AACN published their guiding principles for appropriate staffing in September 2018 that concludes with the following call to action:

Meaningful and sustainable change to traditional staffing models is a moral imperative that requires urgent collaborative action. Nurses, interdisciplinary teams, health care executives, safety leaders, payers, and patients must come together to create new and dynamic ways to approach appropriate staffing. This is a high-stakes, high urgency issue but, because staffing issues are so complex, there is a tendency toward the status quo. Collaborative action can produce optimal patient outcomes, lower nurse turnover, higher patient and family satisfaction, and improved financial viability for hospitals.<sup>62</sup>

## What's Next?

While it is easier to recognize when safe staffing isn't in place, the solution to determining exactly what constitute safe staffing is more elusive and far more complex. While there is no silver bullet solution, innovative strategies are emerging from both practice and research may help inform effective policy. As we move forward to joining this call for a new lens for addressing the critical issue of safe nurse staffing, the solutions cannot be found from legislation alone nor management in isolation. True solutions and evidence-based practices must come from collaborative efforts beginning with staffing committees with strong direct care nursing voices developing unit-based strategies. Innovative plans need to be tested, evaluated and successes shared. This must be done in tandem with system-wide approaches to assuring real-time data with appropriate information allowing nimble modifications for real-time action. If this were an easy fix, it would have been done years ago but success will require combined efforts aimed at a shared goal of staffing models that promote quality patient outcomes, improved work environments that increase nurse retention, as well as support fiscal well-being of organizations.

One good example comes from Akron Children's Hospital<sup>63</sup> illustrating the possibilities that can emerge when nursing leadership and staff partner with finance and human resources to improve nursing job satisfaction and decrease costs. Many current scheduling systems still rely on decades old processes that at best, consider census and possible acuity to determine staffing

58 Dawes, et al, 2005; Tilson, et al 2011

59 ICN, 2018, para.1

60 Id

61 Pearce, et al 2018

62 AACN, <https://www.aacn.org/policy-and-advocacy/guiding-principles-for-staffing> para. 13

63 Young, White, and Dorrington, 2018

plans often using cumbersome and antiquated data systems. By examining real data with support of their information systems and data analytic specialists, they were able to develop key metrics, taking into account a myriad of factors contributing to determining adequate staffing. One such metric was defined as “operational vacancy rate” reflecting FTE who are operationally unavailable due to orientation, vacations, family leave, and approved but vacant position that may still be officially attributed to specific units. By considering this metric, they were able to identify significant gaps of up to 21% in scheduled versus actual available staff and that use of premium pay was often kicked in to cover gaps. This lose-lose realization for both adequate staffing and fiscal responsibility resulted in the approval of additional permanent nursing positions and subsequent cost savings by decreasing premium cost of overtime and temporary staff.<sup>64</sup>

Dr. Bernadette Melnyk, a highly recognized expert in evidence-based practice, once said that “In God we trust, but everyone else better bring data to the table.” It will take more examples like the one from Akron Children’s Hospital to help move health care closer to the reality of evidence-based staffing. Promising models may well emerge when direct care nurses become fully engaged with staffing councils, in partnership with other key organizational stakeholders, motivated by research evidence, and guided by expert opinion and recommendations.

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64 Id

## RECOMMENDATIONS

- Continue to develop research concerning best evidence-based practice on staffing guidelines.
- Staffing complaints and public reporting of staffing plans present an opportunity to evaluate proximal nurse staffing plans and methods vis a vis patient and nurse outcomes; such research ought to be pursued.
- With a two-year period until the current Washington state safe staffing law sunsets, nurses must be enabled to freely report instances of unsafe staffing and be full participants in the staffing committee process; the law ought to be studied for its impact, if any, on patient care.
- The issue of staffing, safe nurse staffing, its impact on patient/nurse outcomes, and the current state of the literature should be a standard objective/outcome of nursing education.
- Finally, nurses must continue to speak out and advocate for the importance of safe staffing, as described above, to safe patient care and nurse outcomes.

# REFERENCES

- Aiken, L.H., Sochalski, J., & Anderson, G.F. (1996). Downsizing the hospital nursing workforce. *Health Affairs*, 15 (4), 88-92.
- Aiken, L.H., Clarke, S.P., & Sloane, D.M. (2000). Hospital restructuring: Does it adversely affect care and outcomes? *Journal of Nursing Administration*, 30 (10), 457-465.mn
- Aiken, L., Clarke, S., Sloane, D., Sochalski, J., & Silber, J. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*, 288 (16), 1987-1993.
- American Association of Critical Care Nurse (2019) Staffing: It's time for a new approach, Retrieved from <https://www.aacn.org/clinical-resources/staffing?page=1>
- Avalere. (2015). Optimal nurse staffing to improve quality of care and patient outcomes. Silver Spring, MD: American Nurses Association.
- Ball, J.E., Bruyneel, L., Aiken, L.H., Sermeus, W., Sloane, D.M., Rafferty, A.M., Lindquist, R., Tishelman, C., & Griffiths, P. (2018). Post-operative mortality, missed care, and nursing staffing in nine countries: A cross-sectional study. *International Journal of Nursing Studies*, 78, 10-15.
- Brennan, C.W., Daly, B.J., & Jones, K.R. (2013). State of the science: The relationship between nurse staffing and patient outcomes. *Western Journal of Nursing Research*, 35 (6), 760-794.
- Dawes, M., Summerskill, W., Glasziou, P., Carabellotta, A., Martin, J., Hopayian, K., Porzolt, F., Burls, A., & Osborne, J. (2005). Sicily statement on evidence-based practice. *BMC Medical Education*, 5, doi: 10.1186/1472-6920/5/1.
- Donaldson, N., & Shapiro, S. (2010). Impact of California mandated acute care hospital nurse staffing ratios: A literature synthesis. *Policy, Politics, & Nursing Practice*, 11 (3), 184-201.
- Driscoll, A., Grant, M.J., Carroll, D., Dalton, S., Deaton, C., Jones, I., Lehwaldt, D., McKee, G., Munyoubwe, T., & Astin, F. (2018). The effect of nurse-to-patient ratios on nurse-sensitive patient outcomes in acute specialist units: A systematic review and meta-analysis. *European Journal of Cardiovascular Nursing*, 17 (1), 6-22.
- Griffiths, P., Ball, J., Drennan, J., Dall'Ora, C., Maruotti, A., Pope, C., Saucedo, A.R., & Simon, M. (2016). Nurse staffing and patient outcomes: Strengths and limitations of the evidence to inform policy and practice. *International Journal of Nursing Studies*, 63, 213-225.
- Griffiths, P., Recio-Saucedo, A., Dall'Ora, C., Briggs, J., Maruotti, A., Meredith, P., Smith, G.B., & Ball, J. (2018). The association between nurse staffing and omissions in nursing care: A systematic review. *Journal of Advanced Nursing*, 74, 1474-1487.
- International Council of Nurses (2018). Position statement: Evidence-based safe nurse staffing, Retrieved from: <https://www.icn.ch/sites/default/files/inlinefiles/ICN%20OPS%20Evidence%20based%20safe%20nurse%20staffing.pdf>
- Kane, R.L., Shamliyan, T.A., Mueller, C., Duval, S., & Wilt, T.J. (2007). The association of registered nurses staffing levels and patient outcomes: Systematic review and meta-analysis. *Medical Care*, 45 (11), 1195-1204.
- Kim, C.G., & Kim, J.S. (2018). The association between nurse staffing levels and paediatric nursing-sensitive outcomes in tertiary care hospitals. *Journal of Nursing Management*, 26, 1002-1014.
- Lang, T.A., Hodge, M., Olson, V., Romano, P.S., & Kravitz, R.L. (2004). Nurse-patient ratios: A systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. *JONA*, 34, (7/8), 326-337.
- Lankshear, A.J., Sheldon, T.A., & Maynard, A. (2005). Nurse staffing and health care outcomes: A systematic review of the international research evidence. *Advances in Nursing Science*, 28 (2), 163-174.
- Law, A.C., Stevens, J.P., Hohmann, S., & Walkey, A.J. (2018). Patient outcomes after the introduction of statewide ICU nurse staffing regulations. *Critical Care Medicine*, 46 (10), 1563-1569.
- Livanos, N. (2018). A broadening coalition: Patient safety enters the nurse-to-patient ratio debate. *Journal of Nursing Regulation*, 9 (1), 68-70.
- Melnyk, B. (2016, September 16). Evidence-based practice. Retrieved from: OPENPediatrics website: <https://www.openpediatrics.org/assets/video/evidence-based-practice-changing-nursing-culture-and-improving-outcomes>
- Mitchell, B.G., Gardner, A., Stone, P.W., Hall, L., & Pogorzelska-Maziarz, M. (2018). Hospital staffing and health care associated infections: A systematic review of the literature. *The Joint Commission Journal on Quality and Patient Safety*, 44, 613-622.
- Myers, H., Pugh, J.D., & Twigg, D.E. (2018). Identifying nurse-sensitive indicators for stand-alone high acuity areas: A systematic review. *Collegian*, 25, 447-456.
- Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., & Zelevinsky, K. (2002). Nurse-staffing levels and the quality of care in hospitals. *New England Journal of Medicine*, 346 (22), 1715- 1722.



- Oppel, E.M. & Young, G.J. (2018). Nurse staffing patterns and patient experience of care: An empirical analysis of U.S. hospitals. *Health Services Research*, 53 (3), 1799-1818.
- Prescott, P. (1993). Nursing: An important component of hospital survival under a reformed health care system. *Nursing Economic\$,* 11 (4), 192-199.
- Schulman, C. (2018). Beyond nurse staffing rations: Creating a new reality. Retrieved from <https://youtu.be/Jr2VyKfbhcg>
- Shin, S., Park, J.H., & Bae, S.H. (2018). Nurse staffing and nurse outcomes: A systematic and meta-analysis. *Nursing Outlook*, 66, 273-282.
- Sovie, M. (1995). Tailoring hospitals for managed care and integrated health systems. *Nursing Economic\$,* 13 (2), 72-83.
- Stone, P.W., Pogorzelska, M., Kunches, L., & Hirschhorn, L.R. (2008). Hospital staffing and health care associated infections: A systematic review of the literature. *Healthcare Epidemiology*, 47 (1), 937-944.
- Thungjaroenkul, P., Cummings, G.G., & Embleton, A. (2007). The impact of nurse staffing on hospital costs and patient length of stay: A systematic review. *Nursing Economic\$,* 25 (5), 255-265.
- Tilson, J.K., Kaplan, S.L., Harris, J.L., Hutchinson, A., Ilic, D., Niederman, R., Potomkova, J., & Zwolsman, S.E. (2011). Sicily statement on classification and development of evidence-based practice learning assessment tools. *BMC Medical Education*, doi: 1186/1472-6920-11-78.
- Washington State Nurses Association (2019). Safe nurse staffing. Retrieved on January 29, 2019 from: <https://www.wsna.org/nursing-practice/safe-nurse-staffing>
- West, E., Mays, N., Rafferty, A.M., Rowan, K., & Sanderson, C. (2009). Nursing resources and patient outcomes in intensive care: A systematic review of the literature. *International Journal of Nursing Studies*, 46, 993-1011.