


2019

Acuity-based Nurse Staffing and the Impact on Patient Outcomes

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Walden University

College of Health Sciences

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Sara Kollman

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Walden University

2019

Abstract

Acuity-based Nurse Staffing and the Impact on Patient Outcomes

by

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MS, Walden University, 2012

BS, University of North Dakota, 1993

Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Nursing Practice

Walden University

August 2019

Abstract

The costs of healthcare in the United States are of national concern. The systematic review of the literature (SRL) explored the practice-focused nursing question regarding the relationship between the use of acuity-based staffing (ABS) models and positive patient outcomes. Analyzing the impact of ABS models on patient quality outcomes and the potential economic value could provide evidence essential for the healthcare executives responsible for fiscally prudent labor management and for creating an evidence-based business case for adequate, patient-centric nurse staffing. The synergy model for patient care and Covell's nursing intellectual capital theory guided the doctoral project. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses systematic review process steps were completed to organize the SRL and report findings. A comprehensive review of the literature yielded 527 articles, with 5 studies that met inclusion criteria in the final review. Analysis and synthesis of the SRL identified several patient outcomes that were significantly correlated with ABS staffing, including medication errors, falls, patient safety incidents, missed care, and mortality. The current body of evidence was insufficiently robust to demonstrate ABS staffing was superior to other nurse staffing models. The implications of this project for positive social change include demonstrating a need for additional research on ABS and the impact of ABS on patient outcomes.

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Dedication

This work is dedicated to Jean Sanderson Shue (my mentor and forever “work wife”) and to all the phenomenal colleagues I have worked with, learned from, and laughed and cried with during my 26 years as a professional nurse. I have cherished every moment and each life lesson along the way. Your dedication to our patients, unwavering commitment to excellence, and your ability to role model caring and compassion in the most challenging of situations make you all my heroes.

Acknowledgments

First and foremost, I want to thank my loving, devoted husband, Rod for his encouragement, patience, and ever-present support throughout my graduate education. I could not have completed my doctorate without him by my side every step of the way. I would also like to thank my DNP chair and mentor, Dr. Barbara Niedz for the guidance, wisdom, and the occasional “push” to help me complete my academic journey.

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Section 1: Nature of the Project

Introduction

A significant association between lower patient-to-nurse ratios and improved patient outcomes has been reported (Aiken et al., 2018; Griffiths et al., 2018; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Shekelle, 2013; Shin, Park, & Bae, 2018). The American Nurses Association (ANA) advocates that the foundation of value and quality healthcare delivery requires evidenced-based nurse staffing that individualizes care to achieve the best patient outcomes (ANA, 2018). The preeminent strategies to manage hospital nurse-patient staffing levels are ratio-based or acuity-based staffing (ABS) methods, such as those using patient classification systems (ANA, 2018; Gray & Kerfoot, 2016; Pearce et al., 2018). Ratio-based staffing models are the most prevalent in the body of evidence; however, studies have indicated that better patient outcomes, such as lower readmissions and mortality, are a result of the nurse's experience level which may not be reflected in ratio-based staffing (Gray & Kerfoot, 2016; Smith, Casey, Hurst, Fenton, & Scholefield, 2009). The ANA recently called for an update to the principles of staffing and suggested preliminary recommendations that include adopting outcome-oriented ABS models (Pearce et al., 2018).

The existing administrative practice gap is the propensity of healthcare organizations to reduce nurse staffing to limit personnel expenses; however, this is contrary to emerging evidence that higher nurse staffing has positive patient outcomes and reduces costs through the prevention of hospital-associated conditions (HACs; Li, Bowman, & Smith, 2016). A comprehensive analysis of the impact of ABS models on

patient outcomes was needed, and I addressed this significant gap through a comprehensive systematic review of the literature to summarize the current findings, along with identifying implications and recommendations for practice. My goal for positive social change was to generate evidence for hospital finance and nursing executives to optimize safe nurse staffing practices while limiting labor expenses in the provision of high-quality healthcare.

Problem Statement

The costs of healthcare in the United States continue to be of national concern, with cost being twice as much compared to 10 other high-income countries (Emanuel, 2018). Welton (2015) found hospital labor expense is 68.1% of all inpatient operational costs, and registered nursing costs alone represent 25.5% of those labor costs. As a result, nursing labor is often targeted by hospital executives to reduce expenses and improve profit margins. However, emerging evidence shows investing in safe, evidence-based nurse staffing optimizes patient outcomes and reduces costs of care (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Cimiotti, Aiken, Sloane, & Wu, 2012; Li, Bowman, & Smith, 2016). Matching individual patient care requirements with the nurse skill set using ABS models is needed to improve the return on investment of high-cost nursing labor resource utilization, and to clarify the value that professional nurses bring to patient quality outcomes.

While numerous studies have shown that improved patient outcomes are related to nurse staffing levels, a critical analyses and summary of ABS's impact on patient quality outcomes are lacking in the existing body of evidence (Aiken et al., 2018; Aiken,

Clarke, Sloane, Sochalski, & Silber, 2002; Cimiotti, Aiken, Sloane, & Wu, 2012; Griffiths et al., 2018; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Li, Bowman, & Smith, 2016; Shekelle, 2013; Shin, Park, & Bae, 2018). Ratio-based staffing models have been legislated in an attempt to address the patient safety and quality gaps that exist in healthcare; however, California's nurse-to-patient mandatory ratios have shown higher costs without the expected decrease in adverse events (Mark, Harless, Spetz, Reiter, & Pink, 2013; Reiter, Harless, Pink, & Mark, 2012; Serratt, 2013a, 2013b). Ratio-based staffing models have been a positive first step, but they continue to fall short and are not sufficient to meet the dynamic staffing challenges and complex patient care needs in today's environment. A more definitive evidence-based review of adequate, safe staffing levels based on individualized patient care demands and nurse skill level is required.

In 2018, the ANA and the International Council of Nurses defined safe nurse staffing as an appropriate number of nurses available at all times, a suitable mix of education, skills, and experience to meet patient care needs, and working environments that enhance quality care (ANA, 2018; Avalere Health LLC, 2015; International Council of Nurses, 2018). The recommendations no longer support numeric, fixed ratio staffing models and instead suggest outcome-based safe, staffing models such as ABS models (ANA, 2018). Acuity-based staffing models use key variables such as the patient's changing condition and holistic care needs, nursing workload and nursing experience level, and organizational factors to create a variable, flexible and effective staffing model. Nursing workload, instead of average nursing staff to patient ratios, has been identified as being a more sensitive measure of patient care need (Lee et al., 2017). Using ABS models

to guide nurse staffing levels have been shown to reduce hospital-acquired infections (HAIs) and mortality (Aiken et al., 2018; Ball et al., 2018; Lee et al., 2017). Using the body of knowledge to identify the value of ABS models to patient outcomes within the context of the current economically driven and fiscally challenging U.S. healthcare environment is imperative to highlight the vital role of the nursing profession and to justify the investment in requisite staffing resources. A critical analyses and summary of ABS model's impact on patient quality outcomes are lacking in the existing body of evidence. Thus, compiling a systematic review of extant research on the relationship of ABS models to patient outcomes adds value to nurse leaders and hospital executives broadly.

Purpose

I used a systematic review of the literature to summarize the current findings, along with identifying implications and recommendations for practice. The existing gap is the propensity of healthcare organizations to reduce nurse staffing to limit personnel expenses; however, this is contrary to emerging evidence that higher nurse staffing has positive patient outcomes and reduces costs through the prevention of HACs (Li, Bowman, & Smith, 2016).

In a large propensity-matched study, Li, Bowman, and Smith (2016) found higher RN staffing reduced the HACs of pressure ulcers (PUs), central line-associated blood stream infections (CLABSIs) and catheter-associated urinary tract infections (CAUTIs) by 10–25% reduced mortality 5–20%, and reduced length of stay (LOS) by 4–6%. The Centers for Medicare and Medicaid Services (Centers for Medicare and Medicaid

Services [CMS] 2018a, 2018b) estimated the costs per HAPI, CLABSI and CAUTI are \$38,700, \$45,000, and \$7200 respectively. Even more compelling was a recent article in JAMA Internal Medicine that identified for every \$100,000 invested solely for CLABSI prevention quality interventions, a savings of \$315,000 could be achieved, creating more than a three-fold return on investment (Nuckols et al., 2016). Objectively reviewing the impact of ABS models on patient quality outcomes and the potential economic value will be essential evidence for the healthcare executives and leaders responsible for fiscally prudent nurse labor management and for creating a compelling business case for investing in adequate, patient-centric nurse staffing as both a patient care quality and business strategy.

The practice focused question for the doctoral project was: In nursing practice, does the use of ABS models result in positive patient outcomes? Summarizing the evidence by the scholarly systematic review to answer this question will shape the future direction of professional nursing hospital-based staffing models using evidence-based, outcome-oriented methods.

The purpose of the DNP project was to provide healthcare leaders and executives with actionable evidence to support the ANA direction of the shift to outcome-focused ABS models. Since 14 states have addressed hospital nurse staffing through various laws and regulations, substantial evidenced-based support of ABS models will be required shift from the ratio-based model frequently endorsed (ANA, 2018).

Nature of the Doctoral Project

I completed the DNP project through a systematic review of the literature. I summarized the evidence obtained and implications and recommendations for practice; my goal is to have the findings published as a part of the dissemination plan. The long-term objective is to provide a high-quality systematic review that can guide future study of the impact of ABS models on patient outcomes.

Using a systematic approach minimized biases and random errors by following a structured, transparent and recorded review process. The 11 procedural steps outlined in Walden University's Manual for Systematic Review guided my systematic review of the literature (Walden University, 2017). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) provided organizational structure to the systematic literature review reporting process (PRISMA, 2015). Monthly literature search processes for newly published additions to the body of evidence occurred until revisions of the scholarly project were no longer feasible, with the last search on March 1, 2019.

Database search plans included peer-reviewed studies from 2009 to 2019 in the Cochrane library, CINAHL, Medline, PubMed, EBSCO, and Embase. Key words and inclusion criteria were tracked using a search term collection tool and are detailed in Section 3 of the proposal. Tables were used to organize the literature reviewed, and the National Institute of Health's Study Quality Assessment Tools were used to evaluate the quality of the evidence (NIH: National Heart, Lung, and Blood Institute [NIH], n.d.).

The purpose of the project was to complete a comprehensive systematic review of the literature and to analyze whether or not ABS models resulted in positive patient

outcomes. If evidence from the literature validates improved clinical outcomes, prevention of safety events, adverse safety event costs, and greater patient and nurse satisfaction, the systematic review will contribute to the business case for ABS implementation. By addressing this gap, evidence regarding the efficacy of ABS models to patient safety and quality outcomes, and the financial cost-effectiveness of patient-driven staffing methods will be added to the existing body of knowledge. Answering this practice-focused question through a systematic review of the literature comprehensively analyzed the value of ABS models to optimal patient outcomes within the current economically driven and fiscally challenging U.S. healthcare environment.

Significance

Key stakeholders are healthcare executives, particularly chief nursing and financial officers, as well as human resource and quality management leaders. Professional nurses practicing in hospital environments and patients are also stakeholders; however, the focus of this project was hospital nursing executive leadership.

Nursing executives are responsible for balancing human resources and clinical outcomes, and economic pressures to minimize labor costs continue to accelerate as hospitals attempt to remain financially viable in the accountable care era. A recent qualitative study by Kelly, Lankshear, and Jones (2016) identified that the mounting financial pressures of reducing staffing costs while improving the quality of care were one of the greatest stressors for nursing executives. Ensuring adequate staffing levels impact healthy work environments that support professional engagement, positive

interdisciplinary relationships, and effective collaboration. Because inadequate staffing levels have been correlated with nurse burnout, decreased engagement and increased turnover, the executive pressures related to effective nurse staffing are extensive and multifaceted.

Potential contributions to nursing practice vary from nurse satisfaction with workloads to reduced burnout, to enhanced retention, and improvements in work environments. According to the ANA (2018), adequate staffing levels have shown to reduce nurse fatigue, decrease nurse burnout, and improve nurse retention and job satisfaction. Refinements and improvements to current hospital-based nurse staffing practices can have significant financial implications since the estimated cost associated with the turnover of one nurse is over \$88,000, or higher for specialty practice nurses (Duffield, Roche, Homer, Buchan, & Dimitrelis, 2014). The ANA's white paper on optimal nurse staffing reported that each percentage point of annual nurse turnover is estimated to cost approximately \$300,000 (ANA, 2018; Avalere Health LLC, 2015). Using the national average of a 16.4% turnover rate, hospitals spend nearly \$5 million dollars per year in associated turnover costs (ANA, 2018; Avalere Health LLC, 2015).

The analysis of ABS models and impact on patient outcomes targeted hospital practice areas, and most studies have been conducted in large health care systems or academic medical centers. Findings are transferable to other nursing practice areas such as critical access hospitals, small rural healthcare organizations, or long-term care where current gaps have been identified (Bae & Yoder, 2015; Cramer, Jones, & Hertzog, 2011; Eliopoulos, 2015; Sofer, 2017). The analysis may also be beneficial to a broad base of

healthcare leadership and executives. With the impact of value-based purchasing in healthcare reimbursement levels, quality outcomes and healthcare revenue are interwoven and directly impact hospital financial margins. As a result, quality outcomes, as a result of ABS models, require in-depth analysis.

In an attempt to control healthcare spending which is nearly twice as much as other high-income countries, the U.S. healthcare system has shifted to quality and outcome-based financial reimbursement (Lagasse, 2018). The nursing workforce is often targeted for staff reductions since it represents the predominant labor expense in most hospitals (Welton, 2015). Efficiently and effectively managing nursing labor expense while obtaining the best possible patient outcomes by matching the needs of the patients to the skill set of the nurse is vital to minimize nurse labor costs (Welton, 2015).

In this systematic review of the literature, I evaluated the existing body of evidence on the impact of ABS models on patient outcomes. Improving the effectiveness of healthcare resource utilization is aligned with Walden University's goal to create positive social change (Walden University, 2018). This doctoral project positively impacts social change through evidence-based recommendations that can be used to create safer healthcare organizations, improve patient outcomes and prudently manage nursing resource costs and overall healthcare expenditures in a fiscally responsible manner.

Summary

With the ANA's recent recommendations to move to outcome-oriented ABS models, a comprehensive appraisal of the impact of ABS models on patient outcomes is

needed. The financial and quality outcome pressures continue to mount for healthcare executives. There are significant risks for hospital-based nurses related to burnout and retention, as well as the quality of care risks to patients related to optimized staffing levels. These factors cumulate to create urgency in completing a systematic review of the evidence surrounding ABS models and patient quality outcomes.

Additional background and context are identified through an extensive review of the relevance to nursing practice in Section 2. The theoretical basis for the study and key concepts are defined. An in-depth issue analysis in relation to the national healthcare economic and regulatory environment, and the doctoral student role, motivations and bias risks are explored.

Section 2: Background and Context

Introduction

The financial and quality pressures of today's healthcare environment and the ANA's recent recommendations to move to outcome-oriented ABS models requires comprehensive inquiry of the impact of ABS models on patient outcomes. A systematic review of the evidence surrounding ABS models and patient quality outcomes is needed to guide best practice hospital-based nurse staffing strategies and to provide healthcare executives with summative evidence on the topic to optimize human capital and labor costs related to patient outcomes. A critical analyses and summary of ABS model's impact on patient quality outcomes are lacking in the existing body of evidence. Thus, compiling a systematic review of extant research on the relationship of ABS models to patient outcomes adds value to nurse leaders and hospital executives broadly.

In the systematic review of the literature, I will summarize the current findings and identify implications and recommendations for practice. The existing gap is the propensity of healthcare organizations to reduce nurse staffing to limit personnel expenses; however, this is contrary to emerging evidence that higher nurse staffing has positive patient outcomes and reduces costs through the prevention of HACs (Li, Bowman, & Smith, 2016).

I used the American Association of Critical Care Nurses' (AACN) synergy model for patient care and Covell's nursing intellectual capital theory to inform my doctoral project. Additional background and context will be identified through an analysis of the relevance to professional nursing practice, from a patient quality and safety, human

resource, and economic perspectives. An in-depth contextual review of the issue related to the U.S. healthcare economic and regulatory environment will be summarized. I will explore my vital role in contributing to the body of evidence, including motivations and bias risks.

Concepts, Models, and Theories

The AACN synergy model for patient care and Covell's nursing intellectual capital (NIC) theory were the guiding model and theory used for the doctoral project (AACN, 2018; Curley, 2007; Covell, 2008). While the synergy model provides the nursing practice framework for delineating the professional nurses' role in directly impacting patient outcomes and organizational success, the NIC theory conceptualizes nursing knowledge as a healthcare asset and its relationship to patient and business outcomes from economic, financial and organizational learning perspectives (AACN, 2018; Curley, 2007; Covell, 2008).

The core concept of the AACN synergy model is that the needs of the patients and families drive the competencies needed by the professional nurse (AACN, 2018). The premise is that when the patient's needs and the nurse's competencies align, the synergy enables optimal patient outcomes and nurse well-being (AACN, 2018). Eight patient characteristics and eight nurse competencies are identified by the model. The patient characteristics include resiliency, vulnerability, stability, complexity, resource availability, participation in care, participation in decision making, and predictability (AACN, 2018). The eight nurse competencies are clinical judgment, advocacy and moral

agency, caring practices, collaboration, systems thinking, response to diversity, facilitation of learning, and clinical inquiry (AACN, 2018).

The synergy model has been applied to nearly every area of practice, from education to clinical settings to leadership (Hardin & Kaplow, 2017). The model is a framework for guiding optimal staffing by recognizing and addressing the dynamic and ever-changing healthcare needs of hospitalized patients. Balancing these unique needs with the nurse's competency level as outlined in the AACN Standards for Establishing and Sustaining Healthy Work Environments matches the definition of ABS model and is aligned with the goals of this systematic review (AACN, 2018).

The NIC theory developed as a middle range theory from organizational learning theory and was derived from intellectual capital theory in the economics and accounting fields (Covell, 2008; Covell & Sidani, 2013a, 2013b). The purpose was to conceptualize the nursing knowledge existing within healthcare organizations, and its relationship to both patient and organizational outcomes (Covell, 2008; Covell & Sidani, 2013a, 2013b). The two main concepts of the theory are interdependent tenets of nursing human capital and nursing structural capital (Covell, 2008; Covell & Sidani, 2013a, 2013b). Nursing human capital is the knowledge, skills, and experience of nurses, while the nursing structural capital includes the policies, procedures, guidelines, staffing, and scheduling systems used to support nursing practice (Covell, 2008; Covell & Sidani, 2013a, 2013b). The three major propositions are that nurse staffing and professional development influence nursing human capital, nursing human capital influences patient and organizational outcomes, and nursing structural capital influences patient and

organizational outcomes (Covell, 2008; Covell & Sidani, 2013a, 2013b). Although a relatively new and unknown theory, the conceptualization of nursing knowledge as a business asset that translates to patient and organizational outcomes makes the NIC theory an exceptional fit for the project. Substantiating nurse staffing as an economic necessity to optimal patient outcomes in today's volatile and challenging healthcare environment matches the purpose of the systematic review of ABS models on the impact to patient outcomes.

In addition to completing the 11 procedural steps outlined in Walden University's Manual for Systematic Review, the PRISMA checklist was used to organize the systematic literature review process steps through the preparation, retrieval, appraisal, synthesis and reporting of findings (PRISMA, 2015; Walden University, 2017). Key words and inclusion criteria were tracked using a search term collection tool to allow transparency and to facilitate replication of the project. Fineout-Overholt's General Appraisal Overview for All Studies template and evidence table were used to gather and analyze the study in a consistent, standardized method (Melynck & Fineout-Overton, 2019). The quality of the evidence was re-evaluated with the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) as required in the Walden University Manual for Systematic Review (SQUIRE, 2017; Walden, 2017).

Relevance to Nursing Practice

The evidence shows significant associations between lower patient-to-nurse ratios and patient quality outcomes (Aiken et al., 2018; Griffiths et al., 2018; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Shekelle, 2013; Shin, Park, & Bae, 2018). Nurse staffing

has been studied since the 1950s (Pearce et al., 2018). Ratio-based or ABS methods have been the dominant strategies utilized to manage nurse-patient staffing levels (ANA, 2018; Gray & Kerfoot, 2016; Pearce et al., 2018). ABS models were introduced in the 1970s, and they consider not only the individual patient's care needs, but also match the patient's needs with the skill level of the nurse (Trepanier, Lee, & Kerfoot, 2017). Studies have shown better patient outcomes, including lower readmissions and mortality, are a result of the nurse's experience level (Gray & Kerfoot, 2016; Smith, Casey, Hurst, Fenton, & Scholefield, 2009).

Return on investment of ABS is achieved by avoiding costs attributed to preventable mortality and readmissions, shorter lengths of stay, and reduced intensive care needs (Silber et al., 2016). Hospital-acquired infections (HAI) occur 30% less in the hospitals with the best nurse staffing levels (Aiken et al., 2018). A recent 10-year retrospective study in Asia found that higher nurse staffing levels had approximately an 8-9% positive effect on reducing readmissions of chronic obstructive pulmonary disease patients (Kim, Park, Han, Kim, & Kim, 2016).

Medication errors and missed care are indicators of inadequate staffing levels. A 2-year study identified a significant relationship between registered nurse (RN) staffing and medication errors, noting that for every 20% decrease in staffing below recommended minimum levels, medication errors increased by 18% (Frith, Anderson, Tseng, & Fong, 2012). An international study identified missed nursing care resulting from inadequate nurse staffing were significantly associated with 30-day case-mix adjusted mortality (Ball et al., 2018). Ball et al. (2018) identified that an increase of one

patient in the nurse's workload was associated with a 7% increase in the odds of a patient dying within 30 days of admission; and, a 10% increase in the percent of missed nursing care increased this mortality risk to 16%.

Maintaining critical care nurse workload in an effective range was found to improve patient survival to discharge to 95% probability; however, excessively high workload was associated with more than a 95% chance of death, even if this workload occurred for one day during the intensive care unit stay (Lee et al., 2017). The study specifically addressed patient outcomes related to nursing workload, instead of average nursing staff to patient ratio since ratios were considered to be an insensitive measure of patient care need (Lee et al., 2017). Duffin (2014) found that seven additional lives would be saved for every 100 patients with improved nurse staffing and this finding was attributed to the detection of early signs of patient deterioration.

The ANA advocates that the foundation of value and quality healthcare delivery requires appropriate nurse staffing that individualizes care to achieve the best patient outcomes (ANA, 2018). Ratio-based staffing tools are the most prevalent in the body of evidence; however, the ANA recently called for an update to the principles of staffing and preliminary recommendations to include adopting ABS models (Pearce et al., 2018).

Legislative efforts continue at the state and federal levels to improve nurse staffing as a patient safety initiative. The policy currently under consideration is the Safe Staffing for Nurse and Patient Safety Act which was introduced in both the U.S. Senate and House of Representatives in 2018 (ANA, 2018). Similar legislation has been introduced several times; however, it has not successfully passed. This most recent bill

requires Medicare-participating hospitals to form committees, comprised of a majority of direct care nurses, to create and implement unit specific nurse-to-patient ratio staffing plans (ANA, 2018). According to the ANA (2018), the legislation proposes safe staffing will benefit patients, RNs and hospitals by decreasing adverse health events, nurse turnover, and costly hospital readmissions, resulting in an estimated annual cost savings of nearly \$3 billion. This bill goes beyond ratios and considers the complexity/ acuity of the patients, nurse experience levels, and workflow issues such as admissions and discharges (ANA, 2018). The call for nurse staffing regulation as a patient outcome and safety priority now spans beyond the state and federal levels to international levels (Shin, Koh, Kim, Lee, & Song, 2018).

In 2011, Medicare conditions of participation outlined guidelines for required nursing services detailed 42 Code of Federal Regulations 482.23; however, the vague and nebulous language has resulted in states moving to legislation to specifically outline optimal nurse staffing to meet patient care needs in the absence of a federal mandate (U.S. Government Publishing Office, n.d.). There are 14 states which have legislated nurse staffing standards including California (CA), Connecticut (CT), Illinois (IL), Massachusetts (MA), Minnesota (MN), Nevada (NV), New Jersey (NJ), New York (NY), Ohio (OH), Oregon (OR), Rhode Island (RI), Texas (TX), Vermont (VT) and Washington (WA) (ANA, 2018). California's nurse staffing standards are the most rigid and it is the only state that has legislated mandatory minimum nurse to patient ratios, while Massachusetts has legislated nurse to patient ratios for intensive care units only (ANA, 2018). Seven states (CT, IL, NV, OH, OR, TX, and WA) require nurse-driven

staffing committees to facilitate responsible staffing plans and policies, while Minnesota requires a chief nursing officer or designee to develop a core staffing plan (ANA, 2018). Five states (IL, NJ, NY, RI, and VT) require public reporting or other disclosure mechanisms through regulatory channels (ANA, 2018).

Although ratio-based staffing models have tried to address the patient safety and quality gaps that exist in today's healthcare organizations, they appear to fall short and are not sufficient to meet the dynamic staffing challenges and complex patient care needs in today's healthcare environment. A critical review of ABS's impact on patient outcomes is lacking in the existing body of evidence.

A comprehensive systematic review of the literature to analyze if ABS models result in positive patient outcomes will alleviate this gap. If the evidence validates improved clinical outcomes, prevention of safety events and the associated costs, and enhanced patient and nurse satisfaction, the systematic review may also contribute to the business case for ABS implementation. The systematic review used the existing body of knowledge to surface extant research regarding the efficacy of ABS models to patient safety and quality outcomes and the financial cost-effectiveness of patient-driven staffing methods. Addressing the DNP project practice-focused question through a systematic review of the literature will summarize the value of ABS models to optimal patient outcomes within the context of the current economically driven and fiscally challenging U.S. healthcare environment.

No systematic reviews of ABS models and their impact on patient quality outcomes were identified through a preliminary review of the literature. Comprehensive

analyses and appraisal of ABS models on patient outcomes are needed and the doctoral systematic review project will aim to rectify this significant gap. Additional background and context were identified through an extensive review of the relevance to nursing practice, from patient quality and safety, human resource, and economic perspectives.

Local Background and Context

California has legislated nurse-to-patient ratios, yet the costs and quality of care have not shown superior results, nor have they remedied RN turnover (Mark et al., 2013; Reiter et al., 2012; Serratt, 2013a, 2013b). Significant reductions of ancillary support staff have been experienced throughout the state to offset the mandated RN expense costs (Mark et al., 2013). Since relocating to California 2 years ago, I have personally seen reductions in certified nursing assistants, unit secretaries, monitor technicians, and phlebotomists in one hospital's critical care areas alone. The nurse shortage in California is expected to be the worst in the nation by 2030 (Department of Health and Human Services [HRSA], 2017). Significant regional variation is expected, with the Central Valley region of California projected to be most impacted at levels far below the national 25th percentile of RN-to-population ratio by 2035 (HRSA, 2017; Spetz, 2019). Identifying alternative staffing strategies that positively impact patient care quality, enhance nursing workforce satisfaction, and decrease turnover, while demonstrating fiscal responsibility and prudent healthcare expense management are imperative to the future U.S. healthcare economic viability.

Although state legislation has attempted to improve patient safety and quality outcomes through individual strategies and regulations, no federal level plan has been passed in the legislature (ANA, 2018). Mandated ratios can foster rigidity without individualized patient need based primarily on unit type of the patient's location. An unintended consequence has been the reduction of other healthcare personnel and support staff resulting in increased non-nursing work being added to nurses (Mark et al., 2013). The costs associated with mandated staffing also has the potential to defer needed investments in technology or facilities due to the additional personnel expense (Mark et al., 2013).

Adequate nurse staffing is vital to maintaining patient safety and quality outcomes. Although ratio-based staffing strategies have attempted to ensure this margin of quality and safety, optimal nurse staffing is often not associated with the correct number of nurses, but rather the skill and experience of the nurse matching the need of the individual patient. With hospital reimbursements changing to value-based purchasing models, the associations between adequate nurse staffing and optimal quality and safety outcomes are more important than ever and may lead to investing in nursing as an economic strategy to maintain financial margins.

For the doctoral project, acuity-based nurse staffing and the impact on patient outcomes will be rigorously explored through a systematic review of the literature. Acuity-based nurse staffing is defined in accordance with the key characteristics outlined by the ANA and ICN including: (a) flexible and variable staffing methods that adapt to the patient's changing needs, (b) an evidence-based patient acuity or nurse workload

measurement tool, and (c) evidence of a synergistic approach to matching the patient's care needs with nurse's skills and competencies. This definition is aligned with the AACN synergy model used as a guiding theory for this project.

Patient outcomes were defined based on the National Database of Nursing Quality Indicators (NDNQI) nursing-sensitive outcome measures and the CMS value-based purchasing, HAC and hospital readmission reduction measures (CMS, 2018a, 2018b; Jones, 2016). The use of clearly defined outcomes including mortality, readmissions, failure to rescue, length of stay, HACs and hospital-related patient safety incidents allows consistent application of the outcome criteria. Consistently defined and applied outcome measures improve applicability of the project findings to the NIC theory which conceptualizes that nurse staffing, a component of nursing human capital, and nursing structural capital influence patient and organizational outcomes (Covell, 2008; Covell & Sidani, 2013a, 2013b). Substantiating nurse staffing as an economic necessity to optimal patient outcomes in today's volatile and challenging healthcare environment matches the purpose of the systematic review of ABS models on the impact to patient outcomes.

Role of the DNP student

My role as the doctoral student was to conduct a thorough and complete systematic review of the literature, to provide clarity on the motivation and to explore potential bias risks. Validating the nursing profession's unique impacts on patient outcomes has always been one of my leadership passions. The first 23 years of my career were in a robust, evidence-based Magnet environment at a large, academic medical center that utilized a well-validated, evidence-based and flexible ABS nurse staffing model.

Best-in-class quality outcomes were expected and achieved; and, nurse-staffing was driven completely by the needs of the patient, based on the workload assessment tool (the science) as well as charge nurse expertise (the art). As the manager of a 33-bed pediatric and adult cardiac surgery and transplant intensive care unit, it wasn't unusual to staff with 35-37 nurses per shift. The acuity of the neonate, pediatric, transplant, cardiac assist device, and other specialty patients supported this intense level of staffing.

Moving to the ratio-mandated practice environment of California just as I began my doctoral studies was a culture shock. Mandated ratios are a start; however, in two years as a Director of Critical Care, I have witnessed cuts of numerous ancillary staff members, including certified nursing assistants, unit secretaries, monitor technicians, transport staff and phlebotomist roles to maintain labor costs and maintain financial margins. This has resulted in the nurses assuming these job functions and often spending significant time performing non-nursing specific tasks. Also, the charge nurses are often required to step away from their leadership roles to take a patient assignment to maintain mandated staffing levels. Witnessing the stark contrast first-hand in ratio-based compared to ABS models, and the impacts in both patient quality outcomes and safety as well as with nurse satisfaction and retention, intensified my desire to study them in-depth.

Being in leadership roles and having the responsibility to safely staff critical care units by using both staffing models piqued my curiosity regarding potential outcome differences. Although significant overarching evidence could be found specifically to ratio-based staffing and quality outcomes, the gap in ABS models and patient outcomes was surprising. I have no direct relationship or conflict of interest in this project.

With my aspirations to serve as a future nurse executive, it is imperative to have robust evidence to support adequate staffing strategies. Given the financial challenges and the labor costs associated with nurse staffing, showing a return on investment for any staffing model is essential. More importantly, substantiating nursing's professional contributions to quality outcomes provides direction for future staffing standards, legislation and business decisions.

Potential bias exists due to the tenure differences and personal experiences with ABS models compared to ratio-based staffing models. Other types of bias risks include publication, time lag or multiple publication bias, citation bias, and outcome reporting bias. However, using a systematic approach outlined by PRISMA and Walden University's Manual for Systematic Review minimizes biases and random errors by following a structure, transparent and documented review process (PRISMA, 2015; Walden University, 2017).

Summary

The AACN synergy model for patient care and Covell's nursing intellectual capital theory will be used to provide theoretical support of the doctoral project. Showing return on investment by comprehensively summarizing the patient quality outcomes directly impacted by ABS staffing models is needed to guide efficient hospital-based nurse staffing and to guide healthcare executives with summative evidence to optimize human capital management.

My role as an emerging leader and future nurse executive is to provide summative evidence to shape the future of nurse staffing models and patient quality outcomes. The

collection and analysis plan for completing the systematic review of the literature is detailed in the final section of the project proposal, including the sources of evidence, analysis and synthesis and project plan summary.

Section 3: Collection and Analysis of Evidence

Introduction

A critical analyses and summary of ABS model's impact on patient quality outcomes are lacking in the existing body of evidence. Thus, compiling a systematic review of extant research on the relationship of ABS models to patient outcomes adds value to nurse leaders and hospital executives broadly. Completion of the systematic review of the literature summarizes the current study findings, along with identifying implications and recommendations for practice. The existing practice gap is the propensity of healthcare organizations to reduce nurse staffing to limit personnel expenses; however, this is contrary to emerging evidence that higher nurse staffing has positive patient outcomes and reduces costs through the prevention of HACs (Li, Bowman, & Smith, 2016).

The U.S. healthcare costs are of national concern. Nursing labor costs are the preponderance of operational expense for healthcare organizations; however, investing in adequate nurse staffing optimizes patient safety and quality outcomes while reducing the overall costs of care. Evaluating the ability of ABS models to improve high-cost nursing labor resource utilization, and to clarify the value professional nurses bring to patient quality outcomes is an economic imperative. Expanding the body of knowledge on the existing gap of the impact of ABS models on patient outcomes within the context of the current U.S. healthcare economic environment is valuable to justify the investment in sufficient staffing resources. Findings may contribute to healthcare executives' and

nursing leaders' abilities to optimize evidence-based and cost-effective, responsible nurse staffing strategies.

Section 3 details the collection of evidence published in the peer-reviewed literature. Key search terms and database research strategies are summarized. Exhaustive and comprehensive search processes are outlined to guide the analysis and synthesis of evidence for the systematic review.

Practice-Focused Question

A critical analyses and summary of ABS model's impact on patient quality outcomes are lacking in the existing body of evidence. Thus, compiling a systematic review of extant research on the relationship of ABS models to patient outcomes adds value to nurse leaders and hospital executives broadly. The existing gap is the propensity of healthcare organizations to reduce nurse staffing to limit personnel expenses; however, this is contrary to emerging evidence that higher nurse staffing has positive patient outcomes and reduces costs through the prevention of HACs (Li, Bowman, & Smith, 2016). In addition, California's legislatively-mandated nurse to patient ratios have not shown significant improvements in the quality of care, nor have they remedied RN turnover, while they have shown significant increases the labor costs resulting in the loss of ancillary support staff (Mark et al., 2013; Reiter et al., 2012; Serratt, 2013a, 2013b). The current findings, along with identifying implications and recommendations for practice are summarized through the systematic review of the literature.

The doctoral project practice focused question was: In nursing practice, does the use of acuity-based staffing (ABS) models result in positive patient outcomes?

Summarizing the evidence by the scholarly systematic review to answer this question is pivotal in shaping the future direction of professional nursing hospital-based staffing models using evidence-based, outcome-oriented methods.

The purpose of the DNP project was to provide healthcare leaders and executives with actionable evidence to support the ANA direction of the shift to outcome-focused and evidence-based ABS models. Since several states have addressed hospital nurse staffing through various laws and regulations, and national legislation continues to be pursued, substantial evidenced-based support of ABS models is required for a shift from the ratio-based model frequently endorsed (ANA, 2018). The systematic review aligns to the practice-focused question by consolidating the evidence for the contribution of ABS models on patient outcomes.

Sources of Evidence

Sources of evidence included peer-reviewed studies published from 2009 to 2019 identified from Cochrane library, CINAHL, Medline, PubMed, EBSCO, and Embase. Level I to IV studies, including randomized controlled trials (RCT), quasi-experimental and cohort studies, and integrative reviews evaluating the outcome of ABS were included. Grey literature was excluded. Only studies available in English without significant flaws were included for review.

Terms to evaluate ABS models included *nurse staffing*, *skill-based staffing*, and *acuity-based staffing*. The review targeted hospital-based acute care settings, with other practice areas such as ambulatory care, long-term care or behavioral health being excluded.

Patient outcomes were defined based on the National Database of Nursing Quality Indicators (NDNQI) nursing-sensitive outcome measures and the CMS value-based purchasing, HAC and hospital readmission reduction measures (CMS, 2018a, 2018b; Jones, 2016). Measures included mortality, readmissions, failure to rescue, length of stay, HACs like infections, pressure and device-related injuries, and harm a consequence of a fall as well as hospital-related patient safety incidents (PSI), including omitted or missed care.

Analysis and Synthesis

Walden University's Manual for Systematic Review guided the overall process for the doctoral project (Walden University, 2017). Eleven key steps are outlined and provided a framework for project completion. The PRISMA systematic review process flow diagram template and checklist were used to organize and report database searches (PRISMA, 2015). After identification of the studies from the database searches, the quality of the evidence was evaluated with Fineout-Overholt's General Appraisal Overview for All Studies template and the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) as required in the Walden University Manual for Systematic Review (Melynck & Fineout-Overton, 2019; SQUIRE, 2017; Walden, 2017).

The PRISMA systematic review process flow diagram template and checklist were used to streamline, organize, track and report database searches. There are four stages for identifying studies for review including identification, screening, eligibility, and inclusion (Liberati et al., 2009; PRISMA, 2015). The PRISMA process steps included preparation, doing the database search, identifying additional sources, removing

all duplicates, screening the studies and identifying excluded studies, determining eligibility and exclusions with rationale, and finalizing inclusion studies (Liberati et al., 2009).

Database search findings were summarized in a table including the database searched, search terms used, inclusion criteria, and number of studies identified to enhance validity of the literature search. The inclusion and exclusion criteria were used to guide evaluation of fit and the process of elimination of studies from the broad search. Each study was evaluated at several stages. The first evaluation was from the title and abstract to identify preliminary fit for inclusion. The number of studies rejected by the exclusion criteria was recorded and detailed in a table throughout the systematic review to enhance validity. The studies included were read thoroughly and critically appraised.

Data extraction from the identified studies was recorded on an evidence evaluation table for replicability and to enhance validity of findings. All variables were listed and defined, and any assumptions made were recorded as outlined by the evidence table template (Melynk & Fineout-Overton, 2019). Credibility of primary study results were examined to evaluate strength of evidence to enhance validity using Fineout-Overholt's General Appraisal Overview for All Studies template and the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) as required in the Walden University Manual for Systematic Review (Melynk & Fineout-Overton, 2019; SQUIRE, 2017; Walden, 2017). Risk of bias was assessed at the individual study level and was synthesized in the final analysis. Primary studies were condensed and presented with a brief analysis as the volume of studies surfaced did not preclude this type of

individualized summary. The Fineout-Overholt's General Appraisal Overview for All Studies and the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) tools aided in evaluation of each study (Melynk & Fineout-Overton, 2019; SQUIRE, 2017; Walden, 2017). Using consistent tools and processes for evaluation reduces reviewer bias, and aids in the reliability and validity of the systematic review.

Summary

The systematic review followed evidence-based, structured tools and processes to improve reliability and to limit the risk of bias. Searching numerous databases limits the risk of study selection bias; however, it does not prevent publication bias. Providing documentation and tracking of processes will allow replication and adds validity to the findings.

The final phase of the systematic review of the literature was to relate the finding to the practice-focused question. The analysis results, including conclusions, study descriptions as well as evaluation of the methods, results and applicability to practice, was extensive and comprehensive enough to be published. The goal of the project was to summarize the current research knowledge to guide future nurse staffing strategies in a patient- and nurse-centric, yet fiscally responsible, manner.

Section 4 details the findings and recommendations identified through the systematic review of the literature. The process steps are highlighted, quality of the studies selected are summarized, and the knowledge informed from the analysis was collated and synthesized. Interpretation of the results, including applicability and limitations, as well as recommendations for future study and practice are summarized.

Section 4: Findings and Recommendations

Introduction

The financial and quality outcome pressures continue to mount for healthcare executives. These challenges are amplified in states where mandatory staffing ratios have been legislated to improve quality outcomes. Administrative practices of reducing nurse staffing to limit expenses is contrary to emerging evidence that higher nurse staffing levels have been associated with positive patient outcomes and reduced costs through the prevention of HACs (Li, Bowman, & Smith, 2016). Significant quality and safety risks to patients related to sub-optimal staffing levels have been reported (Aiken et al., 2018; Griffiths et al., 2018; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Shekelle, 2013; Shin, Park, & Bae, 2018). The cumulative impact of these factors create urgency in completing a systematic review of the evidence surrounding nurse staffing models and patient quality outcomes.

The purpose of the DNP project was to provide healthcare leaders and executives with actionable evidence to support the ANA direction of the shift to outcome-focused and evidence-based ABS models. The practice focused question for the doctoral project is: In nursing practice, does the use of ABS models result in positive patient outcomes? An analysis of the impact of ABS models on patient outcomes is needed, and this significant gap was addressed through a comprehensive systematic review of the literature to summarize the current findings, along with identifying implications and recommendations for practice. The positive social change from this project was to generate evidence to hospital finance and nursing executives to optimize safe nurse

staffing practices in the provision of high-quality healthcare while limiting labor expenses.

Exhaustive and comprehensive search processes were completed to guide the analysis and synthesis of evidence for the systematic review. Sources of evidence included peer-reviewed studies published from 2009 to 2019 identified from Cochrane library, CINAHL, Medline, PubMed, EBSCO, and Embase. Level 1–4 studies, including RCT, quasi-experimental and cohort studies, and integrative reviews evaluating the outcome of ABS were included in the search; however, there were no level 1–3 studies identified. Grey literature was excluded. Only studies written in English with no significant study flaws were included in the review. The review focused on hospital-based acute care settings, and other practice areas such as ambulatory care, long-term care or behavioral health were excluded.

Key search terms to evaluate ABS models were *nurse staffing*, *skill-based staffing*, and *acuity-based staffing*. Boolean connectors were utilized to refine the search. Patient outcome key search terms were defined based on the NDNQI nursing-sensitive outcome measures and the CMS value-based purchasing, HAC and hospital readmission reduction measures (CMS, 2018a, 2018b; Jones, 2016). Measures included mortality, readmissions, failure to rescue, length of stay, HACs like infections, pressure and device-related injuries, and harm a consequence of a fall as well as hospital-related patient safety errors, including medication errors, and omitted or missed care. The Walden librarian was consulted numerous times to validate the exhaustive use of related search terms and enhance reliability in the search's comprehensiveness. The PRISMA systematic review

process flow diagram template and checklist were used to streamline, organize, track and record database searches.

A comprehensive search yielded 527 studies, with an additional 9 studies located through review of the studies' reference lists. Summary of the comprehensive search is detailed in the study selection flow diagram (see Appendix A). After removal of duplicate records 185 records remained. Initial screening by title and abstract-only review identified 114 studies which were reduced to 43 studies eligible for full-text review. Meticulous analysis for fit with the inclusion/ exclusion criteria and direct correlation with the practice-focused question resulted in 38 studies being excluded. The primary reason for exclusion was due to lack of clearly defined and implemented acuity-based staffing method ($n=30$). Other exclusions included: (a) three studies that used ratio-based staffing model with acuity-adjusted component(s), (b) two studies that utilized nurse-perceived workload staffing model, (c) two studies lacked a patient outcome defined by inclusion criteria, (d) one study included licensed practical nurses in the staffing model, and (e) one study was determined to have significant flaws.

Numerous systems were used for recording, tracking, organizing and analyzing the evidence. Zotero citation management software was used to gather search results, organize sources of evidence and sort studies for screening. The software allowed for storage of full-text documents selected for final review. In addition, the studies were printed to allow for multiple reviews and in-depth analysis.

The five articles were analyzed a minimum of three times. The first review occurred during the full text review stage and allowed for general overview of the study.

During the second review, Fineout-Overholt's General Appraisal Overview for All Studies template and evidence table were used to gather and analyze the study in a consistent, standardized method (Melnik & Fineout-Overton, 2019). A third review was completed, and the quality of the evidence was re-evaluated with the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) as required in the Walden University Manual for Systematic Review (SQUIRE, 2017; Walden, 2017). The PRISMA checklist and Walden systematic review process steps for completion of a systematic review were completed to assure integrity of the systematic process and complete reporting of the study results (PRISMA, 2015; Walden, 2017). No outliers or missing information were identified and the greatest integrity risk to the systematic review were publication and reviewer bias. An independent literature search and appraisal of the evidence was conducted by a nurse researcher as a bias prevention strategy.

Findings and Implications

All five research studies were identified as Level of Evidence (LOE) 4 as defined by Melnyk and Fineout-Overton (2019). The analysis and synthesis of the five research studies was completed using Fineout-Overholt's General Appraisal Overview for All Studies template and the quality of the evidence was re-evaluated with the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) as required in the Walden University Manual for Systematic Review (Melnik & Fineout-Overton, 2019; SQUIRE, 2017; Walden, 2017). Each study was comprehensively summarized in

the following section and the complete Summary of Findings Evidence Table was presented in Appendix B.

Breckenridge-Sproat, Johantgen, and Patrician (2012) completed a descriptive correlational study using a secondary analysis of the Military Nursing Outcomes Database (MilNOD) to examine the relationships between nurse staffing and workload on medication errors and patient falls. Workload and staffing factors were analyzed separately and combined using step-wise regression and the goodness of fit of the assumptions were noted. Analyses were completed for each patient unit type: (a) medical-surgical, (b) step down, or (c) critical care. Although higher patient acuity (workload factor) was associated with increased medication errors and patient falls, no significant associations were identified related to RN care hours or skill mix (staffing factors). These findings showed greater significance in medical-surgical clinical units and appear to be mediated by work environment. The complexity and thoroughness of the study were hard to assess due to poorly defined variables, and limited generalizability outside of the unique military hospitals staffing model. The contribution of this study is the use of the robust longitudinal database and microsystem level analysis of the associations between nursing staffing and workload to patient outcomes.

Duffield et al. (2011) combined a longitudinal retrospective analysis with a unit-level cross sectional study to examine the relationships of nursing staffing and workload to patient outcomes. The strength of the study was the use of an acuity-based nurse workload evaluation tool to measure the impact of staffing levels to outcomes; however, the lack of parametric data, including basic sample sizes or sufficient data to thoroughly

validate the reported findings limited the feasibility or generalizability of this study. The novel study design hampered the effectiveness and highlighted the need for clearly defined workload measurement criteria.

The third study was a Finnish research study that used an established, well-validated nurse workload measurement tool, the RAFAELA system, to examine the correlations between nurse workload and both patient safety incidents (PSI) and mortality (Fagerstrom, Kinnunen, & Saarela, 2018). The 1-year long observational study analyzed nearly 250,000 patient-nurse intensity classifications by logistic regression, using three levels of deviation to identify the odds ratios (ORs) of the PSI and mortality. When nurse workload was above the optimal levels ORs for PSI were 1.28 and mortality were 1.42 (95% CI). When nurse workload was below the optimal levels, ORs for PSI and mortality were 0.67 and 0.55 respectively (95% CI). The study showed evidence that both increased PSI and mortality were correlated with above optimal nurse workload. The weakness of the study is that RN skill attributes, and other confounding variables such as ancillary support or physician levels were not considered. Overall, this was a well-done study with a robust nurse workload standardized tool.

The fourth study was a large national cross-sectional study of 303 U.S. neonatal intensive care units (NICUs; Lake et al., 2018). The impact of infant acuity rating by a standardized NICU tool and nurse workload were analyzed to identify correlations in self-reported missed care. Missed care was identified 36% overall and increased to nearly 50% when acuity increased above the median. Regression analysis identified that the addition of acuity explained the variance from 0.087 to 0.110, with one standard

deviation of acuity increase being associated with 0.3 increase, or 47% odds in missed care. Strengths of the study included the large multicenter design, use of a validated patient acuity-nurse workload tool, and consistency with other NICU studies. Limitations included: (a) the risk of bias due to utilization of hospitals using NDNQI RN surveys (disproportionally Magnet) and having a 75% BSN RN rate which may not be a representative sample of NICU RNs, (b) limitations of causal inference due to the study design including self-report of missed care, and (c) confounding variables such as interruptions or other workload factors. The study's statistical findings were robustly reported and no analytical concerns were identified. The evidence supports further research in other practice areas in similarly designed multicenter studies to expand the early findings of the correlations between nurse workload, patient acuity and missed care.

The final and most robust research study by Needleman et al. (2011) was funded by the Agency for Healthcare Research and Quality (AHRQ). It was published in the New England Journal of Medicine and was a retrospective, single-center observational study of the associations between mortality and nursing shifts below target ABS nurse staffing levels. Over three million separate shift level records were sampled in the study. Rigorous control procedures, detailed definitions including use of a validated and reliable ABS patient classification/nurse workload tool and process steps including sensitivity checks were outlined and are the strengths of the study. Significant associations between increased mortality and increased exposure to sub-optimally acuity-based staffed nursing shifts were identified (hazard ratio 1.02; 95% CI, 1.01-1.03; $p < 0.001$). Limitations include the single-center design and potential confounding variables such as being unable

to identify DNR patients, which may have had staffing implications and impacted the mortality statistics. The recommendations are to design and replicate studies similar to this in multicenter or international research and to further explore the confounding variables, such as the impact on physician or ancillary staffing on mortality.

Although limited evidence was identified, positive correlations of ABS staffing and improved patient outcomes are beginning to emerge. Patient outcomes showing a statistically significant correlation with ABS staffing included medication errors, falls, PSI, missed care and mortality (Breckenridge-Sproat et al., 2012; Fagerstrom et al., 2018; Lake et al., 2018; Needleman et al., 2011). An incidental finding was that three studies also analyzed the work environment, and this was correlated with improved patient outcomes when work environments were rated more highly, indicating mediating effects on patient adverse events (Breckenridge-Sproat et al., 2012; Duffield et al., 2011; Lake et al., 2018). Although early evidence is emerging to support ABS staffing models and the positive impact to patient outcomes, the limited number of studies identified, inconsistent measurement of nurse-sensitive patient outcome criteria, and lack of standard acuity workload definition and measurement tools hamper the generalizability of the findings.

Unanticipated Limitations and Impact on Findings

The lack of a standardized and measurable definition of acuity-based staffing was the predominant theme and the most significant limitation. To overcome this, meticulous full-text review of the nursing staffing models described in each study was required to evaluate if the defined acuity-based staffing model criteria, including the acuity and individual care needs of the patient, the skill of the nurse and/ or other organizational

factors requiring flexible and non-ratio driven staffing strategies were met. The clarification of defined acuity-based staffing method alone eliminated 35 of 38 studies for inclusion in the final review. Significant evidence has emerged that nurse staffing levels impact patient outcomes, resulting in both the ANA and ICN recommendations for evidenced-based safe staffing (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken et al., 2018; ANA, 2018; Avalere Health LLC, 2015; Cimiotti, Aiken, Sloane, & Wu, 2012; Griffiths et al., 2018; International Council of Nurses, 2018; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Li, Bowman, & Smith, 2016; Shekelle, 2013; Shin, Park, & Bae, 2018). Despite this call to action at both national and international level, evidence specifically exploring acuity-based staffing methods that synergistically matches patient needs to available professional nursing care is limited.

Risk of publication bias is considerably high, given the lack of studies meeting the inclusion and exclusion criteria between 2009 and 2019. Inability to control for confounding variables was consistent across all studies. Adverse events are generally self-reported events and are at risk of underreporting when used as an outcome variable. With this underreporting, the findings are subject to error; however, this risk should be a consistent risk in all studies and healthcare arenas. Pham, Girard, and Provonost (2013) noted that only approximately 7% of all adverse events are reported to incident reporting systems and wide variations in perceived need to report exist between providers, work area and organization cultures, and level of harm and/ or near miss events.

Reviewer bias is the greatest risk to validity of the systematic review. Although multiple independent reviewers minimize this risk, the scope of this project did not allow for this control strategy. An independent literature search and appraisal of the included studies was conducted by a nurse researcher to minimize the risk of reviewer bias. An additional mediating strategy was consultation with the Walden librarian multiple times throughout the review process to obtain an objective perspective on the exhaustive and complete search strategy utilized. The expert opinion of the librarian also provided guidance and strategies for tracking, record keeping and organization throughout the SRL. Standardized evaluation tools were used to mitigate bias. Another control strategy was using the doctoral committee for consultation and development of consensus on the evidence identified from the five studies selected for inclusion in the systematic review. Despite the attempts to limit reviewer bias, this risk cannot be completely eliminated and may influence the findings.

Implications

The current evidence is not robust enough to demonstrate ABS staffing is superior to other nurse staffing models. The overarching research continues to provide clear evidence that overall optimal safe nurse staffing and qualifications such as baccalaureate prepared nurses impact patient outcomes (Aiken et al., 2018; ANA, 2018; Gray & Kerfoot, 2016; Griffiths et al., 2018; International Council of Nurses, 2018; Kane et al., 2007; Shekelle, 2013; Shin, Park, & Bae, 2018; Smith et al., 2009). Adequate staffing levels impact healthy work environments for professional nurses, improve patient safety, and enhance quality outcomes (AACN, 2017). Since inadequate staffing levels have been

correlated with nurse burnout, decreased engagement and increased turnover, the executive pressures related to effective nurse staffing are extensive and multifaceted (AACN, 2017).

Despite the nursing workforce being over 3 million members strong and representing the largest segment of the U.S. healthcare workforce, significant nursing shortages are anticipated by 2030 (ANA, 2018; Avalere Health LLC, 2015; Institute of Medicine [IOM], 2010). State and region workforce disparities are expected. California's shortage is expected to be the worst in the nation and the Central Valley region of the state is projected to be most impacted, with levels far below the national 25th percentile of RN-to-population ratio by 2035 (HRSA, 2017; Spetz, 2019). It will be imperative for nursing leaders to retain the existing workforce as well as expand the current membership to meet future demand. In addition, preventing turnover reduces the exorbitant costs incurred by hospitals, which are estimated at \$300,000 per 1% of annual RN turnover (ANA, 2018; Avalere Health LLC, 2015). Demonstrating prudent and responsible healthcare expense management, including effective nurse staffing strategies and the prevention of turnover are essential healthcare leader skills that will be imperative to the future U.S. healthcare economic viability.

The SRL demonstrated that these concerns are a global phenomenon, since two of the five studies identified were international studies. The recently published ICN's elements of evidence-based safe nurse staffing and ANA's white paper on optimal nurse staffing will be instrumental in aiding well-designed research. Using standardized nurse staffing definitions and measures, as well as nurse-sensitive quality outcome measures to

establish sufficient evidence is foundational to developing outcome-based, fiscally responsible nurse staffing.

Positive Social Change

The positive social change aim is to generate evidence for hospital finance and nursing executives to optimize safe nurse staffing practices while limiting labor expenses in the provision of high-quality healthcare. Completing a systematic review of the literature evaluated the existing body of evidence on the impact of ABS models on patient outcomes and improving the effectiveness of healthcare resource utilization is aligned with Walden University's goal to create positive social change (Walden University, 2018). This doctoral project positively impacts social change through evidence-based recommendations that can be used to guide safer healthcare organizations, improve patient outcomes and prudently manage nursing resource costs and overall healthcare expenditures in a fiscally responsible manner.

Recommendations

Recommendations include modeling the Fagerstrom et al. and Needleman et al. (2011) studies identified in this review since they were well-designed and illustrated the most robust acuity-based staffing models and measurement tools. In addition, studies comparing RBS and ABS models in matched cohort studies may illustrate key strengths or weaknesses of the two predominant staffing strategies. International, multicenter and other significant large studies are needed to better understand the implications of optimal safe nurse staffing has on patient outcomes.

Granular and robust unit-level studies are needed to help define the confounding variables and impact of work environment, hospital culture and other unique considerations. The ICN's elements of evidence-based safe nurse staffing and ANA's white paper on optimal nurse staffing will be instrumental in aiding well-designed research. Using standardized nurse staffing definitions and measures, as well as nurse-sensitive quality outcome measures to establish sufficient evidence is foundational to developing outcome-based, fiscally responsible nurse staffing.

Strengths and Limitations

The strength of this doctoral project SRL is that it reinforces a significant gap in the evidence on acuity-based nurse staffing and the impact to patient outcomes exists. The review identified and synthesized the identified evidence yet very little credible evidence was found, and no similar studies were identified. Patient outcomes showing a statistically significant associations with ABS staffing included medication errors, falls, PSI, missed care and mortality (Breckenridge-Sproat et al., 2012; Fagerstrom et al., 2018; Lake et al., 2018; Needleman et al., 2011).

The greatest limitation of the study was the lack of a standardized and measurable definition of acuity-based staffing, various nurse workload classification tools and variable outcome measure definitions. To overcome this, meticulous full-text review of the nursing staffing models described in each study was required to evaluate if the defined acuity-based staffing model criteria, including the acuity and individual care needs of the patient, the skill of the nurse and/ or other organizational factors requiring

flexible and non-ratio driven staffing strategies were met. This increased the risk of reviewer bias due to the subjectivity of the evaluation for inclusion.

Applying the ICN's elements of evidence-based safe nurse staffing and ANA's optimal nurse staffing criteria will be instrumental in aiding well-designed research.

Using standardized nurse staffing definitions and measures, as well as nurse-sensitive quality outcome measures to establish sufficient evidence is foundational to developing outcome-based, fiscally responsible nurse staffing.

Section 5: Dissemination Plan

Dissemination Plan

The dissemination plan for the doctoral project SRL is multifaceted. First, abstracts for poster and/ or podium presentations will be submitted for the Association of California Nurse Leader's (ACNL) annual meeting and the American Organization for Nursing Leaders (AONL) national meeting. Neither call for abstracts are posted but are expected third quarter. Because of the legislated nurse-to-patient ratios in California, engaging the state's nurse leaders may be pivotal in encouraging more robust research on the topic. Influencing leaders at the national level may foster inquiry and highlight the need for additional study on this topic.

Targeted journals for a publication submission include the American Journal of Nursing, Journal of Nursing Administration, or other journals targeting nurse executives and healthcare leaders. Queries will be sent after the doctoral project has been successfully defended. Another dissemination strategy is to meet with the leadership of the California Hospital Association to share the outcome of my project. Because of my involvement with ACNL, I interacted with a lobbyist earlier this year and there was interest in the doctoral project. There is a profound network of healthcare, political, and lobbyist leaders at both the state and federal levels. Sharing my work with these leaders may create opportunities to build on or expand of this evidence and has the potential to influence policy and legislation in the interest of safe staffing in hospitals across the state and country.

Analysis of Self

The doctoral project was an intense and rigorous application of everything I have learned throughout my doctoral program. The systematic review of the literature was far more difficult than I ever imagined. This is likely only a first step in a long journey of investigation and discovery on the topic of nurse staffing and the impact to patient outcomes since my long-term goal is to serve in a chief nurse executive role.

As a future nurse executive, it will be vital to remain actively engaged as a scholar-practitioner and use the best evidence available to lead nursing practice. Balancing optimal safe nurse staffing practices, while creating healthy work environments and reducing turnover in a fiscally responsible manner is my goal as an influential and authentic nurse leader. This project is only the beginning of the responsibility I feel towards growing and developing the nursing profession's role in the future of U.S. healthcare.

Summary

The evidence has clearly defined the impact of adequate, safe nurse staffing to patient safety and quality outcomes. The method of achieving those optimal safe staffing levels remains clouded in a myriad of definitions, strategies, models, and inconsistent workload measurement tools. Ratio-based nursing has been a sound start to legislatively setting a minimum safe staffing level per patient; however, it does not synergistically consider the unique needs of the patient or individual skill of the nurse and has not shown the patient outcomes or fiscal responsibility demanded by the current healthcare economy. The doctoral project introduces the existing body of evidence and demonstrates

the need for substantially more research on the topic of acuity-based nurse staffing and the impact on patient outcomes.

References

- Aiken, L. H., Ceron, C., Simonetti, M., Lake, E. T., Galiano, A., Garbarini, A., ... Smith, H. L. (2018). Hospital nurse staffing and patient outcomes. *Revista Medica Clinica Las Condes*, 29, 322-327. <http://dx.doi.org/10.1016/j.rmcl.2018.04.011>
- Aiken, L. H., Clarke, S. P., Sloane, D. M., Sochalski, J., & Silber, J. H. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job satisfaction. *JAMA*, 288, 1987-1993. <http://dx.doi.org/10.1001/jama.288.16.1987>
- American Association of Critical-Care Nurses. (2018). AACN synergy model for patient care. Retrieved from <https://www.aacn.org/nursing-excellence/aacn-standards/synergy-model>
- American Association of Critical-Care Nurses. (2017). Healthy work environments. Retrieved from https://www.aacn.org/search?searchText=healthy%20work%20environments#page/1?globalsearchcontentcategory_sm=
- American Nurses Association. (2018). Nurse Staffing. Retrieved from <https://www.nursingworld.org/practice-policy/work-environment/nurse-staffing/>
- Avalere Health LLC. (2015). Optimal nurse staffing to improve quality of care and patient outcomes. Retrieved from <https://www.nursingworld.org/practice-policy/advocacy/state/nurse-staffing/>
- Bae, S. H., & Yoder, L. H. (2015, October-December). Implementation of the Centers for Medicare & Medicaid Services' nonpayment policy for preventable hospital-acquired conditions in rural and nonrural US hospitals. *Journal of Nursing Care*

Quality, 30, 313-322. <http://dx.doi.org/10.1097/NCQ.0000000000000119>

Ball, J. E., Bruyneel, L., Aiken, L. H., Sermeus, W., Sloane, D. M., Rafferty, A. M., ...

RN4Cast Consortium (2018). Post-operative mortality, missed care and nurse staffing in nine countries: A cross-sectional study. *International Journal of Nursing Studies*, 78, 10-15. <http://dx.doi.org/10.1016/j.ijnurstu.2017.08.004>

Breckenridge-Sproat, S., Johantgen, M., & Patrician, P. (2012). Influence of unit-level staffing on medication errors and falls in military hospitals. *Western Journal of Nursing Research*, 34, 455-474. <http://dx.doi.org/10.1177/0193945911407090>

Centers for Medicare & Medicaid Services. (2018a). Hospital-acquired conditions (present on admission indicator). Retrieved from <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalAcqCond/index.html>

Centers for Medicare & Medicaid Services. (2018b). The hospital value-based purchasing (VBP) program. Retrieved from <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/HVBP/Hospital-Value-Based-Purchasing.html>

Cimiotti, J. P., Aiken, L. H., Sloane, D. M., & Wu, E. S. (2012). Nurse staffing, burnout, and health care-associated infection. *American Journal of Infection Control*, 40, 486-490. <http://dx.doi.org/10.1016/j.ajic.2012.02.029>

Covell, C. L. (2008). The middle range theory of nursing intellectual capital. *Journal of Advanced Nursing*, 63(1), 94-103. <http://dx.doi.org/10.1111/j.1365-2648.2008.0426.x>

- Covell, C. L., & Sidani, S. (2013a). Nursing intellectual capital theory: Implications for research and practice. *Online Journal of Issues in Nursing, 18*. Retrieved from www.nursingworld.org/OJIN
- Covell, C. L., & Sidani, S. (2013b). Nursing intellectual capital theory: Testing selected propositions. *Journal of Advanced Nursing, 69*, 2432-2445.
<http://dx.doi.org/10.1111/jan.12118>
- Cramer, M. E., Jones, K. J., & Hertzog, M. (2011, October-December). Nurse staffing in critical access hospitals: Structural factors linked to quality care. *Journal of Nursing Care Quality, 26*, 335-343.
<http://dx.doi.org/10.1097/NCQ.0b013e318210d30a>
- Curley, M. A. (2007). *Synergy: The unique relationship between nurses and patients* (1st ed.). Indianapolis, IN: Sigma Theta Tau International.
- Department of Health and Human Services. (2017). Supply and demand projections of the nursing workforce: 2014-2030. Retrieved from https://bhwh.hrsa.gov/sites/default/files/bhw/nchwa/projections/NCHWA_HRSA_Nursing_Report.pdf
- Duffield, C., Diers, D., O'Brien-Pallas, L., Aisbett, C., Roche, M., King, M., & Aisbett, K. (2011). Nursing staffing, nursing workload, the work environment and patient outcomes. *Applied Nursing Research, 24*, 244-255.
<http://dx.doi.org/10.1016/j.apnr.2009.12.004>
- Duffield, C. M., Roche, M. A., Homer, C., Buchan, J., & Dimitrelis, S. (2014, December). A comparative review of nurse turnover rates and costs across

countries. *Journal of Advanced Nursing*, 70, 2703-2712.

<http://dx.doi.org/10.1111/jan.12483>

Duffin, C. (2014). Increase in nurse numbers linked to better patient survival rates in ICU. *Nursing Standard*, 28(33), 10.

<http://dx.doi.org/10.7748/ns2014.04.28.33.10.s8>

Eliopoulos, C. (2015, April). The clinical and business case for improving nurse staffing in long-term care. *Annals of Long-Term Care: Clinical Care and Aging*, 23(4), 12-13. Retrieved from <https://www.managedhealthcareconnect.com/home/altc>

Emanuel, E. J. (2018, March 13). The real cost of the US health care system. *JAMA*, 319, 983-985. <http://dx.doi.org/10.1001/jama.2018.1151>

Fagerstrom, L., Kinnunen, M., & Saarela, J. (2018). Nursing workload, patient safety incidents and mortality: An observational study from Finland. *BMJ Open*, 8(e016367), 1-10. <http://dx.doi.org/10.1136/bmjopen-2017-016367>

Frith, K., Anderson, E., Tseng, F., & Fong, E. (2012). Nurse staffing is an important strategy to prevent medication errors in community hospitals. *Nursing Economics*, 30, 288-294. Retrieved from

https://www.nursingconomics.net/necfiles/specialissue/2012/Frith_Staffing.pdf

Gray, J., & Kerfoot, K. (2016, January-March). Expanding the parameters for excellence in patient assignments: Is leveraging an evidence-data-based acuity methodology realistic? *Nursing Administration Quarterly*, 40(1), 7-13.

<http://dx.doi.org/10.1097/NAQ.000000000000138>

Griffiths, P., Recio-Saucedo, A., Dall'Ora, C., Briggs, J., Maruotti, A., Meredith, P., ...

- Ball, J. (2018, January). The association between nurse staffing and omissions in nursing care: A systematic review. *Journal of Advanced Nursing*, 74, 1474-1487. <http://dx.doi.org/10.1111/jan.13564>
- Hardin, S. R., & Kaplow, R. (2017). *Synergy for clinical excellence: The AACN synergy model for patient care* (2nd ed.). Burlington, MA: Jones & Bartlett Learning.
- Institute of Medicine (IOM). (2010a). *The future of nursing: Leading change, advancing health*. Retrieved from Institute of Medicine: <https://web.archive.org/web/20150211165201/http://iom.edu/Reports/2010/The-Future-of-Nursing-Leading-Change-Advancing-Health.aspx>
- International Council of Nurses. (2018). Evidence-based safe nurse staffing. Retrieved from https://www.icn.ch/sites/default/files/inline-files/ICN%20PS%20Evidence%20based%20safe%20nurse%20staffing_0.pdf
- Jones, T. L. (2016, May). Outcome measurement in nursing: Imperatives, ideals, history, and challenges. *The Online Journal of Issues in Nursing*, 21(2), Manuscript 1. <http://dx.doi.org/10.3912/OJIN.Vol21No02Man01>
- Kane, R. L., Shamliyan, T. A., Mueller, C., Duval, S., & Wilt, T. J. (2007, December). The association of registered nurse staffing levels and patient outcomes: Systematic review and meta-analysis. *Medical Care*, 45, 1195-1204. Retrieved from <https://www.jstor.org/stable/40221602>
- Kelly, D., Lankshear, A., & Jones, A. (2016, December). Stress and resilience in a post-Francis world - A qualitative study of executive nurse directors. *Journal of Advanced Nursing*, 72, 3160-3168. <http://dx.doi.org/10.1111/jan.13086>

- Kim, S. J., Park, E. C., Han, K. T., Kim, S. J., & Kim, T. H. (2016). Nurse staffing and 30-day readmission of chronic obstructive pulmonary disease patients: A 10-year retrospective study of patient hospitalization. *Asian Nursing Research*, *10*, 283-288. <http://dx.doi.org/10.1016/j.anr.2016.09.003>
- Lagasse, J. (2018). Why U.S. healthcare costs so much: High drug prices, doctor salaries and services. Retrieved from <https://www.healthcarefinancenews.com/news/why-us-healthcare-costs-so-much-high-drug-prices-doctor-salaries-and-services>
- Lake, E. T., Staiger, D. O., Cramer, E., Hatfield, L. A., Smith, J. G., Kalisch, B. J., & Rogowski, J. A. (2018). Association of patient acuity and missed nursing care in U.S. neonatal intensive care units. *Medical Care Research and Review*, 1-18. <http://dx.doi.org/10.1177/1077558718806743>
- Lee, A., Cheung, Y. S., Joynt, G. M., Leung, C. H., Wong, W. T., & Gomersall, C. D. (2017). Are high nurse workload/ staffing ratios associated with decrease survival in critically ill patients? A cohort study. *Annals of Intensive Care*, *7*(46), 1-9. <http://dx.doi.org/10.1186/s13613-017-0269-2>
- Li, X., Bowman, S. M., & Smith, T. C. (2016). Effects of registered nurse staffing level on hospital-acquired conditions in cardiac surgery patients: A propensity score matching analysis. *Nursing Outlook*, *64*, 533-541. <http://dx.doi.org/10.1016/j.outlook.2016.05.002>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P., ... Moher, D. (2009, July). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation

and elaboration. *PLoS Medicine*, 6(7), 1-28.

<http://dx.doi.org/10.1371/journal.pmed.1000100>

Mark, B. A., Harless, D. W., Spetz, J., Reiter, K. L., & Pink, G. H. (2013, April).

California's minimum nurse staffing legislation: Results from a natural experiment. *HSR: Health Services Research*, 48, 435-454.

<http://dx.doi.org/10.1111/j.1475-6773.2012.01465.x>

Melnyk, B. M., & Fineout-Overholt, E. (2019). *Evidence-based practice in nursing and healthcare: A guide to best practice* (4th ed.). Philadelphia, PA: Wolters Kluwer Health.

Needleman, J., Buerhaus, P., Pankratz, V. S., Leibson, C. L., Stevens, S. R., & Harris, M. (2011, March 17). Nurse staffing and inpatient hospital mortality. *New England Journal of Medicine*, 364, 1037-1045.

NIH: National Heart, Lung, and Blood Institute. (n.d.). Study Quality Assessment Tools. Retrieved from <https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools>

Nuckols, T. K., Keeler, E., Morton, S. C., Anderson, L., Doyle, B., Booth, M., ...

Shekelle, P. (2016, December). Economic evaluation of quality improvement interventions for bloodstream infections related to central catheters: A systematic review. *JAMA Internal Medicine*, 176, 1843-1854.

<http://dx.doi.org/10.1001/jamainternmed.2016.6610>

Pearce, P. F., Morgan, S., Matthews, J. H., Martin, D. M., Ross, S. O., Rochin, E., &

Welton, J. M. (2018, July-August). The value of nurse staffing: ANA principles

- redevelopment and direction for the future. *Nursing Economic\$, 36(4)*, 169-176.
- Pham, J. C., Girard, T., & Pronovost, P. J. (2013). What to do with healthcare Incident Reporting Systems. *Journal of Public Health Research, 2(3)*, 154–159.
<https://doi-org.ezp.waldenulibrary.org/10.4081/jphr.2013.e27>
- PRISMA. (2015). Transparent reporting of systematic reviews and meta-analyses: Key documents. Retrieved from <http://www.prisma-statement.org/>
- Reiter, K. L., Harless, D. W., Pink, G. H., & Mark, B. A. (2012, June). Minimum nurse staffing legislation and the financial performance of California hospitals. *HSR: Health Services Research, 47*, 1030-1050. <http://dx.doi.org/10.1111/j.1475-6773.2011.01356.x>
- Serratt, T. (2013a). California's nurse-to-patient ratios, part 3: 8 years later, what do we know about hospital level outcomes? *The Journal of Nursing Administration, 43*, 581-585. <http://dx.doi.org/10.1097/01.NNA.0000434505.69428.eb>
- Serratt, T. (2013b). California's nurse-to-patient ratios, part 2: 8 years later, what do we know about hospital level outcomes? *The Journal of Nursing Administration, 43*, 549-553. <http://dx.doi.org/10.1097/NNA.0b013e3182a3e906>
- Shekelle, P. G. (2013, March 5). Nurse-patient ratios as a patient safety strategy. *Annals of Internal Medicine, 158*, 404-409.
- Shin, J. H., Koh, J. E., Kim, H. E., Lee, H. J., & Song, S. (2018). Current status of nursing law in the United States and implications. *Health Systems and Policy Research, 5(1)*, 1-7. <http://dx.doi.org/10.21767/2254-9137.100086>
- Shin, S., Park, J. H., & Bae, S. H. (2018). Nurse staffing and nurse outcomes: A

systematic review and meta-analysis. *Nursing Outlook*, 66, 273-282.

<http://dx.doi.org/10.1016/j.outlook.2017.12.002>

Silber, J. H., Rosebaum, P. R., McHugh, M. D., Ludwig, J. M., Smith, H. L., Niknam, B.

A., ... Aiken, L. H. (2016, June 1). Comparison of the value of nursing work environments in hospitals across different levels of patient risk. *JAMA Surgery*, 151, 527-536. <http://dx.doi.org/10.1001/jamasurg.2015.4908>

Smith, S., Casey, A., Hurst, K., Fenton, K., & Scholefield, H. (2009). Developing, testing, and applying instruments for measuring rising dependency-acuity's impact on ward staffing and quality. *International Journal of Health Care Quality Assurance*, 22(1), 30-39. <http://dx.doi.org/10.1108/09526860910927934>

Sofer, D. (2017, February). Proposed regulations for long-term care omit nurse staffing mandates. *AJN: American Journal of Nursing*, 117(2), 12. <http://dx.doi.org/10.1097/01.NAJ.0000512282.40618.94>

Spetz, J. (2019). *Regional forecasts of the registered nurse workforce in California*.

Retrieved from

<https://rnworkforce.ucsf.edu/sites/rnworkforce.ucsf.edu/files/California%20RN%20regional%20forecasts%20summary%202019-03-25.pdf>

SQUIRE. (2017). Revised standards for quality improvement reporting excellence

SQUIRE 2.0. Retrieved from [http://squire-](http://squire-statement.org/index.cfm?fuseaction=Page.ViewPage&PageID=471)

[statement.org/index.cfm?fuseaction=Page.ViewPage&PageID=471](http://squire-statement.org/index.cfm?fuseaction=Page.ViewPage&PageID=471)

Trepanier, S., Lee, D. W., & Kerfoot, K. M. (2017, July-August). Interoperable acuity-based staffing solutions: Lessons learned from a multi-hospital system. *Nursing*

Economics, 35(4), 184-204.

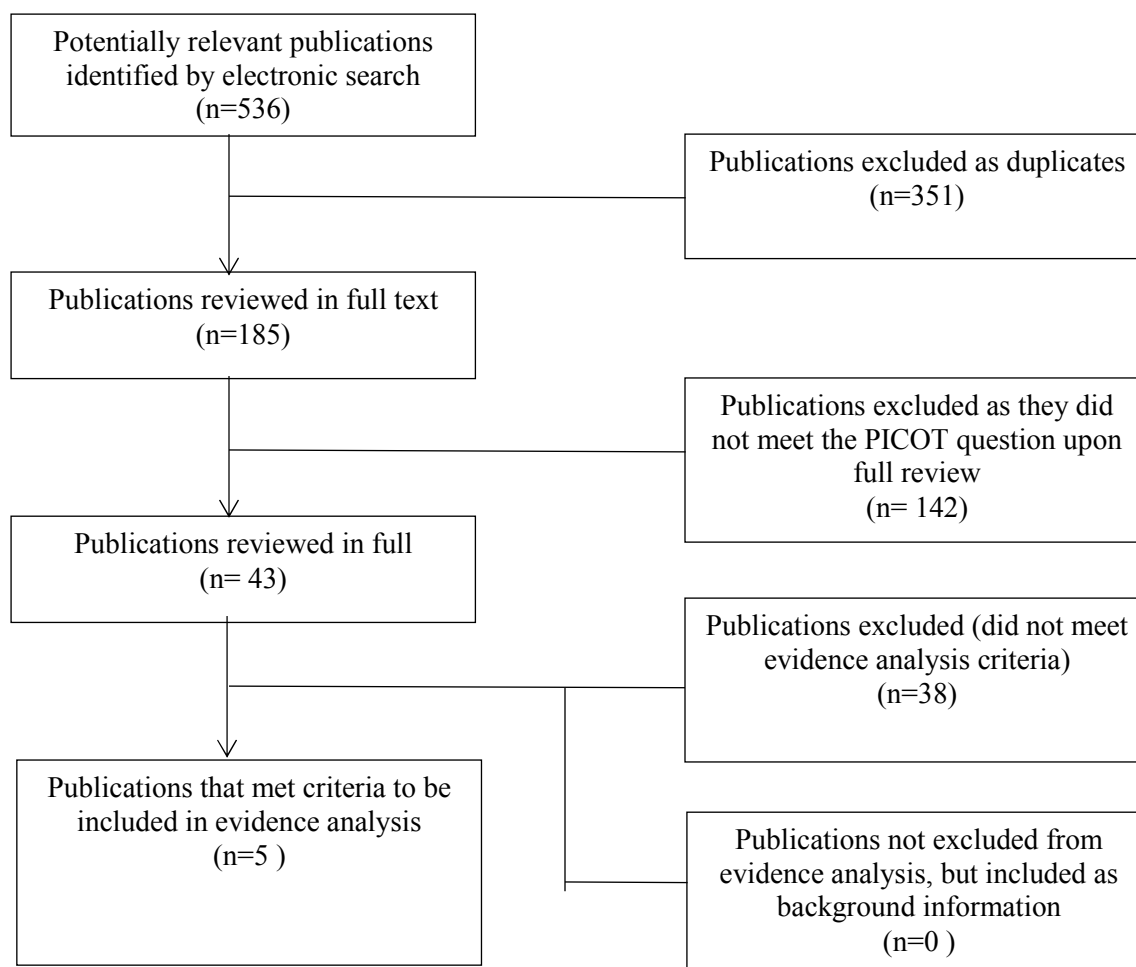
U.S. Government Publishing Office. (n.d.). Content details: 42 CFR 482.23 - Condition of participation: Nursing services. Retrieved from <https://www.govinfo.gov/app/details/CFR-2011-title42-vol5/CFR-2011-title42-vol5-sec482-23>

Walden University. (2017). Manual for systematic review: Doctor of Nursing Practice (DNP) scholarly project. Retrieved from https://academicguides.waldenu.edu/ld.php?content_id=32773133

Walden University. (2018). 2018-2019 Walden University catalog: September 2018. Retrieved from <https://catalog.waldenu.edu/mime/media/view/160/55134/2018%E2%80%932019+Walden+University+Catalog+%28September+2018%29.pdf>

Welton, J. M. (2015, October). Hospital nursing workforce costs, wages, occupational mix and resource utilization. *Journal of Nursing Administration*, 45(10), S10-S15. <http://dx.doi.org/http://dx.doi.org.ezp.waldenulibrary.org/10.1097/NNA.0b013e3182250a2b>

Appendix A: Study Selection Flowchart and Inclusion/Exclusion Criteria



Inclusion Criteria	Exclusion Criteria
Studies published in English Published 2009-2019 Level 1-4 studies Hospital-based acute care settings Defined acuity-based nurse workload measurement tool used RN staffing	Studies not published in English Grey literature Non-hospital-based settings (ambulatory, long-term care, behavioral health) Subjective staffing tools Non-RN staffing

Databases searched: CINAHL, Cochrane, EBSCO, Embase, Medline, and PubMed

Search terms included: “acuity-based staffing”, “skilled based staffing”, “nurse staffing”, “mortality”, “readmissions”, “failure to rescue”, “patient safety incidents”, “adverse events”, “hospital-acquired conditions”, “hospital-acquired infections”, “missed care”, “pressure ulcers”, “pressure injury”, “fall”, “length of stay”, “medication errors”, “medication events”

Appendix B: Evidence Evaluation Table

Practice-Focused Question: In nursing practice, does the use of acuity-based staffing (ABS) models result in positive patient outcomes?

Citation: Author, Date of Publication, & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
Breckenridge-Sproat, S. et al. (2012). Influence of unit-level staffing on medication errors and falls in military hospitals	Examine relationships of nurse staffing and workload on medication errors and patient falls; explore the effect of the practice environment on the relationships	Donabedian's Health Quality Model	Secondary analysis of longitudinal Military Nursing Outcomes Database (MilNOD) data set	MilNOD data 2003-2006; 4 US Army hospitals / 23 inpatient units – shift level data set 2006 annual survey of direct care RNs (n=320) using Practice Environment Scale of the Nursing Work Index (PES-NWI)	IV#1- workload factors (WKL); average daily acuity measured by WMSN divided by census IV#2 – nurse staffing factors (NS); nursing care hours per patient per shift divided by number of patients; further analyzed by skill mix and category of Army RN IV#3 (co-variate)– practice environment (ENV); PES-NWI composite score aggregated to the unit level All IV evaluated by unit type - medical surgical (MS), step down (SD) or critical care (CC) DV#1 - medication	DV#1 and DV#2 - Monthly shift-level error rate (shifts with MAE divided by total number of shifts)	Negative binomial Generalized Linear Mixed (GzLM) regression model applied to both DV and compared to intercept Goodness of fit measured by Bayesian Information Criterion (BIC) Step-wise analysis for each construct (SF, WL, SF+WL and each merged with ENV)	DV#1 – BIC/likelihood χ^2 MS (2959.381/142.957; p<0.001); SD (928.417/95.401; p<0.001); CC (1342.247/109.144; p<0.001) demonstrate fair fit model; MS intercept 2.148 (p<0.001); acuity 1.015 (p<0.05) significantly associated with higher MAE; DV#2 – BIC/likelihood χ^2 MS (2534.454/160.001; p<0.001); SD (804.999/48.2	<u>LOE</u> – 4 <u>Strengths</u> : secondary analysis from a large multisite, multiphase database. <u>Weakness</u> – generalizability to non-military hospitals is limited (staffing categories unique to military hospitals); secondary analysis with limited control of variable definitions, measurement, data collection and other design aspects; self-report nurse survey; incident reports and underreporting <u>Feasibility</u> – limited use in practice due to military personnel and staffing structures; however, this creates early analysis regarding nurse skill/

					<p>administration error (MAE); self-reported deviation from order traceable to nurse from incident reports DV#2 – fall (F); any unplanned descent to the floor identified in incident reports</p>		<p>56; $p < 0.001$); CC (1003.106/22.299; no p noted) demonstrate fair fit model in MS and good model fit in CC; MS intercept 1.356 ($p < 0.05$); acuity 0.328 ($p < 0.05$) significantly associated with increase in F DV1 with ENV inclusion – significant predictor of MAE ($\beta = -3.086$, $p = 0.001$) DV2 with ENV inclusion – not significant predictor of fall ($\beta = 9.283$, $p = 0.155$) Higher patient acuity was associated with an increase in both adverse events (MAE/F); ENV mediated MAE but not fall Neither total nursing care hours nor RN</p>	<p>patient need synergy and impact on MAEs</p> <p><u>Conclusion</u> – Patient acuity and staff category, not census, affected MAE and falls</p> <p><u>RECOMMENDATION</u> – need for standardized definitions and measure of staffing, workload and outcomes; no standard acuity measures; additional metrics around medical event rate (per total meds dispensed; more robust pt. fall risk controls)</p>
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								skill mix was statistically significant predictor of the MAE or fall	
Duffield, C. et al. (2011). Nursing staffing, nursing workload, the work environment and patient outcomes.	Examine the relationship of nurse staffing and workload, in the context of work environment, to patient outcome at the unit-level	Patient Care System model	Exploratory study combining longitudinal retrospective analysis of administrative data with a cross-sectional unit-level data collection arm #1. longitudinal - retrospective patient discharge and nursing payroll/scheduling data from 2001-2006 arm #2. primary data collected	New South Wales; 80 acute care units from 19 public hospitals; 5 fiscal years (2001 - 2006);	IV#1 - Nurse staffing (NS) – RN hours per patient hour IV#2 - Nurse workload (WKL); IV#3 - Working environment (ENV) DV -Patient outcomes (PO); Outcomes Potentially Sensitive to Nursing (OPSN), falls and MAE	7 different tools used Acuity-based tool: PRN-80 Workload classification tool -IRR 87.2% Nursing supply/demand factor (required hours of care from PRN-80 tool/HPPD of care provided	Longitudinal study arm – descriptive statistics Linear regression used to link nurse staffing to patient outcomes Cross sectional arm – patient outcomes as counts; regression modeling	Demand/supply factor (perfect match of patient workload acuity and nurse supply is 100)– overall average = 124; only one quarter of all units were balanced between staffing & workload; <i>Reported</i> increased unanticipated changes in patient acuity, decreased resource adequacy, and decreased specialist nursing support were	<u>LOE</u> – 4 <u>Strengths</u> : acuity workload measurement tool used and represented a distinct concept in the model, different from staffing numbers or skill mix. <i>Reported</i> findings of the cross-sectional part of the study amplified the longitudinal study findings, workload and work environment variables showed an interpretable pattern <u>Weakness</u> : Confounding variables and poorly defined IV/DV. Excessive overlap potentiates risk of overestimation of findings. Constrained analytic possibilities due to study design and difficulty merging study

			<p>from 80 randomly selected patient care units in 19 hospitals from 2004-2005</p> <p>arm1 &2 matched – 43 wards in 13 hospitals</p>					<p>statistically related to tasks delayed or not done (data not shown).</p>	<p>arms.</p> <p><u>Feasibility:</u> Difficult to apply in practice due to wide variations at unit level.</p> <p><u>Conclusion:</u> Due to study design and lack of transparent statistical analysis to validate reported findings, insufficient evidence to support reported study conclusions. Additional research is needed at the hospital level.</p> <p><u>RECOMMENDATION:</u> Study reinforces the necessity to include consistently defined measures of workload and the working environment in future studies of the relationships of nurse staffing to patient outcomes.</p>
<p>Fagerstrom, L. et al. (2018). Nursing workload, patient safety incidents and mortality: An observational study from Finland.</p>	<p>Does the daily workload per nurse, as measured by the RAFAELA system, correlate with patient safety incidents (PSI) and patient mortality (MORT)?</p>	<p>None identified</p>	<p>Observational study</p>	<p>36 units from 4 Finnish hospitals; 249,123 patient-nurse intensity classifications, nursing resources, PSI & MORT for 1 year</p>	<p>IV - Nurse Workload (WKL); optimal workload measured by patient classification system DV#1 - PSI DV#2 - MORT</p>	<p>RAFAELA standardized, evidence-based nurse staffing system (feasibility, validity and reliability tested) – daily patient classifications by RN Recommended WKL determined</p>	<p>Logistic regression; adjusted & unadjusted models done; +/- 15%, 7.5% & 30% deviation Odds ratios</p>	<p>When WKL/nurse was above the assumed optimal level, the unadjusted odds for a PSI were 1.28 (95% CI 1.13 to 1.45) that of the assumed optimum level</p> <p>ORs for MORT were 1.42 (95% CI</p>	<p><u>LOE</u> – 4</p> <p><u>Strengths-</u> RAFAELA standardized, scientifically tested nursing workload and patients’ nursing intensity tool used. Tool has been validated and IRR measured frequently. Extensive statistical reporting included.</p> <p><u>Weakness</u> – self-reporting of PSI;</p>

						<p>by PAONCIL method (considers contextual & organizational factors) PSI from The Reporting System for Safety Incidents in Healthcare Organizations (HailPro) – categorized in 4 categories + MORT added as 5th category</p>	<p>1.19 to 1.69)</p> <p>If WKL/nurse was below the recommended optimal level: ORs for PSI 0.67 and MORT 0.55</p>	<p>Potential confounding factors other than those identified by PAONCIL. Effects of skill mix, competence level or work experience on patient outcomes not considered.</p> <p><u>Feasibility:</u> Applicability to practice and similar studies could be replicated in other countries, or using other acuity-based staffing models</p> <p><u>Conclusion –</u> Evidence that optimal WKL is correlated with fewer PSI and MORT events. Odds for a PSI were 10%–30% higher, and for MORT about 40% higher when WKL was higher than optimal levels.</p> <p>Additional study is needed to identify the influence of other confounding variables such as physicians’ patient-related direct time, other ancillary support, or influence of skill mix and/ or nurse-specific traits on PSI and MORT.</p> <p><u>RECOMMENDATION:</u> A multicenter study with several hospitals is needed to further test the generalizability of the results. Other case-</p>
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									matched, or longitudinal studies comparing ratio-based to acuity-based nurse staffing models on patient outcomes are needed.
Lake, E. T. et al. (2018). Association of patient acuity and missed nursing care in U.S. neonatal intensive care units.	Missed care in the NICU related to nurse workload, work environment and patient acuity	Donabedian's theory of quality	Cross sectional correlational study	303 NICUs in 41 states and the District of Columbia	IV#1: Infant acuity IV#2: Nurse workload (WKL) IV#3: Nurse work environment (ENV) DV: missed care (MC)	RN acuity rating of each NICU patient (Rogowski et al., 2015) Average acuity nurse workload 2016 NDNQI RN survey; 2016 annual survey PES-NWI Self-report of missed care	Descriptive stats Ordinary linear regression Logistic regression	Missed care (N=5861): 36% overall 27.1% with acuity-adjusted patient below median 49.4% with acuity-adjusted patient above median Addition of acuity increased explained variance from 0.087 to 0.110 (1SD increase in acuity associated with 0.30 increase in missed care) Addition of average acuity, a 1SD increase in acuity was associated with 47% odds of missed care	<u>LOE</u> – 4 <u>Strengths</u> – large national sample; consistent with other NICU studies; use of validated tools; <u>Weakness</u> – sample units were NDNQI hospitals (quality focused; disproportionately Magnet) (bias or mediating effects); number of BSN participates higher than national average. Cross sectional design limits causal inference Confounding variables (interruptions, surges in patient volumes r acuties) <u>Feasibility</u> : applicable to practice as evidence from a large multicenter study and model for future multicenter studies; may not be generalizable outside of level II-IV NICUs <u>Conclusion</u> – provides evidence that patient acuity adjustments (in lieu of ratios in critical care settings), flexibility in staffing policy compliance and allow

									<p>staff nurse input into decisions Nurses with high acuity-adjusted WKL missed care double to triple the percentages of nurses with low-acuity work loads A 1 SD increase in nurse workload by patient number(s) or acuity increased odds of missed care by 1.5 to 2 times and increased frequency of missed care by 0.3 to 0.6 activities</p> <p><u>RECOMMENDATION</u> – additional study of the relationship of acuity to NICU quality outcomes; further development of standard acuity workload measures</p>
Needleman et al. (2011). Nurse staffing and inpatient hospital mortality.	Association between mortality and patient exposure to nursing shifts during which RN staffing was 8 hours or more below target staffing by acuity-based staffing (ABS) using sufficient statistical controls	None identified	Retrospective, observational Cross-sectional	Large tertiary academic medical center; 43 hospital inpatient units; 197,961 admissions and 176,696 nursing shifts Data from 2003-2006; over 3 million separate records evaluated;	IV RN staffing per unit-shift DV mortality (MORT)	Variance of target hours of nursing care and actual hours of nursing care per shift (patient classification tool) Death at hospital discharge and predicted in-hospital mortality by DRG	Cox proportional-hazards models with adjustment for patient and hospital unit characteristics	Significant association between increased MORT and increased exposure to nursing shifts during which RN staffing was 8 hours or more below target staffing by ABS (hazard ratio (HR) per below target shift, 1.02; 95% CI, 1.01-1.03; P<0.001); restricted to	<p><u>LOE</u> – 4</p> <p><u>Strengths</u> – large sample size, multiple nursing units and shifts; ABS patient classification system “well-calibrated and audited” tool rigorous control procedures outlined. Extensive controls for potential sources of an increased risk of death other than nurse staffing Funded by AHRQ; published in NEJM Sensitivity checks completed across different levels of care, excluding ICU, first admissions only; including readmissions,</p>

								<p>just first 5 days HR increased to 1.03 (95% CI, 1.02 -1.05; P<0.001); in sliding window of previous 6 shifts HR 1.05 (95% CI, 1.02 -1.07; P<0.001)</p>	<p>adjusting sliding window to 30 shifts</p> <p><u>Weakness</u> – one hospital; tertiary medical center; confounding variable; unable to identify “DNR” patients which may have had staffing implications</p> <p><u>Feasibility</u>: Generalizable to other acute care hospitals due to inclusive sample. May not be generalizable to smaller non-academic facilities.</p> <p><u>Conclusion</u> – need to match staffing with patient need and create flexible, adaptive staffing models; strong evidence for ABS staffing models, and suboptimal staffing impact on patient mortality</p> <p><u>RECOMMENDATION</u>: replicate study in other organizations or multisite analysis; complete study to identify other confounding or mediating factors, such as physician staffing, ancillary staff support or work processes</p>
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Legend:

LOE = level of evidence

LOE 4 = well-designed case-control and cohort studies

DV = dependent variable

IV = independent variable

MS = medical-surgical unit

SD = step down unit

CC = critical care unit

WKL = workload

NS = nurse staffing

ENV = environment

MAE = medication administration error/ event

F = fall

PO = patient outcome

MORT = mortality

PSI = patient safety incident

MC = missed care

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