A COMPARISON OF THE NURSING COSTS ASSOCIATED WITH THE IMPLEMENTATION OF THE MANDATED NURSE-TO-PATIENT RATIOS IN CALIFORNIA

A DISSERTATION IN Nursing

Presented to the Faculty of the University Of Missouri-Kansas City in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

By

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A COMPARISON OF THE NURSING COSTS ASSOCIATED WITH
THE IMPLEMENTATION OF THE MANDATED
NURSE-TO-PATIENT RATIOS IN CALIFORNIA

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ABSTRACT

Nurse executives are challenged to provide adequate nurse staffing to prevent adverse patient outcomes, promote patient satisfaction and enhance nurses’ job satisfaction. Historically, nurse staffing strategies have involved the use of patient classification systems, the use of time studies to predict staffing numbers and the best guesses of the nurse administrators. Collective bargaining units moved to include staffing ceilings or nurse-to-patient ratios to address staffing needs in hospitals.

In 1999, the state of California signed AB394 into law requiring the implementation of mandated minimum nurse-to-patient ratios. The California Department of Health Services estimated that the mandated nurse-to-patient ratios would cost California hospitals $956 million annually after implementation given adequate recruiting sources (CHA, 2004). While this estimate was made prior to the known fiscal impact of the ratios, no study has been published addressing the actual costs differences to the hospitals of the mandated nurse-to-patient ratios that were implemented in 2004.
As other states consider introducing legislation to implement the staffing ratios as California has done, the impact of these costs should be revealed.

The aim of this study was to examine the impact on nursing costs expressed as a percentage of hospital operating costs from before the staffing ratios in California were implemented (2002) and after the staffing ratios were implemented (2006). Two hundred eighty-two hospitals were included in this study. Financial and productivity data were obtained from the Office of Statewide Health Planning and Development in California. Examination of the percentage of total hospital operating costs attributed to nursing costs shed light on the fiscal impact of the mandated nurse-to-patient ratios in California. Results demonstrated that there was significant difference in the percentage of total hospital operating costs attributed to Registered Nurse costs and to overall nursing costs. There was no significant difference in the percentage of total hospital operating costs attributed to the costs for the licensed vocational nurse. In addition, there were no significant differences noted in the level of unit support staff (aides/orderlies, technicians, clerical) after the implementation of the ratios.

This abstract of 336 words is approved as to form and content.

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The undersigned, appointed by the Dean of the School of Nursing, have examined a dissertation titled "A Comparison of the Nursing Costs Associated with the Implementation of the Mandated Nurse-to-Patient Ratios in California," presented by Shelly Carol Wells, candidate for the Doctor of Philosophy degree, and hereby certify that in their opinion it is worthy of acceptance.

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CHAPTER 1

INTRODUCTION

Statement of the Problem

In an industry where fiscal resources are at best limited and the demand for nurses is high, the financial impact of the minimum nurse-to-patient ratios upon hospital costs in the state of California must be examined. Use of a nurse-to-patient ratio is a staffing strategy that determines a set number of patients that one nurse can care for in a given time frame. The use of mandated minimum nurse-to-patient ratios has been one of many proposals to improve the working conditions of nurses and patient outcomes.

While the concept of mandating minimum nurse-to-patient staffing ratios is not foreign to the hospital industry, the numbers that comprise the ideal nurse-to-patient ratio are elusive. Labor unions throughout the country have been negotiating contracts with nurse-to-patient ceilings for a number of years (American Federation of Teachers [AFT], 2001). The state of California implemented minimum nurse-to-patient staffing ratios in 2004 after intense deliberation by nurses, hospital executives, and California Department of Health officials (Larkin, 2007). It remains the only state in the United States (U.S.) with mandated nurse-to-patient ratios.

There was little empirical research available for California regulators to use when determining the optimal number of nurses to patients for quality care, safety to nurses and patients, or to link the costs of the staffing to any benefits provided by the ratios. The ratios were finally established using a compromise of the numbers proposed by the
professional nursing organizations, the collective bargaining units representing nurses and the health care executive organizations as well as from the conclusions drawn from the California Department of Health Services after conducting their own interviews and assessments (Gordon, Buchanan & Bretherton, 2008, Larkin, 2007; Spetz, 2005). While Clarke (2007) has demonstrated some relationship between the number of nurses caring for patients and the number of negative patient events; others (Burnes-Bolton, Aydin, Donaldson, Brown, Sandhu et al., 2007) have demonstrated that the ratios have had no significant impact on patient outcomes or safety issues.

No studies have been published to date linking the costs of the staffing ratios to any potential benefits of the ratios. The largest single expense in any hospital’s budget is the cost of nurse staffing (Bond, Raehl, Pitterle, & Franke, 1999). While an increase in the number of nurses is a big expense, the costs of caring for patients should decrease due to the increased nursing care provided. There is no literature that demonstrates the impact of the mandated staffing ratios on hospital expenses.

Statement of Purpose

The purpose of this study was to compare and contrast the fiscal impact of the nurse-to-patient ratios on hospital costs before and after the statewide implementation of the mandated nurse-to-patient ratios in California. Mandating minimum nurse-to-patient ratios is being considered in states across the country as an answer to the nursing shortage (Larkin, 2007). The results of this study will provide health care executives and policy
makers with the financial information needed to assist in decision making regarding the mandated nurse-to-patient staffing ratios.

Theoretical Framework

The use of mandated nurse-to-patient staffing ratios is more than a human resources issue. It is a patient safety issue and has become a political issue in the state of California. The conceptual model proposed by Bolman and Deal (2003) in their text *Reframing Organizations* is used to explore the topic of mandated nurse-to-patient ratios in California hospitals.

Bolman and Deal (2003) present a four-frame model to view the organization. The four frames: Structural, human resources, politica, and symbolic are used to provide the user with four different views of an organization. The frames may be used individually or blended together to improve one’s understanding of an organization. Bolman and Deal’s (2003) model views organizations as being combinations of complexity, surprise, deception and ambiguity. It suggests there is more than one way to respond to any organizational problem. Examining an organization through the four frames lends a clear analysis of its issues, strengths and weaknesses.

The structural frame (Bolman & Deal, 2003) examines an organization’s environment and technology. It emphasizes the formal relationships, specialized roles and goals of an organization. The structural framework can either enhance or restrain what can be accomplished within an organization. This frame is used to examine role patterns and relationships that result in the accomplishment of organizational goals.
Six assumptions form the underpinning of the structural frame (Table 1). Overlooking the structural frame of an organization results in the misdirection of resources and energy within that organization and may prevent achievement of goals.

Table 1

Assumptions of the Structural Frame

1. Organizations exist to achieve established goals and objectives.
2. Organizations increase efficiency and enhance performance through specializations and division of labor.
3. Appropriate forms of coordination and control ensure that diverse efforts of individuals and units mesh.
4. Organizations work best when rationality prevails over personal preferences and extraneous pressures.
5. Structures must be designed to fit an organization’s circumstances (including its goals, technology, and environment.
6. Problems and performance gaps arise from structural deficiencies and can be remedied through analysis and restructuring.


The human resource frame examines the relationships between the organization and its people. The skills, attitudes, energy, and commitment of the people are considered to be the critical resources that will either yield success for an organization or result in its demise (Bolman & Deal, 2003). The needs of the organization’s people as well as the culture and philosophy of the organization itself are examined for gaps in this frame. There are 4 underpinnings (Table 2) that are used to form this frame.
Assumptions of the Human Resource Frame

1. Organizations exist to serve human needs rather than the reverse.
2. Organizations need ideas, energy, and talent; people need careers, salaries, and opportunities.
3. When the fit between the individual and system is poor, one or both suffer. Individuals are exploited or exploit the organization – or both become victims.
4. A good fit benefits both. Individuals find meaningful and satisfying work, and organizations get the talent and energy they need to succeed.


The political frame presents an organization as being a coalition of interests. Bolman and Deal (2003) explain that organizational goals, structure, and policies result from bargaining and negotiation among various interest groups and members of the various groups feel a constant struggle for power. The power struggle frequently results in organizational conflict and competition for scarce organizational resources. Five assumptions provide the underpinning for the political frame (Table 3).

The fourth and final frame of Bolman and Deal’s model (2003) is the symbolic frame. This frame is used to interpret meanings behind the symbolism and experiences that make up the culture of an organization. Every organization develops rituals, myths, symbols, and ceremonies that impact the organization in various ways. These traditions impact the organizational dynamics at all levels and can be oppressing or affirming. There are six assumptions that drive the symbolic frame (Table 4).
Table 3

*Assumptions of the Political Frame*

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<tr>
<td>1.</td>
<td>Organizations are coalitions of diverse individuals and interest groups.</td>
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<tr>
<td>2.</td>
<td>There are enduring differences among coalition members in values, beliefs, information, interests, and perceptions of reality.</td>
</tr>
<tr>
<td>3.</td>
<td>Most important decisions involve allocating scarce resources – who gets what.</td>
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<tr>
<td>4.</td>
<td>Scarce resources and enduring differences make conflict central to organizational dynamic and underline power as the most important asset.</td>
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<tr>
<td>5.</td>
<td>Goals and decisions emerge from bargaining, negotiations and jockeying for position among competing stakeholders.</td>
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Table 4

*Assumptions of the Symbolic Frame*

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<tr>
<td>1.</td>
<td>What is most important is not what happened but what it means.</td>
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<td>2.</td>
<td>Activity and meaning are loosely coupled; events have multiple meanings because people interpret experience differently.</td>
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<tr>
<td>3.</td>
<td>In the face of widespread uncertainty and ambiguity, people create symbols to resolve confusion, increase predictability, find direction and anchor hope and faith.</td>
</tr>
<tr>
<td>4.</td>
<td>Many events and processes are more important for what is expressed than what is produced. They form a cultural tapestry of secular myths, heroes and heroines, rituals, ceremonies, and stories that help people find purpose and passion in their personal and work lives.</td>
</tr>
<tr>
<td>5.</td>
<td>Culture is the glue that holds an organization together and unites people around shared values and beliefs.</td>
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Organizations are stages for concurrent events that are interpreted in a variety of ways. Any one of these events can be framed in many ways and serve multiple purposes. In any given time or situation, one frame may be more helpful than others (Bolman &
Deal, 2003). Use of the model allows one to view the organization from various perspectives and assists with analysis of organizational issues.

The model developed by Bolman and Deal can be used to examine the California mandated minimum nurse to patient staffing ratios. All four frames can be used to examine the staffing crisis in hospitals across the United States; however, the structural frame is the one frame that best demonstrates the impact of state legislated staffing ratio. Applying the model, the hospital is the organization that is influenced by the four frames. The hospital is complex due to its volume of people, number of departments, ever increasing and changing technology and the ever-changing environment in which it operates. As with any organization, the solution to yesterday’s problem often creates future impediments to getting anything done and ultimately creates new possibilities for disaster (Bolman & Deal, 2003).

The structural frame impacts the effectiveness and goals of an organization. The structural frame involves the division of work within an organization and how that work is accomplished to meet the goals and objectives in an organization (Bolman & Deal, 2003). Nurses provide the majority of patient care in the hospital, and it is reflected in the literature that the number of nurses impacts patient outcomes. The nurses work in the hospitals forward the goals of the hospital in provision of quality care during the diagnosis, intervention, and evaluation of treatment for ill patients. The hospitals’ specific and measurable goals can include but are not limited to length of stay, patient disposition upon discharge and total costs/charges incurred per patient stay. The
mandated nurse staffing ratios may impact the fiscal outcomes for California hospitals after the implementation of the mandated nurse staffing ratios.

Background

The U.S. hospital system has endured a dynamic cycle of change since the implementation of the Prospective Payment System in the early 1980s. The pressures of managed care spending reforms, the Omnibus Balanced Budget Act of 1997, and advances in technology have forced the restructuring, reduction, and reorientation of the staff and management working within this industry (Dunham-Taylor & Pinczuk, 2006). Traditionally, many families have looked to a hospital as a safe haven for loved ones needing comfort and nursing care during illnesses, when giving birth, and when dying (Dunham-Taylor & Pinczuk). Patients come to the hospital for nursing care as evidenced by the fact that every hospitalized patient is assigned to at least one nurse 24 hours a day, seven days a week while in the hospital. This 24 hour direct accountability for patient care has not been assumed by any other health care profession (Welton, Fischer, DeGrace & Zone-Smith, 2006). Numerous studies have associated positive patient outcomes and a reduction in the number of adverse patient outcomes to the care provided to patients by hospital nurses and the number of patients care for by a single hospital nurse (Aiken, Clarke, Sloane, Sochalski & Silber, 2002; Aiken, Smith & Lake, 1994; Huebler, Christian & Marcella, 1980; Kohn, Corrigan & Donaldson, 2000; Kovener & Gergen, 1998; Needleman, Buerhaus, Mattke, Stewart & Zelevinsky, 2002; and Wunderlich, Sloan & Davis, 1996).

As a society prior to 1980, we felt assured that the needs of our family members were being met while they were hospitalized; but the major reimbursement shift in the hospital industry forced us to question the welfare of the hospitalized patient. The
Institutes of Medicine ([IOM] Kohn, Corrigan & Donaldson, 2000) estimated the deaths of 44,000 hospitalized patients annually due to medical errors and brought to the forefront of the hospital industry the need for reform. Concerns about patient safety and outcomes abound today because of the ever-increasing demands for nurses (Clarke, 2007; Institutes of Medicine, 2004; Sugrue, 2005; White, 2002).

The fragmentation, lack of coordination and integration of health care, and its impact upon overall patient and staff safety evidenced within the system has been the focus of governmental and private studies over the past decade (Bleich, Hewlett, Santos, Rice, Cox, & Richmeier, 2003). Wunderlich, Sloan, and Davis (1996) highlighted the changes in the health care system that contributed to changes in staffing patterns and the supply and demand issues related to the nursing market. Kohn, Corrigan, and Donaldson (2000) focused on the error-laden hospital system and the etiologies behind the numerous errors. On the front page of the Chicago Tribune on September 10, 2000, the main headline read: “Nursing Mistakes Kill, Injure Thousands” (Berens). In 2001, the U.S. General Accounting Office (GAO) released a report which details the existing nurse workforce and the multiple reasons for its shrinkage. These reports resulted in the rallying of health care professionals and the public to call for standards to improve safety within the hospital. Among the numerous safety initiatives now being addressed, the call to ensure adequate nurse staffing in the nation’s hospitals has received enormous attention (Clarke, 2007).

The State of California demonstrated its leadership in addressing nurse staffing in hospitals. In 1996, the Registered Nurse (RN) - to population employment figures showed one RN for every 146.5 citizens, one of the lowest ratios in the nation (U.S. General Accounting Office, 2001). In 1997, the California Department of Health Services (DHS) developed regulations requiring staffing to fluctuate based upon the
amount and type of nursing care needed by particular patients on any given hospital unit (Senate Rules Committee, 1999). The mandated use of a patient acuity system and mandated nurse-to-patient ratios for high-risk patient care areas including the Intensive Care Units, Surgery and Post–Anesthesia Care Units, Labor and Delivery, Mother/Baby and Nursery Units, and the Emergency Room were the result of this legislation. In 1998, the California Nurses Association (CNA) and the Service Employees International Union (SEIU) Nurses Alliance once again began to lobby for legislation to mandate minimum nurse-to-patient staffing ratios (Larkin, 2007). This attempt to legislate staffing ratios came after 10 years of unsuccessful lobbying to influence staffing laws in the state. The outcome of this lobbying led to California being the first state in the U.S. to mandate minimum nurse-to-patient staffing ratios for all types of patient care units (AHA News, 1999). Assembly Bill 394 was signed into effect in 1999 (California State Assembly, 1999). The legislation did not prescribe specific staffing ratios, but it did charge the California DHS to work with all stakeholders to determine the appropriate ratios. After nearly three years of argument, in January 2002 the California DHS proposed minimum staffing ratios for public comment (Russell, 2002). Consensus on the ratios was finally achieved in 2003 with the partial implementation of the ratios occurring statewide on January 1, 2004 – one year after the targeted implementation date. Further refinements of the prescribed ratios were implemented on January 1, 2005 and on January 1, 2008 (California Nurses Association/National Nurses Organizing Committee [CNA/NNOC], 2008a).
California politicians and health care consumers are relying upon minimum staffing ratios to improve the nurse-staffing situation in their hospitals. The fiscal implications of this plan are far-reaching with an initial estimate of an additional 5,000 nurses needed and it is estimated by various sources to cost between $60 million and $137 million a year to implement the law (California Health Care Foundation, 2002; Russell, 2002). Similar legislation is being considered in at least 25 other states in this country (Sochalski, Konetzka, Zhu, & Volpp, 2008).

Nurse staffing in hospitals remains a controversial issue (Larkin, 2007). People in favor of government regulation suggest that such mandates will improve working environments for nurses and result in improved patient outcomes. The American Nurses Association (ANA) suggests that there is not enough empirical evidence to develop reliable nurse-to-patient staffing ratios (ANA, 1996). The IOM reported there was insufficient data to support specific nurse staffing criteria (Kohn, Corrigan, & Donaldson, 1999). Opponents to the mandated staffing ratios cite the increased costs and loss of flexibility as an access to care issue (Kovner & Heinrich, 2000). Opponents of mandated nurse staffing ratios believe that such laws will only serve to increase costs and limit access to care in a system already laden with problems (Kovner & Heinrich). Over the years since the implementation of the mandated nurse-to-patient staffing ratios in California, there is no apparent change in nurse-sensitive outcomes to warrant the prescription of specific ratios. In 2007, Burnes-Bolton, Aydin, Donaldson, Brown, Sandhu et al. also suggested not enough evidence was found in the research to support the development of specific nurse staffing criteria. Both the ANA and the IOM suggest that
adequate staffing is a critical component in the provision of quality health care, but neither offers a prescription. In 2007, three years after the implementation of the mandated nurse-to-patient ratios, there remains little evidence of quality improvement related to the intervention (Larkin).

The nursing literature suggests an association between nurse staffing and patient outcomes. In 2000, the ANA outlined nursing-sensitive patient outcomes. While the body of empirical evidence that nurse staffing levels specifically impact quality care and patient outcomes in hospitals; it continues to fall short of providing specific staffing prescriptions (Clarke, 2007). In light of declining financial resources and the nursing shortage in the United States, further research needs to be conducted examining the impact of the existing nurse-to-patient ratios in California before the same model is adopted in other states.

Study Aim

The aim of this comparative longitudinal study is to examine the impact of changes on nursing costs expressed as a percentage of hospital operating costs from before the staffing ratios in California were implemented (2002) and after the staffing ratios were implemented (2006).
Significance of the Study

The California Department of Health Services estimated that the mandated nurse-to-patient ratios would cost California hospitals $422 million in 2004, $652 million in 2005 and $956 million in 2008 and annually thereafter given adequate recruiting sources (CHA, May 26, 2004). While these figures were estimated prior to the known fiscal impact of the ratios, no study has been published addressing the actual costs differences to the hospitals of the mandated nurse-to-patient ratios that were implemented in 2004. The mandate required revisions to the implemented ratios in January 2005 and January 2008 and additional nurses were to be included in the formulas (CNA/NNOC, 2008a). The impact of these costs should be revealed as other states consider introducing legislation to implement the staffing ratios as California (Conway et al., 2008). Examination of the percentage of overall hospital costs attributed to nursing will shed light on the actual fiscal impact of the mandated nurse-to-patient ratios in California and parties to legislation in other states will have more information upon which to base their decisions.

Research Questions

1. Is there a significant difference in the nursing costs attributed to RN staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation?

2. Is there a significant difference in the nursing costs attributed to Licensed Vocational Nurse (LVN) staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation?
3. Is there a significant difference in the overall nursing costs in California, as measured by a percentage of total hospital operating costs before the mandated ratio implementation compared to after the mandated ratio implementation?

4. Is there a significant difference in the composition of the hospital unit level support staff (aides/orderlies, technicians and clerical support) as measured by paid productive hours before the mandated ratio implementation compared to after the mandated ratio implementation?

Definition of Terms

Hospital Total Operating Expenses: Total costs incurred by revenue-producing and non-revenue producing cost centers for providing patient care at the hospital. This excludes non-operating expenses, provisions for income taxes and provisions for bad debt (State of California Office of Statewide Health Planning and Development, 2006).

Licensed Vocational Nurse (LVN): provide basic bedside nursing care to clients under the direction of a physician or registered nurse. The LVN utilizes scientific and technical expertise and manual skills. Duties within the scope of practice of an LVN typically include, but are not limited to, provision of basic hygienic and nursing care; measurement of vital signs; basic client assessment; documentation; performance of prescribed medical treatments; administration of prescribed medications; and, performance of non-medicated intravenous therapy and blood withdrawal (California Board of Vocational Nursing and Psychiatric Technicians, 2009).
Nursing Costs: Nursing costs will be extrapolated using the number of paid productive hours for RNs and LVNs for 2002 and 2006 from the OSHPD database multiplied by the U.S. Department of Labor’s Bureau of Labor Statistic’s Occupational Employment and Wage Estimates for RNs and LVNs in California for 2002 and 2006.

OSHPD: The California Office of Statewide Health Planning and Development (OSHPD) is one of 13 departments within the California Health and Human Services Agency. The OSHPD administers programs which endeavor to implement the vision of "Equitable Healthcare Accessibility for California" including the Healthcare Workforce Development Program and the Rural Health Policy Council. The OSHPD manages the collection of data for every hospital licensed in the State of California and publishes its database in the public domain.

Registered Nurse (RN): Registered Nurse is the designation given to an individual who is licensed to practice professional nursing, holds ultimate responsibility for direct and indirect nursing care, is a graduate of an approved school for professional nursing, and is currently licensed as a Registered Nurse in the state of California. Included in such responsibility is providing nursing care, health maintenance, teaching, counseling, planning and restoration for optimal functioning and comfort, of those they serve.

Assumptions

1. All California hospitals implemented the mandated nurse-to-patient ratio law.
2. Nursing costs, as calculated, are representative of the actual costs of nursing care.
3. The nursing costs are only influenced by the nurses actually providing patient care at
the unit level and do not include costs incurred by nurses in management, ambulatory
service areas or education roles.

Limitations

There are several potential limitations noted in this study. While data definitions are
clearly defined by the OSHPD, data obtained from its database are subject to error from
the self-reports filed by the individual hospitals. The nursing salaries will be estimated
using each hospital’s reported average wages for LVNs and RNs. There are no total
dollar amounts for wages of either LVNs or RNs included in the OSHPD. Findings
from this study may not be generalizable.
CHAPTER 2

REVIEW OF THE LITERATURE

An outcome is defined as an effect or consequence of an action (Morris, 1995). The Institutes of Medicine (IOM) states that outcome measures are the “end results of health care in terms of biologic, physiologic and functioning variables” (Wunderlich, Sloan, & Davis, 1996, p. 108). These types of outcomes are patient-related outcomes and can be positive or negative. They include the incidence of infections, development of decubiti, incident of falls or injury incurred while undergoing treatment in the hospital, or death. Administrative outcomes related to health care include the length of stay (LOS) in a facility and cost of the care provided. Data related to patient outcomes and administrative outcomes are collected by managed care companies, the Center for Medicare and Medicaid Services (CMS), the Joint Commission on Accreditation of Health Care Organizations (JCAHO), the American Hospital Association (AHA) and state health departments throughout the U.S. (AHA, 2002; JCAHO, 2003; and The Centers for Medicare and Medicaid Services, n.d.,). It can be reasoned that the administrative outcomes are directly dependent upon the patient-related outcomes. The administrative outcome measure LOS is the result of the patient’s response to the care provided while in the hospital. The longer a patient stays in the hospital, the more resource-intensive the patient’s stay becomes. As more resources are consumed by the patient, the cost of care rises. Complications that occur also increase the costs of care (Welton, Fischer, DeGrace, & Zone-Smith, 2006). Any change in patient-related
outcomes will influence the administrative outcomes for a facility. This review of the literature will focus on the influence of the nurse staffing on these outcomes.

This literature review will be completed in two sections. The first section will provide a historical perspective of the research associated with nurse staffing's impact on outcomes. This body of literature is pertinent to this study as it supports the need to provide adequate numbers of nurses to promote positive patient outcomes and decrease hospital costs. The second section of the literature review will provide a historical perspective of the development of nurse-to-patient ratios and the mandated nurse-to-patient ratios in California. The selection process of items for inclusion was conducted through the use of computerized data bases including *Lexus Nexus, EbscoHost, Ovid,* and *MEDLINE.* The computerized search engine *Google* (www.google.com) was also used.

**Nurse Staffing's Impact on Outcomes**

The empirical connection between nursing and any type of outcomes was very limited in the health care literature before 1980. Huebler, Christian, and Marcella (1980) published a report on a quality assurance effort at a Veteran's Administration hospital in Georgia. In their efforts to improve quality and decrease the average length of stay in this facility, three patient care units were closed and the staff re-assigned to other units thus increasing the nurse-to-patient ratio. A decrease of eight days in the LOS average was noted after this change. This report did not attribute the decrease LOS to nursing per se, just to staff (physician, nurses, and support staff) who care for patients.
The first report found to address the role of nursing in the incidence of quality outcomes was in 1987. Wan and Shukla (1987) examined reports from 45 U.S. community hospitals for the number of errors in medication, errors in intravenous (IV) fluid administration, patient falls, patient injuries, and inappropriate diagnostic and therapeutic interventions were used as outcome measures. Using multiple regression, significant correlations \((p < .001)\) among three quality of care indicators (medication errors, IV administration errors, and testing/treatment errors) and strong correlations between patient falls and patient injuries were cited \((p < .05)\); however there was no apparent relationship found between these outcomes and nurse staffing. Nursing factors, the hospital's physical design and patient characteristics did not account for the variation in incident rates. Nursing staff mix, nursing delivery model, and nursing resources consumed were not significantly related to the quality of outcomes.

In 1994, Aiken, Smith, and Lake published a study where 39 Magnet hospitals and 195 non-Magnet hospitals, each with over 100 Medicare discharges, were analyzed for differences in predicted mortality using multivariate matched sampling. After adjusting for differences in severity of illness, they reported that the Magnet hospitals had a 4.6% lower mortality rate \((p = 0.026)\) than the non-Magnet facilities. This translated to 0.9 to 0.94 fewer patient deaths per 1,000 discharges (CI [95%]). It was not clear if these results were a direct relation to nurse staffing differences or other Magnet attributes.

That same year, Shamian, Hagen, Hu, and Fogerty (1994) used regression analysis, ANOVA, and descriptive statistics to examine the relationship between length of stay (LOS) and number of hours of nursing care provided per patient day (HPPD).
Data were collected from 1,733 nursing units covering 11 clinical specialty areas from 58 U.S. hospitals. The GRASP® workload measurement system and data from the National Comprehensive Database for Nursing Resource Consumption were used. These data reflected average census, what patients required in nursing resource consumption, how the units were actually staffed, and the worked and paid nursing hours. Additional data included the LOS, average patient age, and skill mix percentages. Ten of the clinical specialty areas showed a statistically significant relationship \( (p < .001) \) between HPPD and LOS. This was an inverse relationship meaning that HPPD increased as a function of decreases in LOS. Reduction of LOS by one day is not equal to an average cost per day savings. The patient that is admitted as a result of the saved day requires more nursing care than the patient that was discharged. This was the first published study to suggest that nursing costs did not demonstrate a cost savings when patient LOS was reduced.

Taunton, Kleinbeck, Stafford, Woods, and Bott (1994) studied associations between patient outcomes and registered nurse (RN) staff absenteeism, separation from the work unit, and nurse workload. Correlational design was employed to determine that nosocomial infections and bloodstream infections correlated positively \( (p < .01) \) with nurse absenteeism. No other significant relationships were found.

In 1995, the American Nurses Association (ANA) published its *Nursing Care Report Card for Acute Care*. A direct result of the ANA Safety and Quality Initiative, literature review, and expert opinion were used to formulate the 21 indicators found to be nurse-sensitive for measurement nationwide in Magnet hospitals and other hospitals
wishing to monitor nursing performance. This was the first use of the term "nursing sensitive indicator" found in the literature.

The IOM released *Nurse Staffing in Hospitals and Nursing Homes: Is It Adequate?* in 1996 (Wunderlich, Sloan, & Davis). A 16 member committee comprised of a variety of nurse experts, health care industry experts, and health care consultants worked to determine whether the quality of care in hospitals had deteriorated and whether empirical evidence links between the number of nursing personnel and the quality of care existed in hospitals. Qualitative data from various nursing personnel groups, nursing organizations, nursing education organizations, and organizations representing the facilities that use nursing services were used to determine opinion and expert opinion. Descriptive statistics from the AHA’s Annual Hospital Survey, the Bureau of Labor Statistics and the Public Health Service data bases were also used, and site visits to various facilities in four regions of the U.S were conducted. There was little empirical evidence linking structural variables (number of nursing staff, patient staffing ratios, and procedures) to good or bad outcomes from care. The actual statistical methods used to analyze these data were not disclosed.

A retrospective epidemiological study published by Archibald, Manning, Bell, Bannerjie, and Jarvis (1997) explored the relationship between nurse staffing, overcrowding and nosocomial infection rates in a pediatric cardiac intensive care unit. Data were obtained from hospital microbiology records, infection control records, patient records, and hospital administrative records. The total number of hours worked by the unit nurses each month was stratified by level of training and included overtime. The
monthly infection rate and the monthly nursing hours per patient day were calculated and explored to identify correlation. A statistically significant inverse linear relationship was found between the nursing hours per patient day and the infection rate \((r = -.77, p = 0.03)\). There was a decrease of nearly two infections per 1000 patient days for each unit increase in the nursing hours per patient day. The major limitation in this study was the lack of data on exposure of these patients to other health care workers.

Melberg (1997) examined the relationships between skill mix and LOS, and salary costs and FTEs from five teaching hospitals in a single healthcare system to determine the effects of a changing nursing personnel skill mix over the 1994 to 1995 fiscal years. Skill mix refers to the various types of nursing staff by job classification necessary to care for the patient population being served (Dunham-Taylor & Pinczuk, 2006). Using descriptive statistics and correlation, these results suggested that there was no correlation between the number of FTEs per 100 occupied beds and RN mix, or the average LOS decreased with an increased percentage of RN mix. Limitations of this study include the lack of report of statistical analysis values and the unknown generalizability.

Blegen, Goode, and Reed (1998) analyzed data from an 880 bed medical center in the Midwestern U.S to describe the relationships among total hours of nursing care, RN skill mix, and adverse patient outcomes. Using multivariate analysis while controlling for patient acuity, these results suggested that nursing care units with higher RN staff mix had lower rates of medication errors ([Beta] = -.312, \(p<.10\)), skin breakdown ([Beta] = .485, \(p<.05\)), patient/family complaints ([Beta] = -.312, \(p<.10\)), infections and death.
Generalizability of these results to all types of hospitals is problematic. There were also limitations as some of these data were derived from incident reports within this hospital and relying on this as the sole source for information on medication errors and falls is problematic (Blegen, Goode, & Reed, p. 50).

Kovner and Gergen (1998) studied 1993 discharge data of patients over age 18 years obtained from 589 acute care hospitals in 10 states to examine the relationship between nurse staffing and selected adverse events thought to be sensitive to nursing care. The hospital level data were then matched to data from the AHA’s Annual Hospital report for the same year. A statistically significant inverse relationship was found between the FTE RNs per adjusted inpatient day and the incidence of urinary tract infections (UTIs) after major surgery ($p < .001$) and a similar statistically significant inverse relationship was found between the FTE RNs per adjusted inpatient day and the incidence of postoperative pneumonia ($p < .001$). Additional statistically significant inverse relationships were found between the FTE RNs per adjusted inpatient day and the incidence of post-operative thrombosis ($p < .01$) and the incidence of post-operative pulmonary compromise ($p < .05$). The matching of the data obtained from these hospitals with that from the AHA data base increases the generalizability of these results.

In 1999, Bond, Raehl, Pitterle, and Franke examined data from the 1992 AHA Annual Survey database and the 1992 Medicare Hospital Mortality Information database for an association between mortality rates and hospital characteristics and staffing levels for 14 categories of hospital personnel in 3,763 U.S. hospitals. Through the use of multiple regression, it was determined that as the number of medical residents, registered
nurses, registered pharmacists, medical technologists, and total hospital personnel per occupied bed increased, the mortality rates decreased. As the number of administrators and licensed practical/vocational nurses increased per occupied bed, mortality rates increased. The analysis model only accounted for 17.26% of the total explainable variance related to mortality rates. The authors cite changes in the hospital industry between the year 1992 and year 1998 may greatly decrease the generalizability of the results.

Lichtig, Knauf, and Millholland (1999) conducted a study to test the relationships between patient outcome indicators and nurse staffing using publicly available state data bases from New York and California. Using regression analysis techniques, it was determined that both higher nurse staffing and higher proportion of RNs were significantly related to shorter LOS ($p < .01$). Lower adverse outcome rates (decubiti, pneumonia rates, post-operative infection rates and UTI rates) were related to a higher proportion of RN staff ($p < .01$).

Pronovost, Jenckes, Dorman, Garrett, Breslow et al., (1999) conducted an observational study to examine if a relationship between the organizational characteristics of intensive care units (ICUs) were related to clinical and fiscal outcomes for patients who are cared for in an ICU after abdominal aortic surgery. Data from 46 Maryland hospitals plus surveys of the ICU directors of these hospitals were included in the analysis. Having an ICU nurse-to-patient ratio of less than one nurse to two patients during the evening shift was related to an increased hospital LOS (Mean increase 17%, 95% CI [1 – 35]). Having an ICU nurse-to-patient ratio of less than 1 nurse to 2 patients
during the day shift was associated with an increased number of patient days in the ICU (Mean increase 49%, 95% CI [17 – 91]). Several limitations were noted with this study. The ICU directors responding to the survey were not responsible for the nurse staffing and the data they provided about nurse staffing ratios and patterns may not have been accurate. When adjusting for severity of illness, the researchers did not use a reliable adjusting measurement and instead relied on their judgment of the patients’ complications cited in the hospital databases.

In 2000, a series of articles in the Chicago Tribune (Berens) was the first to publicly correlate nursing and patient outcomes in the non-professional literature. These articles directly connected problems with nursing staffing to mistakes and deaths in the nation’s hospitals. Because of the wide syndication of the series, this served as the public’s first acknowledgement of nursing’s staffing issues due to shortages and system problems.

The IOM released its landmark document To Err is Human: Building a Safer Health System (Kohn, Corrigan, & Donaldson, 2000) as a part of its Quality in Health Care in America project initiated in 1998. This report was prepared as a synthesis of the health care literature with recommendations proposed for action to improve patient safety in health care settings. It attributed the deaths of 44,000 Americans annually as a result of medical errors, but placed blame for these adverse events on all aspects and participants in the health care system. While nursing was identified as part of the problem, the report fell short of laying blame on the nurses. After the release of the
IOM’s document on patient safety, the number of reports addressing nursing’s impact on patient outcomes increased.

Burnes-Bolton, Jones, Ayden, Donaldson, Brown, et al. (2001) collected data on staffing, patient falls, and decubiti from 38 hospitals in California. They used descriptive analysis to examine relationships between staffing ratios in the hospitals and the incidence of falls or decubiti development. No relationships between the number of nurses and the incidence of falls or decubiti were found. Sovie and Jawad published the results of their study “Hospital restructuring and its impact on outcomes: Nurse staffing regulations are premature” in 2001. Using regression analysis techniques these researchers examined the effects of nursing structure on patient falls, decubiti formation, UTIs, and patient satisfaction scores in 29 university teaching hospitals. Increased nursing hours worked per patient day were associated with lower fall rates and lower incidence of UTI \( (p < .05) \). Higher levels of patient satisfaction were associated with adequate pain management \( (p < .05) \).

In 2002, there was an increase in the number of studies published addressing the impact of nurses on outcomes. Aiken, Clarke, Sloane, Sochalski, and Silber surveyed 10,184 nurses and examined 232,342 medical records of post-operative patients (general surgery, orthopedic surgery, and vascular surgery) discharged from 168 hospitals in Pennsylvania between April 1, 1998 and November 30, 1999. Using a cross-sectional analysis, these researchers examined the data for an association between the nurse-to-patient ratio, patient mortality, and failure to rescue. Results suggested that each additional patient per nurse was associated with a 7% \( (OR \, 1.07; \, 95\% \, CI \, [1.02 – 1.12]) \)
increase in the likelihood of dying within 30 days of admission. There was also a 7\% (OR, 1.07; 95\% CI [1.02 – 1.11]) increase in the odds of failure to rescue with each additional patient per nurse. In this study, a hospital with an average ratio of one nurse to eight patients had a 31\% higher mortality rate than a hospital with a one nurse to four patient ratio.

Barkell, Killinger, and Schultz (2002) published a descriptive study analyzing the impact of a change in the nurse staffing model on the LOS, variable cost, patient satisfaction, incidence of UTI, incidence of pneumonia and pain management in bowel resection patients. The staffing model change entailed the decrease in total care staff on the unit, but more RN caregivers on the unit. Data were collected retrospectively from the medical records of 65 bowel resection patients cared for on the same nursing unit over the course of one year. Findings indicated significant differences in pain management between the two staffing models ($p < .01$) with the model using more RN caregivers resulting in better pain management. Other patient outcomes were comparable between the two models despite the decreasing total number of caregivers on the unit. The small sample size limits the generalizability of this study.

Using interviews of nurses and hospital executives and descriptive analysis of data from the JCAHO Sentinel Events Reports, Barnard (2002) determined that nurse staffing contributed to nearly a quarter of hospital incidents that kill or injure patients. Buerhaus, Needleman, Mattke, and Stewart (2002) published a literature review in *Health Affairs* confirming that findings from a growing number of studies have identified a relationship between hospital nurse staffing and adverse outcomes in the medical-surgical
patient population. The JCAHO published *Healthcare at the Crossroads: Strategies for Addressing the Evolving Nursing Crisis* in 2002. This whitepaper used descriptive statistics to report that nurse staffing levels have been a factor in 24% of the 1,609 sentinel events reported to the JCAHO as of March 2002.

Kovner, Jones, Zhan, Gergen, and Basu (2002) examined data from the National Inpatient Sample (NIS) data base from 1990 through 1996 for the impact of nurse staffing on adverse events that were thought to be sensitive to nursing care. Using a cross-sectional descriptive study design, multivariate modeling using Poisson regression analysis techniques was employed. Results indicated an inverse relationship between RN hours per adjusted inpatient day and pneumonia \((p < 0.05)\) for patients who were either emergency or routine admissions.

Langemo, Anderson, and Volden (2002) conducted a pilot study using the ANA report card indicators. Patient outcome data included patient falls and skin integrity. The data were collected from three rural and three urban hospitals in North Dakota. Findings demonstrated that the longer the patient stayed in the hospital, the higher the prevalence rate and the number of decubiti \((r = 0.59, p < .05)\). Findings also suggested that the higher the percentage of unlicensed assistive personnel used to care for patients, the higher the number of patient falls \((r = 0.75, p < .05)\).

Needleman, Buerhaus, Mattke, Stewart, and Zelevinsky (2002) examined the relationship between the amount of care provided by nurses in the hospital and patient outcomes. Descriptive statistics and regression analysis were used to analyze administrative data for 799 hospitals in 11 states covering 5,075,969 medical discharges.
and 1,104,659 surgical discharges. In the medical patient population, an association was found between RN staffing and six outcomes. Higher RN staffing was associated with a shorter LOS (incident rate ratio = -1.12; 95% CI [2.0 - 0.24], *p* = .03), lower incidence of urinary tract infection (incident rate ratio 0.48; 95% CI [0.38 - 0.61], *p* < .001), lower incidence of upper gastrointestinal bleeds (incident ratio rate = 0.68, 95% CI [0.45 - 0.9], *p* = .03), a lower incidence of hospital acquired pneumonia (incident rate ratio 0.59; 95% CI [0.44 - 0.80], *p* = .001), a lower incidence of cardiac arrest and shock (incident rate ratio = 0.46; 95% CI [0.27 - 0.82], *p* = .007), and a lower failure to rescue rate (incident rate ratio = 0.81; 95% CI [0.66 - 1.0], *p* = .05). In the surgical patient population, higher nurse staffing was associated with a lower incidence of urinary tract infections (incident rate ratio 0.67; 95% CI [0.46 - 0.98], *p* = .04) and a lower failure to rescue rate (incident rate ratio 0.73, 95% CI [0.49 - 1.09], *p* = 0.12). It is noted that there are fewer patient outcomes associated with nurse staffing in the surgical patient population than the medical patient population and the authors attributed that difference to the overall perception that the surgical patient is a healthier patient than the medical patient in the hospital. A cited limitation of this study was the difficulty abstracting data from patient charts when building the data base, thus resulting in a possible under-reporting of adverse events.

An epidemiological study published by Stegenga, Bell, and Matlow (2002) investigated the relationship between nurse staffing and the incidence of gastrointestinal infections on a pediatrics ward in an Ontario Canada hospital. The study examined 2,929 admissions to a pediatrics ward for a total of 13,606 patient days. During this study
period, 43 gastrointestinal infections were detected in 37 patients. Results indicated that
the monthly rate of gastrointestinal infection was significantly correlated with the
monthly nurse-to-patient ratio ($r = 0.56, p < 0.05$). A significant relationship was also
noted between the pre-infection nurse-to-patient ratio and the non-pre-infection nurse-to-
patient ratio ($p < 0.05$). Limitations of this study, as cited by the authors, included the use
of hours per patient day that included education and training hours as well as the nurse-
to-patient data used from unit records were incomplete.

Tourangeau, Giovannetti, Tu, and Wood (2002) conducted a retrospective study
of patients in 75 Canadian acute care hospitals with discharge diagnoses of an acute
myocardial infarction (AMI), a cerebrovascular accident (CVA), pneumonia, or
septicemia to examine the effects of nursing-related variables on 30 day mortality rates
for hospitalized patients. The records of 46,941 patients were analyzed. Findings
supported a relationship between lower 30 day mortality rate and three nurse-related
factors including a rich RN skill mix, nurse experience (as measured in years), and the
number of shifts of work missed.

Tucker (2002) examined the records of 13,515 neonates in 54 randomly selected
neonatal intensive care units (NICUs) in the United Kingdom to assess whether patient
volume, staffing levels, and nurse workload are associated with risk-adjusted outcomes of
infant mortality, cerebral damage, and nosocomial bacteremia. Regression analysis
suggested that risk-adjusted mortality and cerebral damage were unrelated to patient
volume or nurse staffing provisions ($p < .05$). It was noted that infant mortality was
increased with increased workloads of any type in the NICUs.
Whitman, Kim, Davidson, Wolf, and Yang (2002) employed correlation analysis to examine the relationships between nurse staffing and patient outcomes including central line blood associated infections, decubiti, patient falls, medication errors, and restraint use across a variety of specialty nursing units (cardiac and non-cardiac intensive care units) ICUs, cardiac and non-cardiac intermediate care, and medical-surgical care units. The sample included a total of 95 patient care units in 10 acute care hospitals. No significant relationships were found between staffing and the incidence of decubiti or central line blood infections ($p < .05$). Significant inverse relationships were discovered between nurse staffing and patient falls in the cardiac intermediate care unit ($r = -0.53, n = 18, p < 0.05$); medication errors in both the cardiac ($r = -0.55, n = 15, p < 0.05$) and non-cardiac ICUs ($r = -0.65, n = 12, p < 0.05$) and restraint use in the medical-surgical units ($r = -0.48, n = 12, p < .01$). These results suggest that there is a high degree of variability between types of nursing units when examining the impact of nurse staffing; however in this study, when a relationship was present, lower nurse staffing levels did result in higher rates of the adverse outcomes.

A 2002 study conducted by the research staff at Modern Healthcare used Solucient’s databases and the AHA’s Annual Survey to examine the impact of nurse staffing on hospital mortality rates. The variables examined included RN FTEs, bed counts, staffing mix, teaching hospital affiliation, and operational, fiscal and clinical statistics. Using multiple regression analysis, it was determined that low nurse staffing was a predictor of risk-adjusted mortality rates. Hospitals that had been awarded the
"Top 100 Hospitals" designation at least once had higher staffing levels and lower mortality rates than those hospitals that had not received that designation.

Studies on the impact of nurse staffing on patient outcomes continued to appear in the nursing and health care literature. Cho, Ketefian, Barkauskas, and Smith (2003) performed regression analysis to examine the impact of nurse staffing on the specific patient outcomes including patient falls, decubiti, adverse drug reactions, hospital acquired pneumonia, UTI, wound infection, and sepsis. The sample consisted of 232 acute care hospitals in California and involved 24,204 post-operative patients within 20 surgical DRG categories. Three statistically significant relationships between nurse staffing and patient outcomes were reported. The RN hours worked had a significant inverse relationship with the incidence of pneumonia (OR = 0.91; 95% CI [0.85 - 0.97], p < .01). The higher proportion of RNs had a significant inverse relationship with the incidence of pneumonia (OR = 0.37; 95% CI [0.15 - 0.91], p < .05). The total hours of nursing care provided demonstrated a positive relationship with the incidence of decubiti (OR 1.13; 95% CI [1.01 - 1.27], p < 0.05). This was an interesting finding in that the incidence of decubiti actually increased with the hours of nursing care provided. A major limitation of this study is the fact that the nurse staffing measurement was annualized and this did not account for seasonal staffing variations and variations of patient needs during periods of increased acuity.

Clarke and Aiken (2003) used data from the AHA Annual Survey and the Healthcare Utilization Project (HCUP) data base to examine the impact of nurse staffing on failure to rescue incidence. The researchers stated that each additional patient per
nurse was found to be associated with a 7% increase in the odds of failure to rescue.
Curtin (2003) published an integrated literature review of 41 articles dated from 1987 to 2003. She concluded that the research supports a direct and measurable impact of nurse staffing on patient outcomes, incidence of medication errors, LOS, and patient mortality. She further postulated that the literature is indicating that there is a consensus that supports a nurse-to-patient ratio ranging from 1:4 to 1:6 in most acute care settings and a nurse-to-patient ratio ranging from 1:1 to 1:2 in high acuity settings. It was also hypothesized that the ratios are not sufficient to stand alone and a nurse’s experience level and interactions between the nurse and other clinical providers must be considered.

Loan, Jennings, Brosch, Depaul, and Hildreth (2003) conducted a retrospective pilot study in a military hospital setting to examine the impact of nurse staffing on the incidence of decubiti and length of stay. The medical records of 872 patients were reviewed and daily staffing data from five patient care units were reviewed. Descriptive statistics and odds ratio analysis were performed and determined that the length of stay was twice as long for patients who developed decubiti when compared to those who were identified to be at risk but did not develop decubiti. No relationship was found between nurse staffing and the incidence of decubiti.

McCue, Harless, and Harless (2003) studied the impact of nurse staffing on the operating expenses and operating margin of the hospitals. Data from the years 1990 to 1995 in the HCUP database of 422 hospitals in 11 states plus data from the CMS database and the AHA’s Annual Survey were analyzed using a standard model of costs and profit. The operating margin ratio was used to determine that a 1% increase in RN FTEs
increased operating expenses by about 0.25%; however there was no significant effect on hospital profit margins. It was noted that higher levels of non-nurse staffing resulted in higher operating expenses and lower profits. Several limitations were noted. First, there was a change in the AHA database definition and data points in the five years from hospital unit RNs to total facility RNs. This may have misrepresented the numbers of RNs providing direct patient care in the later years of the period studied. Secondly, the lack of specific salary data for nursing care providers may have resulted in either an overestimate or underestimate of the associated costs.

McGillis-Hall, Doran, Baker, Pink, Sidani et al. (2003) conducted a study at the 19 teaching hospitals in Ontario Canada to evaluate the impact of different nurse staffing models on the patient outcomes of functional status, pain control, and patient satisfaction with nursing care. The sample was comprised of 1742 adult medical/surgical and 741 obstetrics patients in these hospitals. Both the Functional Index Measurement (FIM) tool and the SF-36 (acute form) were administered to the adult medical/surgical patients within 72 hours of admission and repeated five to seven days later and six weeks later. They were administered to the obstetrics patients within eight hours of admission, repeated five to seven days later and again six weeks later. The Brief Pain Inventory-Short Form (BPI-SF) was administered to all medical/surgical patients within the first 48 hours of admission, on discharge, and six weeks post-discharge. It was administered to the obstetrics patients eight hours after admission, repeated on discharge, and then six weeks post-discharge. The Patient Judgment of Hospital Quality Questionnaire (PJHQ) was administered to all patients the day before discharge. Descriptive statistics and
multilevel hierarchical linear modeling were employed to analyze the data. Findings indicated that a higher proportion of RNs was associated with better FIM scores and better social function scores at discharge ($p < .05$). Obstetric patients were more satisfied with their care on units where there was a higher proportion of RNs and RPNs ($p < .05$). The major limitation noted with this study was the potential for attrition due to the time commitment. This could have resulted in some types of patients not being represented thus limiting the generalizability of the results.

In a study by Potter, Barr, McSweeney, and Sledge (2003) patient falls and medication errors, inpatient self-reports of symptom management, self-care and health status, and post-discharge patient satisfaction in a 897 bed hospital in the Midwestern U.S. over a period of one year were investigated. The aim of this study was to investigate the correlation between nurse staffing and patient outcomes at the hospital unit level. Using a prospective correlational design and hierarchical multiple regressions, the authors concluded that with higher percentages of RN care hours provided, patients' health status and perceptions of self-care ability were greater and their perceived pain level was lower. There were no significant correlations between medication errors or patient falls and RN care hours.

Unruh (2003) utilized regression analysis techniques on data from Pennsylvania acute care hospitals to examine the relationship between licensed nursing staff and atelectasis, decubiti, patient falls, pneumonia, post-treatment infections, and UTIs. A greater incidence of nearly all of the adverse events ($p < .05$) occurred in hospitals with fewer licensed nurses and a greater incidence of decubiti and pneumonia ($p < .05$)
occurred in hospitals with a lower proportion of licensed nurses. In this study, no
distinction was made between RNs and licensed practical nurses.

A report published by Stanton for the Agency for Healthcare Research and
Quality (AHRQ) in 2004 suggested that most of the AHRQ-funded research completed
prior to the report had focused on adverse patient outcomes. Using a meta-analysis
approach, the Evidence-Based Practice Center (EPC) reviewed 26 studies on the
relationship between patient safety measures and nurse staffing levels. This review
concluded that higher rates of non-fatal adverse outcomes were associated with lower
nurse-to-patient ratios at both the hospital based level and the unit-based level. There
was no consistency to these data to suggest that lower staffing levels were associated with
a higher mortality rate. It was noted that each of the adverse events measured in the
AHRQ-funded studies (pneumonia, decubiti, UTI, wound infection, falls, sepsis, and
adverse drug reactions) resulted in increased costs to the hospitals.

Lang, Hodge, Olson, Romano, and Kravitz (2004) performed a systematic
literature review on the impact of nurse staffing on outcomes. After reviewing 43
articles, these authors concluded that the evidence suggested that lower failure to rescue
rates, lower inpatient mortality rates, and shorter lengths of inpatient hospital stays were
related to higher nurse staffing; yet found no evidence to support the use of specific
nurse-to-patient ratios. A noted limitation in this review was the lack of consistency of
the level (hospital verses unit level) of the data reported in the studies. Half of the studies
reported data at the hospital level, which may have skewed the analysis since hospital
level data would include the staffing numbers from the intensive care units that employ
different staffing patterns and have differing levels of patient acuity than other units in the hospital.

Estabrooks, Midodzi, Cummings, Ricker, and Giovannetti (2005) examined the data of 18,142 patients from 49 acute care hospitals in Alberta Canada to identify the relationship of nursing education and skill mix, continuity of care, and quality of work environment on 30-day mortality after adjusting for individual patient characteristics and institutional factors. After adjusting for patient characteristics and institutional factors (size, teaching status, and urban status), the odds ratios for the significant nursing characteristics that predict 30-day mortality were: greater nurse-physician relationships (OR = 0.74, 95% CI [0.68 - 0.91]); higher nurse education level (OR = 0.81, 95% CI [0.68 - 0.96]); and greater percentage of nurse caregivers (OR = 0.83, 95% CI [0.73 - 0.96]). These findings explained 36.9% of the variance in addition to the 44.2% of the variance explained by the hospital and patient characteristics. Several limitations to this study were outlined, which included data obtained only on patients with diagnoses of AMI, congestive heart disease, CVA, pneumonia, or chronic obstructive pulmonary disease. Patients with other diagnoses likely will have differing patient characteristics. Another limitation to this study may have been the criteria used to select the 49 hospitals. The chosen hospitals may have differing characteristics than other hospitals in Alberta. This limits the generalizability of this study.

Lankshear, Sheldon, and Maynard (2005) conducted a systematic review of the international literature focusing on nurse staffing and outcomes. These authors postulated that while there was a growing body of evidence suggesting a relationship
between higher nurse staffing and patient outcomes, the estimate of those effects was unreliable. These authors stated no studies were found that used rigorous research methodologies, and the 22 studies they included used secondary data analysis and cross-sectional designs. Many of the studies reviewed obtained data from the AHA Annual Survey database, which does not separate direct care nurses from indirect care nurses. Many of the studies utilized hospital-level data instead of unit-level data, which could have resulted in measurement error of nurse staffing thereby underestimating the effect of staffing.

The relationship between unplanned extubation in the pediatric unit and nurse staffing in a California hospital was studied by Marcin, Rutan, Rapetti, Brown, Rahnamayi et al. (2005). Using a matched, case-controlled design, these researchers explored the relationship between the years of pediatric intensive care unit experience of the nurse and the nurse-to-patient ratio to the unplanned extubation of patients under the age of 18 years. In the multivariate analysis, a nurse-to-patient ratio of 1:2, as compared with 1:1 was associated with unplanned extubation (OR = 2.99; 95% CI [1.14 – 7.86]; p = 0.04). The years of experience of the nurse were not associated with unplanned extubation. Several limitations impact the ability to generalize these results. Data were obtained at one healthcare facility thereby limiting the sample size. The experience levels of the nurses were obtained through the report of the unit's advanced practice nurse, which may not have been accurate.

In a 2006 article, Brooten and Youngblut operationalized the term “nurse dose” in relation to outcomes. After a brief literature review, they suggest decreasing health care
costs and improving patient outcomes is related to the proper "nurse dose". Nurse dose is defined as the number of nurses providing care, the education, and expertise of the nurses and the organizational and patient receptiveness to the nurses.

Needleman, Buerhaus, Stewart, Zelevinsky, and Mattke (2006) acknowledged the impact of increased costs on hospital care costs as the number of registered nurses providing care increases. They simulated options to examine this relationship that included increasing the proportion of hours of care provided by registered nurses to the 75th percentile of total care hours and increasing the proportion of hours of care provided by licensed nurses (both registered nurses and licensed practical nurses) to the 75th percentile of total care hours. They concluded that short-term cost savings of preventing adverse patient events exceed the costs of the nurse staffing increases. This increase was projected to be $242 million if the hospitals in the U.S. increased the proportion of RNs in the skill mix without changing the number of hours of patient care provided by licensed nurses. These authors also suggest that decreases in LOS associated with higher nurse staffing resulted in more than 90% of the projected cost savings. The findings of this study articulate to the cost effectiveness of a higher RN skill mix.

Seago, Williamson, and Atwood (2006) acknowledged that most of the evidence on nurse staffing and patient outcomes has been based on "negative" or adverse patient outcomes. In an attempt to examine a relationship between nurse staffing and "positive" outcomes, they compared data for three adult medical-surgical patients in one university hospital across a four year time span. Positive outcomes included patient satisfaction with pain management, patient satisfaction with physical care requests, patient
satisfaction with instruction, failure to rescue from medication errors, and failure to rescue from decubiti. This longitudinal study used secondary data analyses and a repeated measures design to examine these relationships. After controlling for patient acuity, the analysis suggested that as the total hours of care provided and a higher RN skill mix increased, the levels of patient satisfaction increased ($p < .01$). This finding suggested that both the RN skill mix and the total hours of patient care provided were important variables to increase patient satisfaction. Their examination of the failure to rescue for medication errors as related to nurse staffing demonstrated similar findings as earlier studies. As the RN skill mix decreased, the failure to rescue rate from medication errors increased – although this finding was not statistically significant ($p > 0.1$). There was an increase in the failure to rescue from decubiti as patient acuity increased, but no relationship was found between it and nurse staffing ($p > .01$). These authors concluded that more research on positive outcomes was warranted and that it may be necessary to vary staffing hours and staffing mix on the outcomes desired.

In a 2007 AHRQ report, Kane, Shamliyan, Mueller, Duval, and Wilt analyzed 94 observational studies from 1990 to 2006 in the U.S. and Canada which examined the relationship between nurse staffing and outcomes. Using meta-analysis these authors confirmed previous studies suggesting that increased hospital nurse staffing was associated with better care outcomes, but there was no evidence of a causal relationship. Evidence suggested that the surgical patient population was sensitive to nurse staffing. They suggested that hospitals making an investment in higher nurse staffing also make investments in other quality improvement strategies including attainment of Magnet
certification status. They suggested that it may be a combination of the overall commitment of the hospital to high quality patient care and effective nurse retention strategies that results in better outcomes both for the patient and for the hospital.

In their systematic review of the literature, Thungjaroenkul, Cummings, and Embleton (2007) identified a lack of consistency in definitions and measurement tools for LOS and costs. They concluded this lack of consistency makes it difficult to infer that nurse staffing has a definite impact on hospital costs and LOS. However, the evaluated evidence suggested that a reduction in the numbers of RNs could significantly decrease the quality of care and increase both the LOS and hospital costs.

Tourangeau, Doran, McGillis-Hall, Pallas, Pringle et al. (2006) explored the structures and processes of hospital care that influenced the 30 day mortality rate for acute medical patients. They proposed that the structures and processes of nursing care had a major impact on patient survival and mortality because nurses provide the majority of care to these hospitalized patients. Data from the Canada Discharge Abstract Database, the Ontario Nurse Survey and the Ontario Hospital reporting system for 2003 and survey data from 5,980 nurses employed in Ontario acute care hospitals were used to develop nursing indicators that were hypothesized to impact 30 day mortality. Multiple regression was used to analyze these variables. A higher proportion of RNs in the staff mix and the nurse dose (operationalized by the total number of inpatient clinical worked hours worked by all classes of nurses/ sum of weighted patient cases discharged per hospital) were both predictive of 30 day mortality \((r = -0.06, p = 0.049 \text{ and } r = 0.08, p = 0.024 \text{ respectively})\). An inverse relationship was found between the RN proportion in the
skill mix and the nurse dose \( r = -0.33, p = 0.004 \). This finding confirms the fact that in most hospitals, fiscal resources do not allow for both a high percentage of RN staff and a high number of other types of care staff. Using the regression coefficients, a 10% increase in the proportion of RNs was found to be associated with six less deaths for every 1000 discharged patients; a 10% increase in the proportion of nurses with baccalaureate preparation was associated with nine fewer deaths for every 1000 discharged patients; and a 10% increase in the nurse-reported adequacy of staffing and resources was associated with 17 fewer deaths for every 1000 discharged patients. These findings were consistent with the earlier reports in the literature (Aiken et al., 2002; Blegen, Goode and Reed, 1998; Needleman et al., 2002; and Tourangeau et al., 2002). While 45% of the variance was explained by the variables, 55% of the variance remained unexplained.

Dunton, Gajewski, Klaus, and Pierson (2007) utilized data from the National Database of Nursing Quality Indicators (NDNQI) to examine the role of nurses in preventing patient falls and decubiti. Data were obtained from 1,610 nursing units including general medical-surgical combination units, medical care units, surgical care units, critical care units, rehabilitation units, and step down units. Formal modeling using mixed linear models was used to determine relation between three hospital characteristics (number of staffed beds, teaching status, and Magnet hospitals), the six unit types and eight nursing workforce characteristics (total nursing hours per patient day, RN hours per patient day, skill mix, percent of total nursing hours supplied by agency staff, percent of RNs with a national certification, percent of RNs with a baccalaureate or higher degree,
years of experience in nursing, and mean job enjoyment scale score). These findings
determined that lower fall rates were associated with higher total nursing hours per
patient day, a higher percentage of care hours provided by RNs, and a higher percentage
of experienced RNs on the unit. Lower decubiti incidence was related to a higher
percentage of hours provided by RNs, a higher percentage of RNs on the unit, and
unexpectedly, to fewer total nursing hours per patient day. This unanticipated finding
was thought to be the result of inadequate risk adjustment. The findings did conclude
that a higher percentage of RNs hours provided by nurses with a minimum of 10 years of
experience would promote better patient outcomes related to fall and decubiti prevention.
The major limitation of this study is the NDNQI database. The NDNQI is comprised of
hospitals who volunteer to participate and participants tend to be larger, non-profit
facilities that are Magnet certified. This limits the generalizability of this study.

In their article entitled “Nurse staffing and adverse effects in hospitalized
children”, Mark, Harless, and Berman (2007) examined data from the California OSHPD
database for the years 1996 to 2001. Data from 3.65 million pediatric patients ranging
from 0 to 14 years of age discharged from 286 general and children’s hospitals were
analyzed for the effect of the numbers of RN- provided care on the mortality and
complication rates. Results from this study supported studies conducted in the adult
patient population (Kovner et al., 2002; Kovner & Gergen, 1998; Needleman et al., 2002)
including the finding that increased RN staffing was associated with a statistically
significant decrease in cardiopulmonary complications ($p < .001$), a decrease in
pneumonia ($p < .01$), and in septicemia ($p < .001$). Contrary to other findings in the
literature, there was no relationship found between the RN staffing and patient mortality or UTIs. Limitations of this study included the fact that this was the first study where the Medstat disease staging model was used as a risk adjustment tool in examining nurse staffing and patient outcomes.

Ridley (2008) studied the relationship between nurse education levels and patient safety outcomes through the use of an integrative literature review. Twenty-four studies were included. Results suggest that while skill mix and the number of RN care hours are associated with improved patient outcomes, evidence linking RN education level to patient outcomes is lacking.

The literature linking outcomes to nursing is abundant and continues to be a focused area of research. Additional research is identifying few new relationships. In most cases, the studies support the idea that nursing affects patient outcomes; however debate exists about what variables should be used as outcomes. Differences with nursing measurement exist including the use of hours per patient day, nurse-to-patient ratios, skill mix, the inclusion or exclusion of licensed practical/vocational nurses, and the use of nursing assistants and unlicensed assistive personnel to measure nursing. There is inconsistency in the settings where nursing is measured. Data are obtained from either a unit-based level or aggregate data from the hospital level. Some measure data from a single facility while others measure data that span great geographical regions. The multiple methods for data collection make analyses and comparing results difficult.

Despite these different approaches toward data collection and analyses it must be noted that in most cases, RN staffing levels are often linked in some way to patient
outcomes, LOS, and costs in acute care hospitals. What is unknown is the optimal number of nurses for each care situation to maximize the positive patient outcomes, lessen adverse patient events, and reduce hospital costs and LOS.

Nurse-to-Patient Staffing Ratios

The debate continues over the number of nurses needed to care for hospitalized patients and the methods used to determine staffing levels. Hospital executives continue to employ scientific management techniques and complicated formulas to develop patient classification systems that may or may not have the ability to predict staffing needs (Dunham-Taylor & Pinczuk, 2006). Nurses who provide direct patient care argue that their workload has become too demanding and exhausting and their patients are in jeopardy because there are simply not enough nurses to meet their needs (Carvouras, 2002).

The use of nurse-to-patient ratios for staffing decisions is not a new concept. Labor Unions have rallied to implement nurse-to-patient staffing ratios in hospitals across the country. Nurses are being organized throughout the U.S. by a host of members of the American Federation of Labor and Congress of Industrial Workers (AFL-CIO) including but not limited to the United American Nurses (UAN), California Nurses Association (CNA), Service Employees International Union (SEIU), American Federation of Teachers – Healthcare Division (AFT), Teamsters, American Federation of County, State and Municipal Employees (AFSCME), Communication Workers of America (CWA) and the United Automobile and Aerospace Workers union (UAW) (AFL-CIO, 2008).
Changes resulting from managed care, declining reimbursement, changing work environments, and nursing shortages have resulted in an increase in union activity. Unions throughout the country have been negotiating contracts with staffing ceilings for a number of years (AFT, 2001).

In 2001, the Australian state of Victoria was the first in the world to implement nurse-to-patient ratios (Australian Nursing Journal, 2001). The nurse-to-patient ratios were set at 1:4 on both the morning and afternoon shifts at the major hospitals in Victoria and modified ratios were implemented in some specialty units. The Australian Nursing Foundation acted in 2004 to change the minimum staffing agreement with the state government. The ratios were changed from the patient level to a unit level of 5 nurses to 20 patients (Gerdtz, 2007). This model allows more flexibility based on the needs of the patients on the unit.

California initially implemented nurse-to-patient ratio standards in the 1970s. In 1977, the California Code of Regulations, Title 22, Section 70217 2005 provided nurse staffing ratios of one nurse to two patients in the neonatal and specialized adult intensive and coronary care units (Donaldson, Barnes-Bolton, Aydin, Brown, Elashoff et al., 2005). The California Code of Regulations, Title 22, Section 70217, 2005 was updated in the 1990s to require hospitals to use reliable patient classification systems as a tool to assure staffing based on patient needs (Donaldson et al.).

In 1992, the California Nurses Association (CNA) began lobbying the legislature to consider mandating nurse-to-patient staffing ratios in the state’s hospitals (Sherer, 1993). CNA co-sponsored Assembly Bill (AB) 1445, the first legislative attempt to
establish nurse-to-patient ratios in the U.S., but the legislation was never put to a vote (CNA/NNOC, 2008a). In 1996, the CNA co-sponsored Proposition 216, an initiative that included measures for reform of the Health Maintenance Organizations in the state and would require the Department of Health Services (DHS) to set nurse-to-patient ratios in health care settings. This proposition advanced no further than committee (CNA/NNOC, 2008a). In 1998, the CNA sponsored AB 695. The bill was passed by the state legislature but vetoed by Governor Pete Wilson after a campaign launched by the state’s hospital lobby (CNA/NNOC, 2008a).

In 1999, the CNA sponsored AB 394 and garnered support from the citizens of the state. This bill was passed by the legislature and signed into law by Governor Gray Davis on October 10, 1999 (CNA/NNOC, 2008a). The original legislation called for the nurse-to-patient ratio to be implemented on January 1, 2001. Subsequent legislation passed and signed in 2000 extended the deadline until January 1, 2002 (California Healthcare Association (CHA), December 30, 2003c).

From 2000 to 2002, negotiation between the states’s nursing associations, the hospital associations, and the DHS led to the development of the initial ratio proposals. There was no empirical evidence supporting the proposed ratios because of the limited statewide data source availability; however the policy decision was made to implement ratios without having the evidence of their effectiveness (Buerhaus & Needleman, 2000). Public hearings and comment sessions were held throughout the state. Opponents argued that the ratios would cost over half a billion dollars annually and that access to care would be decreased due to the need to close sections of the hospitals unable to meet the
stated ratio standards (Crandall, 2000; Seago, Spetz, Coffman, Rosenhoff, & O’Neil, 2003). Proponents of the legislation supported the DHS recommendations for staffing ratios, yet there was disagreement between the state’s two major nursing unions – the CNA and the SEIU. The CNA insisted that only RNs be allowed to fill the ratio requirement while the SEIU expected the ratios to be filled by both RNs and LVNs as the SEIU represented both classes of nurses (Berliner, Kovner & Zhu, 2002; Romig, 2000; SEIU, 2002). The Association of California Nurse Leaders, representing middle management, stated it was taking the “middle ground” but generally supported the DHS proposed ratios (Shrinkman, 2002). The public comment period for the proposed ratios ended in 2003 and the final ratios (Table 5) were published in late 2003 for implementation on January 1, 2004 (CNA/NNOC, 2008a).

The regulation implementing the nurse-to-patient ratio law applied to all licensed nurses working within an acute care general hospital in the state of California. A licensed nurse was defined as a registered nurse (RN) or a licensed vocational nurse (LVN); however the law clarified that LVNs could not comprise more than 50% of the nursing workforce in any hospital (CHA, December 30, 2003a). It required hospitals to be in continuous compliance with the ratio throughout the day and night with no averaging allowed. Hospitals were required to provide clinically competent nursing staff to cover for lunch periods and breaks. Nurse supervisors could provide this coverage provided they were deemed to be clinically competent (CHA, December 30, 2003a).
Table 5

*Hospital Minimum Nurse-to-Patient Ratios as Required by AB 394*

<table>
<thead>
<tr>
<th>Hospital Unit Type</th>
<th>Ratio Nurse: Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Health &amp; Psychiatric Units</td>
<td>1:6</td>
</tr>
<tr>
<td>Emergency Departments</td>
<td>1:4</td>
</tr>
<tr>
<td>Triage (RN Only)</td>
<td>1:1</td>
</tr>
<tr>
<td>Radio (RN Only)</td>
<td>1:1</td>
</tr>
<tr>
<td>Trauma</td>
<td>1:1</td>
</tr>
<tr>
<td>Critical Care</td>
<td>1:1</td>
</tr>
<tr>
<td>General Medical-Surgical</td>
<td>1:6</td>
</tr>
<tr>
<td>ICU/CCU</td>
<td>1:2</td>
</tr>
<tr>
<td>Labor and Delivery</td>
<td>1:2</td>
</tr>
<tr>
<td>Ante partum (Not Active Labor)</td>
<td>1:4</td>
</tr>
<tr>
<td>Postpartum</td>
<td>1:6 (mothers only)</td>
</tr>
<tr>
<td>Couplets (moms and babies)</td>
<td>1:4</td>
</tr>
<tr>
<td>Combined Labor and Delivery</td>
<td>1:3</td>
</tr>
<tr>
<td>Mixed Units</td>
<td>1:6</td>
</tr>
<tr>
<td>Neonatal ICU (RN Only)</td>
<td>1:2</td>
</tr>
<tr>
<td>Operating Room (RN Only)</td>
<td>1:1</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>1:4</td>
</tr>
<tr>
<td>Post-Anesthesia Care Unit</td>
<td>1:2</td>
</tr>
<tr>
<td>Specialty Care (Oncology and Dialysis)</td>
<td>1:5</td>
</tr>
<tr>
<td>Step-Down Unit</td>
<td>1:4</td>
</tr>
<tr>
<td>Telemetry Unit</td>
<td>1:5</td>
</tr>
<tr>
<td>Well-Baby Nursery</td>
<td>1:8</td>
</tr>
</tbody>
</table>

Source: California Healthcare Association, September 30, 2003

The regulation also stipulated that every hospital had to develop a written staffing plan that was to be based upon patient care needs as determined by the hospital’s patient classification system. Every patient care area’s plan was to specify patient care
requirements plus the staffing requirements for RNs, LVNs, and unlicensed care personnel. The hospital was required to keep detailed records as to the daily work assignments by category – RN, LVN, or unlicensed – to individual patients on a daily basis (CHA, December 30, 2003a).

On December 30 2003, the CHA filed a lawsuit against the Department of Health seeking modification of the interpretation of the nurse-to-patient ratio law as the language requiring continuous coverage would make compliance with the law virtually impossible because of the state’s nursing shortage (CHA, December 30, 2003b). It was posed that access to care in hospitals would be decreased as hospitals who could not comply with the continuous coverage language would be forced to close beds and departments. Santa Teresita Hospital in Duarte California was the first to request a suspension of its licensed bed requirement due to its inability to comply with the nurse-to-patient ratio law on January 6, 2004 (CHA, January 6, 2004). The Sacramento County Superior Court upheld the interpretation of the continuous coverage language in May 2004 (CHA, May 26, 2004).

An administrative order from California Governor Arnold Schwarzenegger on November 5, 2004 called for a delay in implementing the ratio changes scheduled to occur on January 1, 2005 (CHA, November 5, 2004). This emergency regulation proposal was to maintain the one to six nurse-to-patient ratio staffing level in the medical-surgical units and was to provide relief to the state’s hospitals fearing compliance issues with the scheduled ratio change because of the ongoing nursing shortage (CHA, November 5, 2004). The delay was to be extended until January 1, 2008.
On March 4th 2005, the Sacramento County Superior Court overturned the emergency regulation and restored the 1:5 nurse-to-patient ratio for all medical surgical patient care units (CHA, March 17, 2005). An appeal of the court’s decision was filed in the 3rd District Court of Appeal and the lower court’s decision was upheld (CHA, April 7, 2005). The latest change in the nurse-to-patient ratios occurred on January 1, 2008. New ratios were implemented for the Step-down unit (from one to four to one to three), the telemetry unit (from one to five to one to four) and the oncology and dialysis units (from one to five to one to four) (CNA/NNOC, 2008a). This was the last scheduled change provided by the original legislation passed in 1999.

Since 1999, other states have considered nurse staffing legislation. In 2001, Oregon passed legislation requiring hospitals to adopt staffing plans (Benko, 2001). Nurses in Arizona, Nevada, and Pennsylvania actively pursued options to promote nurse-to-patient ratios in their states the same year (DeMoro, 2002). Thirteen states and the District of Columbia enacted some form of nurse staffing regulation. The District of Columbia enacted nurse-to-patient staffing ratios only to have it suspended in 2004 because of the nursing shortage (ANA, 2007). Texas adopted legislation in 2002 requiring all hospitals to develop, implement and enforce written staffing plans that are compatible with the guidelines set forth by the Texas State Board of Nursing and congruent with the Nursing Code of Ethics (ANA, 2007). Nevada passed legislation in 2003 that required the Legislative Committee on Health to appoint a subcommittee to conduct an interim study on nurse staffing, but no report has been presented (ANA, 2007).
Illinois passed legislation in 2003 requiring public reporting of patient outcomes, nurse staffing plans and ongoing education efforts (ANA, 2007). Legislation in Maine eliminated nurse staffing ratios in 2004 after a study by the Maine Quality Forum Advisory Council concluded that there was no reliable empirical evidence that mandated nurse staffing ratios could insure safe and high quality patient outcomes. The hospitals in Maine now monitor 15 clinical indicators for outcomes (ANA, 2007).

Three states enacted legislation impacting nurse staffing in 2005. New Jersey’s plan calls for every hospital and care facility to post daily staffing information in the facility for public view. The hospitals also submit their staffing data to the state Commissioner of Health and Senior Services monthly and this is made available to the general public on a quarterly basis (ANA, 2007). Rhode Island requires every licensed hospital to submit a core staffing plan to the department of health annually. The report is to be unit and shift specific and the number of care staff by classification (RN, LPN, and nursing assistant) are to be provided (ANA, 2007). Oregon strengthened its 2002 legislation by requiring all hospitals to develop a written staffing plan that includes the number, qualifications, and nursing staff needed for care. The staffing plan must be developed by nurses who provide direct patient care and must be congruent with nationally recognized standards of care (ANA, 2007).

Florida and Vermont ratified legislation in 2006. Florida instituted minimum nurse-to-patient staffing ratios for all nursing home facilities that require at least one certified nursing aide for every 20 residents and one licensed nurse for at least 1.0 hour of direct care per resident daily. The nurse requirement is to never drop below one nurse for
40 patients (ANA, 2007). Vermont added a provision to its Patients’ Bill of Rights for Hospital Patients requiring public access to nurse staffing ratios established in the hospitals (ANA, 2007).

Illinois implemented its “Patient Acuity Staffing Plan” legislation in 2007. This legislation provided every hospital with the flexibility to address its own staffing needs. Each hospital must have a staffing committee consisting of a minimum of 50% nurses who provide care to write, enact, and evaluate the staffing plan that addresses the complexity of patient care, staff skill mix, and technology. Each hospital must also identify an acuity model for adjusting the facility’s staffing plan (ANA, 2007).

Washington passed its Safe Nurse Staffing Act in March 2008. This legislation calls for the development of committees of nurses who provide care to develop, implement, and evaluate nurse staffing plans for each unit and shift based upon patient needs, skill mix, national care standards, and the physical plan of the care unit. This plan and the budgeted nurse staffing schedule must be posted in public (Ammons, 2008; ANA, 2008).

Massachusetts lawmakers approved legislation (SB2816) on July 17, 2008. The legislation entitled “An Act Relative to Patient Safety” provides for the development of hospital nursing care committees to advise each facility on the adoption of a patient acuity system and recommend staffing plans. Each committee will be composed of at least 50% nurses who provide patient care. The legislation puts a restriction of no more than 16 hours in any 24 hour period worked – and no shift is to exceed 12 hours. It prohibits the use of mandatory overtime except in a state or federal declared emergency.
Hospitals would be required to report their staffing outcomes and clinical outcomes to the state Department of Health on a regular basis for the development of a statewide Patient Outcome Report Card (Ropes & Gray, July 22, 2008). HB4783 was a companion bill that mandated minimum staffing ratios along with the staffing plan legislation and staffing restrictions contained in SB 2816. This bill passed the House after revisions eliminated the mandated minimum nurse-to-patient ratios. The revised legislation is scheduled to return to the House for a final vote of acceptance (Ropes & Gray, May 27, 2008).

Connecticut enacted legislation in October 2008 that requires the establishment of a hospital-wide nurse staffing committee, comprised of at least 50% nurses who provide care, to develop a staffing plan. The plan must address the minimum skill mix for each care unit, address the use of traveling and temporary staffing, and identify the level of administrative staffing for each unit to assure that care staff are not consumed by administrative duties. Methodology for regular evaluation of the staffing plan must be developed (ANA, 2007).

Thirteen states introduced staffing legislation in 2008. Arizona proposed a bill (HB2141) that would establish provisions for mandated nurse-to-patient ratios (ANA, 2007). This bill would require a nurse-to-patient ratio of one nurse to two patients for intensive care, one nurse to three patients for pediatric units, and one nurse to four patients for the emergency departments (Raven, 2008). This bill asked every hospital to post the required staffing ratios, enforced through fines, licensure suspension, and revocation for noncompliance (Raven).
In New Jersey, AB1531 and SB1233 were introduced to require hospitals, ambulatory care centers, and psychiatric centers to enact minimum nurse-to-patient staffing ratios after the California model (ANA, 2007). Hawaii’s legislation (SB7281) proposed prescribed ratios for RNs (ANA, 2007).

New York had several nurse staffing legislation items. AB 1439 required the development of a staffing prescription for selected mental care centers. AB3791 and AB220 addressed nurse staffing regulation in nursing homes. AB6119/SB1551 introduced the “Safe Staffing for Quality Care Act” requiring all acute care facilities to submit a publicly disclosed, written nurse staffing plan annually to the state department of health. Minimum staffing ratios would be prescribed and nurses would be empowered to refuse assignments for which they are unqualified to handle. Enforcement of the act would be accomplished through monetary fines (ANA, 2007). This legislation carried over into 2009 and is now presented as AB5370/SB1780 (ANA, 2009a).

Missouri introduced HB 2450 to establish a minimum direct nurse-to-patient ratio by unit type with acuity-based modification capabilities based upon patient need. Every hospital would develop its own advisory panel to adopt an acuity system, develop its staffing ratios, and review those ratios every three years. The staffing plan would be documented and noncompliance would be reported to the State Department of Health and Senior Services. Noncompliance would be addressed through a defined penalty system (ANA, 2008).

Connecticut SB385 sought legislation to improve nursing home staffing (ANA, 2007). Virginia introduced legislation for improvement of nursing home staffing
Virginia’s bill would have required the State Board of Health to establish its staffing standards (ANA, 2007).

The “Safe Staffing for Quality Care Act” (SB1338/HB241) was on the agenda in the Florida Legislature in 2008. This legislation was to extend the mandated minimum nurse-to-patient ratios beyond the hospital to outpatient settings including ambulatory care centers, outpatient surgical centers, and psychiatric centers (ANA, 2008). Florida also sought to require all health care agencies to report its nurse staffing and turnover information through its “Patient’s Right to Know Act”. Facilities would be required to provide its staffing methodology upon request to the public. This legislation carried over to the 2009 legislative calendar (ANA, 2009a).

In 2008, the New Mexico legislature reviewed HB455 that would require public disclosure of nurse staffing information as a portion of a hospital transparency information system (ANA, 2008). Iowa legislation (SB 2296) called for the establishment of unit –based staffing committees to develop and evaluate the unit’s staffing plan. The Committee would be composed of nurses who provide care and the plan must be submitted to the state regulatory agency semi-annually. Whistleblower protection would be afforded to any nurse reporting violation to the regulatory agency (ANA, 2008).

Minnesota’s “Staffing for Patient Safety” act (SB441) called for all licensed hospitals to develop and implement staffing plans prescribing a maximum number of patients a nurse would be allowed to care for. The plan would take into account
admission planning, discharge planning, patient transfers, and skill mix. The plans must be based upon nationally recognized patient care standards (ANA, 2008).

Ohio’s HB 346 required each licensed hospital to establish a staffing committee to develop evidenced based practice care guidelines and unit-based staffing plans. Use of agency and traveling nurses must be considered in the development, implementation, and evaluation of the plan (ANA, 2008). Annually the committee would evaluate the plan based upon patient outcomes, costs of care delivery, and the prevailing care standards. This bill was signed into law in June of 2008 (ANA, 2009a).

West Virginia legislation entitled “Ensuring Patient Safety” Act (HB 2949) called for staffing plans with minimum nurse-to-patient staffing ratios and it prohibited the use of mandatory overtime (ANA, 2008). This piece of legislation has carried over to 2009.

Ten states introduced new legislation in 2009 to address nurse staffing concerns. In Missouri, SB229/HB2183 would require that the daily staffing numbers and schedules be posted in a public venue within each care facility (ANA, 2009a). Minnesota introduced HB 1760 requiring that health care facilities must evaluate any adverse impacts related to staffing levels when conducting root cause analyses of sentinel events (ANA, 2009a). HB725 requires that every hospital create a nursing advisory board to develop acuity based patient classification systems as a component of the quality improvement programs. These committees would be appointed by the state’s Department of Health and Senior Services and would be held accountable for the monitoring and evaluation of a minimum nurse-to-patient ratio staffing plan (ANA, 2009a).
In Texas, HB591/SB476 called for the formation of staffing committees to develop policy and staffing plans for every unit in a care facility. One half of the committee membership must be direct care nurses. Whistleblower protection and mandatory overtime prohibition were both included in this legislation. This bill awaits the governor’s signature into law (ANA, 2009a).

Pennsylvania is considering two piece of legislation addressing nurse staffing. The first - HB1033 calls for a nurse committee to develop staffing plans using nurse sensitive indicators in its care facilities. It includes whistleblower protection. The second – HB147/SB689 establishes the “Health Care Facilities Act” and creates provisions for staffing plans, an acuity system with record keeping, minimum nurse-to-patient staffing ratios, and ties public reporting of staffing level to care facility licensure requirements (ANA, 2009a).

California has two more staffing bills to consider in 2009. SB360 amends the current mandated nurse-to-patient staffing ratio law to exclude nurses from the ratios until they have completed orientation. AB57 would require the University of California hospitals to create written staffing plans and establish a plan for evaluation (ANA, 2009a). Florida’s HB463 requires a nurse-based staffing committee for staffing plan development, evaluation and revision (ANA, 2009a).

The Nevada governor’s veto was over-ridden to enact AB121/BDR492 into law in June of 2009. This legislation requires a staffing plan and minimum nurse-to-patient ratios as well as written reports providing details of the plan and execution submitted to the Director of the Legislative Counsel Bureau in even years and the Legislative
Committee on Healthcare in odd years (ANA, 2009a). Oregon introduced SB564 to legislate nurse-to-patient staffing ratios by unit and specialty (ANA, 2009a).

HB2949 was introduced in West Virginia to establish the “Ensuring Patient Safety Act”. This piece of legislation is designed to establish minimum registered nurse-to-patient staffing ratios using an acuity based system (ANA, 2009a). Connecticut’s SB454 established nurse-to-patient ratios in long term care facilities. These ratios would be calculated based upon the average of daily staffing levels over one year’s time (ANA, 2009a).

Gallagher (1999) suggested that the use of mandated nurse-to-patient ratios to promote adequate staffing and positive patient outcomes was not supported by the research. Kovner and Heinrich stated “data have yet to pinpoint specific levels of nurse staffing that are safe, good, or ideal in hospitals” (2000, p 61). In 2001, the JCAHO announced it was engaging in a retrospective study to attempt to link staffing levels and clinical outcomes. In a 2002 report, the JCAHO implicated low staffing levels in the occurrence of 24% of the sentinel events reported in the years studied (Costello, 2002; Lovern, 2001). Later in the same year the JCAHO Staffing Effectiveness Standards were released effective with the organization’s accreditation surveys starting in July 2002. This attempted to draw attention to the need for adequate staffing for all surveyed agencies (JCAHO, 2002). The staffing standards were not prescriptive and relied on each facility to address the adequacy of its staffing (Tieman, April 8, 2002). The CNA responded to this study by saying the solutions offered by the JCAHO to address staffing were not adequate to enhance patient protection (Business Wire, 2002).
Neither the ANA nor the JCAHO have endorsed the use of specific nurse-to-patient ratios because they cannot support the use of specific ratios that do not account for the dynamic nature of the hospital setting. In 1999, the ANA released its *Principles for Nurse Staffing*. These non-prescriptive guidelines suggest that staffing should be based upon high quality patient care indices, meeting organizational outcomes, and ensuring appropriate quality of life for the nursing staff (ANA, 2000). The ANA supports the concept of setting nurse staffing ratios by legislation - but the number itself must be set at the unit level with direct caregiver RN input, rather than by the legislation (ANA, 2009b).

In 2003, the ANA announced it had been working with U.S. Senator Patrick Inouye (Hawaii) on the Registered Nurse Safe Staffing Act of 2003 (S.991). This bill mandated the development of staffing systems that require input from RNs who provide care and provides whistleblower protection for nurses who speak out about patient care issues and/or inadequate staffing. These guidelines for the staffing systems are congruent with the ANA *Principles for Safe Staffing* and do not address nurse-to-patient ratios (*Managed Care Weekly Digest*, 2003). This bill left Committee for the Senate floor but did not come for vote. In 2007, the Registered Nurse Safe Staffing Act (S.73/H.R. 4138) was re-introduced to the 110th Congress. It remains in Committees and is not likely to make either the Senate or House agendas (ANA, 2008). Provisions for nurse staffing delineated in the Registered Nurse Safe Staffing Act are congruent with the ANA position statement released in 2007 supporting the establishment of nurse-patient ratios for acute care settings, but these ratios must be established by the nurses providing care in
each care setting and not legislated or mandated by government officials (ANA, 2008).

In 2007, U.S Representative Jan Schakowsky introduced H.R. 2123 to the 110th Congress— the first national nurse-to-patient ratio legislation in the country. Like the Registered Nurse Safe Staffing Act, Schakowsky’s bill remains in committee and is unlikely to come to the floor for a vote (Hall, 2008, July 14).

Studies examining the impact of the mandated nurse-to-patient ratios in California are limited. AB394 contained language providing for an evaluation of the ratios and their effectiveness after five years. Hackenschmidt (2004) interviewed emergency department nurses in an urban California hospital for their reactions on the impact of the staffing ratios. Responses ranged from “the law is too rigid” to “the ratios are a victory for patients and nurses” (p. 378). Some nurses felt they had less flexibility after the ratio implementation than they did before the ratio implementation when it comes to determining the best way to care for their patients.

Donaldson, Burnes Bolton, Aydin, Brown, Elashoff et al. (2005) explored the impact of the mandated nurse-to-patient staffing ratios on skill mix and nursing hours of care on both the general medical-surgical units and definitive observation units (step down and telemetry) in a convenience sample of 68 California hospitals. Repeated measures ANOVAs were performed to examine the pre (2002) and post ratio (2004) results. The average total number of hours of care provided by RNs on the medical-surgical care units increased by 20.8% (p = .0001). The average total number of hours of care provided by licensed nurses increased by 17.8% (p = .0001). The number of patients per licensed nurse decreased by 16% (p = .0001) after the implementation and the
number of patients per RN decreased by 17.5% \( (p = .0001) \) (Donaldson et al.). These findings indicated strong compliance with the mandated ratios in this sample of hospitals. No significant differences in the reduction of falls, restraint use, or incidence of decubiti were noted. One limitation in this study was the convenience sampling of hospitals. These data may not have represented other hospitals in the state, thus limiting the generalizability of these findings.

Rothberg, Abraham, Lindenauer, and Rose (2005) performed a cost-effectiveness analysis from a hospital level comparing a staffing ratio of one to eight with a staffing ratio of one to four to study the costs per life saved in a general medical-surgical patient population. While the eight patients to one nurse ratio was the least expensive ratio, it was associated with the highest rate of patient mortality. As the number of patients per nurse decreased, the mortality decreased but the costs increased. Their model demonstrated that a decrease in the nurse-to-patient ratio from five patients to four could save additional lives at a cost of $136,000 per life saved. While the findings suggested that the implementation of lower nurse-to-patient ratios is cost-effective when calculating the lives saved as a result of having more nurses caring for the patients, the mortality data used in this study was from a single large study of Pennsylvania hospitals in the late 1990s which limits the generalizability of the findings.

In 2007, Burnes Bolton, Aydin, Donaldson, Brown, Sandhu, et al. conducted a follow-up study to the 2005 impact study published by Donaldson et al (2005). The database used to study the impact consisted of a convenience sample 185 hospitals located throughout California. These data were analyzed for the impact of the staffing
mandate and then for any relationships between the staffing and patient outcomes on medical surgical units and step-down units. There were significant increases \((p < .0001)\) in the number of hours of RN provided care in the medical-surgical units from 2002 to 2006 of about 1.5 hours and about 1 hour on the step-down units. The RN to patient ratio decreased by about 1.5 patients on the medical-surgical units \((p < .001)\) and by about 0.7 patients in the step-down units \((p < .0001)\). The percentage of care provided by an RN increased by 11.2\% from 2002 – 2006 \((p < .0001)\), and an overall reduction in the use of LVNs on both types of care units was noted \((p < .0001)\). There were no statistically significant trends found in patient falls, in the incidence of decubiti, or restraint use between 2002 and 2006. The authors concluded that the findings on staffing indicate that health care executives have elected to provide patient care through more RNs, but have decreased the numbers of LVNs and other assistive personnel. More research is needed to determine the impact of the decreased supportive personnel on the RN staff. The findings of this study were consistent with those of the 2005 study.

Spetz (2008) used data from two surveys providing information from California hospital nurses to determine their perceptions of improvements in their work environments after the nurse-to-patient ratios were implemented. The surveys were distributed to a random sample of 8,796 RNs registered in California in 2004 and to a stratified random sample (based upon geographical distribution) in 2006. The response rate in 2004 was 58.8\% and in 2006 was 56.29\%. Average nurse satisfaction from 2004 to 2006 improved for most of the assessed variables including the “overall job” \((p = .000)\), the “adequacy of numbers of staff” \((p = .000)\), and “time for patient education” \(p{/}
items. There was no change in satisfaction for the items labeled “satisfaction with the skills of other RNS”, “non-nursing tasks”, “opportunities to learn and use new skills”, and “employer-sponsored educational opportunities”. The changes in satisfaction from 2004 to 2006 could not be solely attributed to changing nurse demographics, job characteristics, or family characteristics. A limitation of this study is the sample of surveyed nurses that may not represent all nurses in California. In addition, the survey did not directly ask if the mandated nurse-to-patient staffing ratios have improved their job satisfaction.

The overarching goals for the implementation of the mandated nurse-to-patient ratios in California were to improve the quality of care, enhance patient safety, and improve the quality of work life for the nurses (Seago, Spetz, Coffman et al., 2003). Preliminary literature on the ratios post implementation hints that the nurses may have a better perception of their job and that more hours of nursing care by RNs were being provided to patients in California hospitals, but the evidence does not demonstrate a significant impact on the quality indicators measured thus far – patient falls, restraint use, and decubiti. More study is indicated for the clinical and administrative outcome measures after the implementation of the mandated nurse-to-patient ratios in the state of California.

There is a relationship between nurse staffing and adverse patient outcomes including pneumonia, urinary tract infections (UTIs), and decubiti noted in the literature. While a relationship exists, there is no definitive answer on how many patients a nurse should be assigned to provide direct care. There is no evidence in the literature of the
impact of the mandated nurse-to-patient ratios on hospital costs. Speculation exists that hospital executives cut support positions in order to finance enough nurses to meet the staffing mandate. This study will estimate the effect of the mandated nurse-to-patient staffing ratios on hospital operating costs.
CHAPTER 3

METHODS

Design

A comparative longitudinal study design was used to examine the difference in hospital costs attributed to nursing costs before and after the implementation of the nurse-to-patient ratio law. The study consisted of collection of the data, building the data base, and analyzing the data. All data were obtained from the resources of the California Office of Statewide Health Policy Development (OSHPD) Hospital Annual Financial Disclosure Database. Authority for the collection and publication of hospital data by the California OSHPD is defined in Sections 443.31 and 443.32 of the state's Health and Safety Code.

California licensed hospitals must submit an annual financial report that includes a detailed income statement, balance sheet, statements of revenue and expense, and supporting schedules. These financial reports are based on a uniform accounting and reporting system developed and maintained by the OSHPD and each report receives a thorough desk audit. The hospitals in this database also report their case mix index data, utilization data, payer mix, discharge data, and ICD-9 Code frequency data on an annual basis to the California OSHPD. These data are available in the public domain on the OSHPD website.

Research Questions

1. Is there a significant difference in the nursing costs attributed to RN staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation?
2. Is there a significant difference in the nursing costs attributed to LVN staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation?

3. Is there a significant difference in the overall nursing costs in California, as measured by a percentage of total hospital operating costs before the mandated ratio implementation compared to after the mandated ratio implementation?

4. Is there a significant difference in the composition of the hospital unit level support staff (aides/orderlies, technicians and clerical support) as measured by paid productive hours before the mandated ratio implementation compared to after the mandated ratio implementation?

Subjects

The subjects identified for this study consisted of all of the acute care licensed hospitals in the state of California who reported their case mix index data, utilization data, financial data, and ICD-9 Code frequency data to the OSHPD in both 2002 and 2006. Each hospital must have (1) been licensed in California both 2002 and 2006; (2) been defined as an acute care general hospitals in both 2002 and 2006; (3) been under the same ownership in 2002 and 2006; (4) been licensed for the same number of beds in 2002 and 2006; (5) been listed at the same location in 2002 and 2006; and (6) the same profit status listing in 2002 and 2006.
Procedures

The study proposal was submitted to both The University of Missouri – Kansas City (UMKC) Social Science Institutional Review Board (IRB) and the University of Oklahoma Health Sciences (OUHSC) IRB for consideration. Neither IRB determined that the study involved human subjects and therefore was not subject to IRB review and oversight.

The first step in building the database was to obtain from the HAFD's Annual Financial Disclosure Reports' pivot charts the listing of all hospitals in the state of California in 2002 and in 2006. The years 2002 and 2006 were chosen as the study years because the literature suggested that some hospitals may have begun to prepare for the staffing ratios in 2003. Using data from 2006 allowed for the effects of the staffing changes resulting from the ratio implementation in 2004 and the required ratio revisions in 2005 to be reflected in the data (Burnes-Bolton, Aydin, Donaldson, et al., 2007).

The lists were then matched across the study years to assure that each hospital was (1) licensed in both 2002 and 2006; (2) defined as an acute care hospitals in both 2002 and 2006; (3) under the same ownership in 2002 and 2006; (4) licensed for the same number of beds in 2002 and 2006; (5) listed at the same location in 2002 and 2006; and (6) listed with the same profit status listing in 2002 and 2006. This matching process helped to assure that the hospitals were operating under the same conditions in the study years of 2002 and 2006. Hospitals on the 2002 and 2006 lists were excluded if they did not meet all of the criteria. The Kaiser-owned hospitals were omitted from this study as
they implemented nurse staffing ratios that exceeded the state minimum ratios prior to the law’s effective date (Donaldson et al., 2005). Data from the remaining hospitals meeting all of the criteria were entered into a Microsoft Office 2007 Excel spreadsheet. This data included the hospital name and the total operating expenses for each hospital for 2002 and 2006.

Once the listing was established, the audited 2002 and 2006 Annual Financial Data Reports for each of the listed hospitals was accessed through the OSHPD website. Detailed reports of direct payroll costs for the revenue producing centers where nursing care is delivered were examined. The 2002 and 2006 total daily average hourly wage rate and the total number of productive hours for the worker classifications (1) RNs, (2) LVNs, (3) Aides and Orderlies, (4) Clerical and other administrative staff, and (5) Technical and Specialist staff were entered into respectively assigned columns on the database for each hospital.

After completing the review of the financial disclosure reports and recording the wage and productivity information in the spreadsheet, Excel formulas to estimate total salary dollar expenses by multiplying the total productive hours by average hourly wage for each worker classification were entered for 2002 and 2006. Next the total salary dollars by worker classification were divided by the hospital total operating expense for both 2002 and 2006 to provide the percentage of the hospital total operating costs attributed to each worker classification in the study years. Using percentage of total hospital operating costs instead of actual dollars allowed direct comparison over time and adjusting for present day dollar value is not required (Pinches, 1997). Finally, the
percentage of overall nursing costs were calculated in Excel by summing the RN and LVN estimated salary dollars and dividing it by the total hospital operating costs for each of the study years.

Analysis

The database was exported into the Statistical Package for Social Sciences (SPSS) Grad Pack Version 17. Statistical analysis included descriptive statistics and general linear modeling statistics.

Pilot Study

The proposed study methodology was previously piloted. After determination by the UMKC and OUHSC IRBs that the research did not involve human subjects, the data base was built as described in the procedures section and generated 282 hospitals that met the inclusion criteria. Using the SPSS random case selector function, a sample of 28 cases was examined from the acute care hospital population licensed in California in both 2002 and 2006. The univariate variables studied in this pilot included: (1) the percentage of total hospital operating costs attributed to estimated RN salary dollars in 2002 and 2006; (2) the percentage of total hospital operating costs attributed to estimated LVN salary dollars in 2002 and 2006; (3) the percentage of total hospital operating costs attributed to estimated total nursing (RN plus LVN) salary dollars in 2002 and 2006; (4) the number of paid productive hours for RNs in 2002 and 2006 and (5) the number of paid productive hours for patient care support staff (technicians, aides/orderlies, clerical) in 2002 and
2006. Descriptive statistics were run on the sample to determine the variable means and to identify any missing data. No missing data were noted.

Paired sample correlations and t-tests were used to compare the estimated salary expenses in percent of total hospital operating expenses for the RN salaries from 2002 and 2006, the LVN estimated salary expenses in percent of total hospital operating expenses in 2002 and 2006 and the combined RN and LVN estimated salary expenses in percent of total hospital operating expenses in 2002 and 2006. All three categories were significantly correlated \((p<.05)\). There was no statistical significance noted between the 2002 and 2006 estimates for the percent of total hospital operating costs due to RN salaries \((p = .072)\), to the LVN salaries \((p = .840)\) or to the total nursing salaries \((p = .072)\). The effect size for this pilot sample was small using Cohen’s \(d\) calculations (ranging from \(d = -.061\) to \(d = 0.2132\)).

Using paired sample T-tests, there was no statistically significant difference \((p = .059)\) found in the number of paid productive hours worked by RNs before and after the implementation of the mandated ratios. There was no statistically significant difference \((p = .645)\) found in the number of paid productive hours worked by the LVNs in 2002 and 2006. These data were explored for significant differences in the paid productive hours worked by patient care support staff including technicians, aides and orderlies and clerical support personnel on the units. No significant differences were noted in the number of paid productive hours of support staff before and after the implementation of the mandated ratios.
Results from this sample suggested that while the productive nursing hours and estimated dollars in nursing salaries increased, there was no statistically significant increase in the percentage of the total hospital operating costs attributed to nursing costs between 2002 and 2006 related to the mandated nurse staffing ratios. There were also no statistically significant differences between the number of paid productive hours of RNs, LVNS, technicians, aides and orderlies or clerical support on the patient care units in the sample hospitals between 2002 and 2006. There were two limitations noted in this pilot study. The nursing salaries were estimated using the hospitals’ average hourly wages for RNs and LVNs working in the patient care units of the sample hospitals in 2002 and 2006. Total dollars spent on LVN and RN salaries were not available in the OSHPD hospital annual financial disclosure report data. The second noted limitation was the small sample and the small effect size of this sample. Additionally, there was the possibility of data error within the OSHPD annual financial disclosure report database. It was anticipated that the limitations for the overall study would be similar.
CHAPTER FOUR
ANALYSIS AND RESULTS

The purpose of this study was to compare and contrast the fiscal impact of the
nurse-to-patient ratios on hospital costs before and after the statewide implementation of
the mandated nurse-to-patient ratios in California. Quantitative data were obtained from
the California Office of Statewide Health Planning and Development (OSHPD) annual
financial disclosure reports for 2002 and 2006. This chapter includes the data
presentation and the statistical methods used to answer the research questions.

Study Population

The listings of the California hospitals licensed in 2002 and 2006 were reviewed
and matched across time. There were 473 hospitals listed in 2002 and 446 hospitals listed
in 2006. The lists were matched for the inclusion criteria including: (1) licensed as a
hospital in California in both 2002 and 2006; (2) licensed as an acute care hospital in both
2002 and 2006; (3) licensed with the same number of beds for 2002 and 2006; (4)
licensed with the same owners in both 2002 and 2006; (5) licensed in the same location in
both 2002 and 2006 and (6) listed with the same financial proprietary status in 2002 and
2006. Descriptive statistics were used to examine the study population (Table 6). No
missing data were noted. Two hundred eighty-two hospitals met all of the criteria and the
respective financial data was entered into the database. The hospitals ranged in licensed
bed size from 3 beds (in a very remote rural setting) to 1335 beds ($M = 173.33$, $SD = 147.592$).

Table 6

*Descriptive Statistics of the Study Population*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minimum</th>
<th>Maximum</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of RN to Total Operating Expense 2002 (N = 282)</td>
<td>.1985</td>
<td>19.0253</td>
<td>7.2062</td>
<td>2.6276</td>
</tr>
<tr>
<td>Percent of RN to Total Operating Expense 2006 (N = 282)</td>
<td>.4754</td>
<td>20.8941</td>
<td>8.0876</td>
<td>3.3525</td>
</tr>
<tr>
<td>Percent of LVN to Total Operating Expense 2002 (N= 282)</td>
<td>0.0000</td>
<td>5.4556</td>
<td>1.0361</td>
<td>.9673</td>
</tr>
<tr>
<td>Percent of LVN to Total Operating Expense 2006 (N=282)</td>
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<td>7.0636</td>
<td>1.0541</td>
<td>1.1431</td>
</tr>
<tr>
<td>Percent of Total Nursing to Total Operating Expense 2002 (N = 282)</td>
<td>.5557</td>
<td>20.2515</td>
<td>8.2423</td>
<td>2.6865</td>
</tr>
<tr>
<td>Variable</td>
<td>Minimum</td>
<td>Maximum</td>
<td>( M )</td>
<td>( SD )</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Percent of Total Nursing to Total Operating Expense 2006 (N=282)</td>
<td>.5392</td>
<td>21.9381</td>
<td>9.1417</td>
<td>3.5372</td>
</tr>
<tr>
<td>Technician Productive Hours 2006 (N=282)</td>
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<td>118856</td>
<td>16436.45</td>
<td>20159.031</td>
</tr>
<tr>
<td>Aide/Orderly Productive Hours 2002 (N=282)</td>
<td>0.0000</td>
<td>820855</td>
<td>105558.90</td>
<td>106836.702</td>
</tr>
<tr>
<td>Aide/Orderly Productive Hours 2006 (N=282)</td>
<td>0.0000</td>
<td>811364</td>
<td>102554.19</td>
<td>111004.593</td>
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<tr>
<td>Clerical Productive Hours 2002 (N=282)</td>
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<td>535231</td>
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<td>50148.666</td>
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<tr>
<td>Clerical Productive Hours 2006 (N=282)</td>
<td>0.0000</td>
<td>256980</td>
<td>34646.48</td>
<td>44942.580</td>
</tr>
</tbody>
</table>

**General Linear Model Statistics**

Paired sample correlations were used to compare the estimated salary expenses as a percent of total hospital operating expenses for the Registered Nurse (RN) estimated salaries from 2002 and 2006, the Licensed Vocational Nurse (LVN) estimated salaries as a percent of total hospital operating expenses in 2002 and 2006, and the combined RN and LVN estimated salary expenses as a percent of total hospital operating expenses in
2002 and 2006, and the paid productive hours for unit level technician support staff, aide and orderly support staff, and clerical support staff in 2002 and 2006. All of the categories were significantly correlated (Table 7). Paired sample t-tests were used to examine differences between the variables for the study years 2002 and 2006 (Table 8).

Table 7

Paired Sample Correlation Results of Estimated Salaries and Productivity

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of RN to Total Operating Expense 2002 &amp; 2006</td>
<td>282</td>
<td>.743</td>
<td>.000</td>
</tr>
<tr>
<td>Percent of LVN to Total Operating Expense 2002 &amp; 2006</td>
<td>282</td>
<td>.863</td>
<td>.000</td>
</tr>
<tr>
<td>Percent of Total Nursing to Total Operating Expense 2002 &amp; 2006</td>
<td>282</td>
<td>.732</td>
<td>.000</td>
</tr>
<tr>
<td>Technician Productive Hours 2002 &amp; 2006</td>
<td>282</td>
<td>.710</td>
<td>.000</td>
</tr>
<tr>
<td>Aide/Orderly Productive Hours 2002 &amp; 2006</td>
<td>282</td>
<td>.856</td>
<td>.000</td>
</tr>
<tr>
<td>Clerical Productive Hours 2002 &amp; 2006</td>
<td>282</td>
<td>.717</td>
<td>.000</td>
</tr>
</tbody>
</table>
Table 8

*Paired Samples t-Test Results of Estimated Salaries and Productivity*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$t$</th>
<th>$df$</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of RN to Total Operating Expense 2002 &amp; 2006</td>
<td>-6.581</td>
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<td>.000</td>
</tr>
<tr>
<td>Percent of LVN to Total Operating Expense 2002 &amp; 2006</td>
<td>-.522</td>
<td>281</td>
<td>.602</td>
</tr>
<tr>
<td>Percent of Total Nursing to Total Operating Expense 2002 &amp; 2006</td>
<td>-6.267</td>
<td>281</td>
<td>.000</td>
</tr>
<tr>
<td>Technician Productive Hours 2002 &amp; 2006</td>
<td>.057</td>
<td>281</td>
<td>.955</td>
</tr>
<tr>
<td>Aide/Orderly Productive Hours 2002 &amp; 2006</td>
<td>.862</td>
<td>281</td>
<td>.389</td>
</tr>
<tr>
<td>Clerical Productive Hours 2002 &amp; 2006</td>
<td>-.700</td>
<td>281</td>
<td>.484</td>
</tr>
</tbody>
</table>

Research Question 1: Is there a significant difference in the nursing costs attributed to RN staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation? There was an increase of approximately 1 percent in
the mean percentage of total hospital operating costs attributed to the estimated RN wages from 2002 to 2006 and this difference was statistically significant \((p = .000)\).

Research Question 2: Is there a significant difference in the nursing costs attributed to LVN staffing in California hospitals, as measured by a percentage of total hospital operating costs, before the mandated ratio implementation compared to after the mandated ratio implementation? There was a slight increase in the mean percentage of the total hospital operating costs attributed to LVN estimated wages, but this difference was not statistically significant \((p = .602)\).

Research Question 3: Is there a significant difference in the overall nursing costs in California, as measured by a percentage of total hospital operating costs before the mandated ratio implementation compared to after the mandated ratio implementation? There was an increase in the mean percentage of the total hospital operating costs attributed to estimated overall nursing costs and this difference was statistically significant \((p = .000)\).

Research Question 4: Is there a significant difference in the composition of the hospital unit level support staff (aides/orderlies, technicians, and clerical support) as measured by paid productive hours before the mandated ratio implementation compared to after the mandated ratio implementation? There was a slight decrease in the mean number of paid productive hours after the implementation of the mandated nurse-to-patient staffing ratios, but this decrease was not statistically significant \((p = .389)\). There was a slight decrease in the number of paid productive hours after implementation of the mandated nurse-to-patient ratios, but this difference was not statistically significant \((p = \ldots\)
.955). There was a slight increase in the mean number of paid productive hours for unit-based clerical support staff; however this increase was not statistically significant ($p = .484$).
CHAPTER FIVE
DISCUSSION, CONCLUSIONS AND IMPLICATIONS

This study examined the differences in estimated Registered Nurse (RN), licensed vocational nurse (LVN), and total nursing costs expressed as a percentage of total hospital operating costs from before the staffing ratios were implemented (2002) and after the implementation of the mandated ratios (2006). The study was framed by Bolman and Deal’s *Reframing Organizations* (2003) framework that was applied to nurse staffing across the hospitals in the state of California. Additionally, the amount of unit level support staff provided for the nursing staff caring for patients before and after the implementation of the ratios was examined.

Bolman and Deal’s framework was useful in this study because it brought to the forefront the need to consider more than one point of view when addressing nurse staffing issues. All four of the frames – structural, human resource, political and symbolic play roles in the perceptions and actualities of nurse staffing in hospitals. In the case of mandated nurse-to-patient staffing roles, the structural and human resource frames were useful in the consideration of the numbers of nurses actually required to perform functions at the unit level in caring for patients. The political and symbolic frames were used when taking into account the roles of organized labor, hospital management, and state government in the nurse staffing issues in California.

Two hundred eighty-two hospitals operating as licensed acute care hospitals in California during 2002 and 2006 were examined in this study. Each of the hospitals were
matched across time to assure each was operating under the same ownership, was licensed for the same bed size, had not relocated, and functioned under the same proprietary status. Data on RN and LVN average hourly salaries, RN and LVN productive paid hours, total hospital operating costs, paid productive hours for unit level aides/orderlies, unit level technicians and unit level clerical support staff were obtained from the California Office of Statewide Health Planning and Development (OSHPD) Office Healthcare Information Division. Both the hospital annual financial disclosure (HAFD) report pivot charts and the HAFD report direct payroll costs were accessed to build the study data base.

Estimated RN costs and LVN costs were extrapolated using the mean hourly wage and number of paid productive hours for each of the worker classifications. The estimated total nursing costs were calculated by summing the mean hourly wages and paid productive hours for the RN and LVN classifications. By expressing the nursing expenses as a percentage of the hospital total operating costs for each of the study years, there was no need to convert the financials to present day net values for comparison.

Results from quantitative data revealed significantly positive correlations \( (p = .000) \) between the study variables across the two years. Significantly positive differences were noted with the estimated RN costs and estimated total nursing costs between 2002 and 2006 \( (p = .000) \). There were no statistically significant differences found between the remaining variables across the study years.
Discussion

Assessing nurse staffing in hospitals is a complex task. Literature exists about the impact of nurses on patient outcomes, patient satisfaction and nurses’ job satisfaction. It is well documented that the fewer number of patients a nurse cares for results in fewer patient complications such as infection, loss of skin integrity and death while also improving patient satisfaction and nurses’ job satisfaction. There is no evidence of an absolute number of patients any one nurse should be allowed to care for at any one time. Further, the literature is clouded by a lack of consistency in the definition of the nurses providing care. In many studies, nurses are not delineated as to whether they are RNs or LVNs. In addition, the reports of unit-based results cannot be compared with hospital-based results.

The use of mandated nurse-to-patient ratios has been used as a staffing strategy by collective bargaining units when negotiating contracts. The move to mandate a nurse-to-patient ratio strategy for every hospital in California was the first time such an approach has been legislated in the United States. The ratios were determined through a consensus of the opinions of the state’s nurses, hospital management and state health department. Implementation of the mandated ratios across the state in 2004 was challenging with the closure of at least one hospital reported. Litigation over the need to maintain the ratios consistently around the clock ensued and was upheld. Evaluation of the impact of the ratios has been limited. The 2007 study by Burnes-Bolton et al. as well as another study by Spetz et al. (2009) reported there were no statistically significant findings in the reduction of adverse patient outcomes after ratio implementation.
The results of this study are consistent with what financial evaluation of the ratios is found in the literature. The Burnes Bolton et al. (2007) study reported that there was a reduction of LVNs being used on medical-surgical units and step-down units. This finding could be tied to the slight overall decrease in the percentage of total hospital operating costs attributed to LVNs from 2002 to 2006 in this study, but the fact that the LVN difference was not found to be statistically significant was supported in the finding in the 2009 study by Spetz, et al., that the LVN levels remained relatively stable throughout the implementation of the ratios. Spetz et al. used hospital operating margins to examine changes in hospital financial status related to the ratio implementation, but concluded that changes in reimbursement and changes in the seismic building requirements also impacted the operating margins. No other financial impact evaluation of the ratios was found in the literature.

Study Limitations

There are several limitations of this study that warrant caution when interpreting the results. While the matching technique was used across the study years to control for potential changes in the hospitals over time, it is possible that other unforeseen financial demands impacted the total hospital operating expenses after 2002. The potential for reporting error in the OSHPD HAFD is another limitation; however a study by Jiang, Stocks and Wong (2006) found that the OSHPD data base more reliable for staffing data was than the other commonly used American Hospital Association Annual Report databases. A third limitation is that it may be possible that some hospitals may have
already geared up for the implementation of the mandated staffing ratios and that may have impacted the financial data for 2002; yet the actual staffing ratio numbers were not finalized until October 2003. Lastly, this study examined the population of hospitals meeting the inclusion criteria and cannot speak to the financial impact on any individual hospital. Cost-effectiveness analysis should be performed in the individual hospitals to determine the impact of the implementation of the nurse-to-patient staffing ratios on the facility.

Conclusions

The following conclusions can be drawn from this study:

1. The percentage of total hospital operating costs attributed to RNs was significantly higher in 2006 (post-implementation) than it was in 2002 (pre-implementation).

2. The percentage of total hospital operating costs attributed to LVNs was not significantly higher in 2006 (post-implementation) than it was in 2002 (pre-implementation).

3. The percentage of total operating costs attributed to total nursing costs was significantly higher in 2006 (post-implementation) than it was in 2002 (pre-implementation).

4. There was no significant difference in the number of unit support staff (aides/orderlies, technicians, clerical) as measured by the paid productive hours for each worker classification from 2002 (pre-implementation) to 2006 (post-implementation).
Implications for Nursing

The purpose of this study was to examine the financial impact of the mandated nurse-to-patient ratio on hospital operating expenses in California. Results from this study would suggest that trial periods of various staffing ratio combinations in differing acute care settings and thorough cost-benefit analyses of each combination should be performed prior to the diffuse implementation of a given nurse-to-patient ratio. The addition of costly nurses may be only a part of the answer to improved patient outcomes, increased patient satisfaction and increased nurses’ job satisfaction. The literature suggests that the patient severity of illness, the physical layout of the work environment, the experience and education levels of the nurse, and the relationships between the nurses, physicians, and managers in the work environment may all have some degree of impact upon patient outcomes, patient satisfaction and nurses’ job satisfaction. These kinds of variables are most often different between patient care units and staffing strategies might be more effective on an individual setting basis rather than a one size fits all mandated ratio approach.

Implications for Future Research

It is difficult to know if the differences between the RN, LVN, and total nursing costs between 2002 and 2006 are the same in the state’s rural hospitals and urban hospitals. The nursing shortage is more critical in rural areas and it has been estimated that the rural RN shortage has been under-estimated in these areas (Cramer, Nienaber,
Helget, & Agrawal, 2006). Further study needs to be conducted on the hospitals by geographic regions. Similar examination of the unit support staff productivity by geographic reason should also be done. There is a need to further examine staffing mixes especially in rural hospitals.

The use of agency nursing staff after the implementation of the nurse-to-patient staffing ratios was not singled out in this study. It would be worthwhile to examine the use of agency staffing before and after the ratios were implemented to determine if the use of the more expensive agency nursing staff was a major factor in the increased percentage of total hospital operating expenses noted in this study.

Finally, through merger of the OSHPD data and the Center for Medicare utilization data risk adjusted for severity of illness, it would be useful to examine for a relationship between the patient length of stay and the percentage of total hospital operating costs attributed to nursing costs. The literature suggests there may be a relationship between increased nurse staffing and decreased length of stay. It also may be necessary to examine the occurrence of “never events” and other adverse events and whether the accompanying lack of CMS reimbursement changes the landscape in terms of RN staffing. Another area of exploration includes whether or not actual costs of complications goes down over time as RN staffing ratios improve.
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