# NURSE RESOURCES AND SURGICAL OUTCOMES IN ELDERLY PATIENTS: THE ROLE OF THE SAFETY NET

by

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A Dissertation submitted to the

Graduate School-Newark

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Nursing

written under the direction of

Professor Jeannie P. Cimiotti

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Newark, New Jersey

October 2014

## ABSTRACT OF THE DISSERTATION

Nurse Resources and Surgical Outcomes in Elderly Patients: The Role of the Safety Net

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**Background**: Hip fracture is common in older adults and often requires surgical intervention. Co-management of these patients by geriatricians and orthopedic surgeons has been linked to better outcomes; however, little is known about the allocation of nurse resources and the quality of care in elderly surgical patients. **Objective:** Examine the allocation of nurse resources in safety net hospitals and non-safety net hospitals and the association between nurse resources and outcomes in elderly patients admitted for surgical repair of hip fracture. Outcomes of interest included in-hospital-mortality, length of stay (LOS) and prolonged length of stay (PLOS). **Methods:** Retrospective study of all patients 65 years of age and older (n = 10,686) admitted to New Jersey acute care hospitals from January 1, 2010 to December 31, 2011 for surgical repair of hip fracture. Data were from New Jersey Department of Health and Senior Services, New Jersey Hospital Association, State Inpatient Database, American Nurses Credentialing Center and Hospital Alliance of New Jersey. Data were merged and examined using descriptive and inferential statistics. **Results:** There was no difference in allocation of nurse resources in safety net and non-safety net hospitals. Patients admitted to safety net hospitals had a 44% increase in odds of in-hospital mortality (*p* = 0.004), 9% increase in LOS (*p* = 0.06) and 51% increase in odds of PLOS (p = 0.041). Each additional hour of registered nurse care per patient day was associated with a 1% decrease in LOS (*p* = 0.058) and 9% decrease in the odds of prolonged length of stay (PLOS) (*p* = 0.012). Magnet accreditation moderated the effect of skill mix and was associated with a 33% decrease in odds of in-hospital mortality (p = 0.059), 67% decrease in LOS (p = 0.000), 99% decrease in odds of PLOS (p = 0.001). Magnet accreditation moderated the effect of registered nurse hours per patient day and was associated with a 53% increase in odds of PLOS (p = 0.001). **Conclusion:** Hospital safety net status and availability of nurse resources are associated with the quality of care in elderly patients admitted for surgical repair of hip fracture.

**ACKNOWLEDGEMENT**

I would like to thank my dissertation Chairperson Dr. Jeannie P. Cimiotti for her boundless energy, research acumen, and commitment to my learning during the dissertation process. Dr. Cimiotti met with me on weekends for highly individualized mentoring sessions regarding methods and data analysis. I have learned a great deal about health services research under her caring instruction. More importantly, Dr. Cimiotti is the change she hopes to see in the world. She pays it forward while leading a conscious and ethical life. I have learned how to balance rigorous academic work with kindness, ethical conduct, and a sense of humor from watching Dr. Cimiotti in action. Thank you, Dr. Cimiotti, thank you.

I would also like to thank the dissertation committee members: Dr. Boyer, Dr. de Cordova, and Dr. Gray-Miceli for their generous offering of time and talents. In addition, I would like to thank Dean Holzemer and Dean D'Alonzo for the Teaching Fellowship appointment that provided substantial support for my doctoral studies.

Lastly, I am very blessed and grateful for the love and support of friends and family. My dear husband Abbas has been at my side during the entire dissertation process as a constant reminder of God's grace. My daughters, Hannah and Sarah, mean the world to me. I am so deeply grateful for the sacrifices they have made during the years I have been working and not with them: thank you, girls. I also want to thank my siblings: Ron, Mary and Ken for their imagination, wit, and understanding. I trust this dissertation is a positive contribution to the family legacy. I love you all deeply.

## DEDICATION

To

Jeannie P. Cimiotti, PhD, RN, FAAN

"Strenuous intellectual work and the study of God's Nature are the angels that will lead me through all the troubles of this life with consolation, strength, and uncompromising rigor."

—Albert Einstein --- To Pauline Winteler – July 3,1897. Albert Einstein Anthology 29–453

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# CHAPTER I. THE PROBLEM

## Discussion of the Problem

Hip fracture in older adults is a common event, and the resulting post-surgical outcome is a major public health concern. Among the elderly, hip fractures lead to substantial morbidity and mortality (Friedman, Mendelson, Bingham, Kates, & McCann, 2009). There are approximately 350,000 hip fractures per year in the United States and more than 90% occur in individuals aged 65 and older (Morris & Zuckerman, 2002). It is estimated that by 2050, hip fractures in the United States may exceed 500,000 annually with the largest number of fractures occurring in females older than 65 years of age (Brown, Starr, & Nunley, 2012).

Surgical intervention is the treatment of choice for patients with hip fractures, in order to return to their pre-injury level of function (Browne, Pietrobon, & Olson, 2009). Hip fractures are mostly a condition of adults 65 years of age and older with the incidence of hip fracture peaking over age 75 (National Center for Health Statistics, 2013). Among this age group, patients have chronic, comorbid conditions that must be managed along with their surgical course of treatment. In the United States, comorbidities among patients with hip fractures have increased (Brauer, Coca-Perraillon, Cutler, & Rosen, 2009). As more comorbid diseases occur the mortality rate from hip fracture can increase up to as much as 9% (Neuhaus, King, Hageman, & Ring, 2013).

Every year, billions of dollars are spent on an ever-increasing number of hip surgeries in the United States. Reducing length of stay for patients undergoing primary total hip replacement has become an important cost control mechanism, as this population is a primary driver of inpatient costs due to hip fracture (Cram et al., 2011).

Hip fracture procedures continue to increase along with the aging population. However, research on the relationship between the allocation of nurse resources and surgical outcomes related to hip fracture is largely unexplored. Co-management of hip fracture by geriatricians and orthopedic surgeons has been reported to lower mortality and length of stay in elderly adults following surgical repair of hip fracture (Della-Rocca et al., 2013; Friedman et al., 2009). Identifying high-risk patients in the preoperative period and minimizing perioperative events are imperative if we are to provide optimal care (Brown, Olson, & Zura, 2012).

In an effort to provide optimal care to those with limited ability to pay, federal policy makers have established what is commonly referred to as the safety net. Safety net hospitals are defined as providers that deliver a significant level of health care and other health-related services to the uninsured, Medicaid, and vulnerable populations (IOM, 2000) who also often present with social problems such as lack of education, lack of access to care, drug abuse, and homelessness (Dohan, 2002). Safety net hospitals tend to be located in geographic areas where the poor and racial or ethnic minorities reside, serving a disproportionate share of uninsured patients (Mobley, Kuo, & Bazzoli, 2011).

Since the late 1990s, safety net hospitals have been under financial strain due to hospital closures, increases in the demand for health care services among indigent and Medicaid populations, and the high costs of care for the uninsured (Mobley et al., 2011; Ross et al., 2012; Bazzoli, Kang, Hasnain-Wynia, & Lindrooth, 2005). Safety net hospital closures and conversions result in loss of local access to vital health care services for vulnerable individuals with limited access to healthcare outside of their neighborhoods (Mobley et al., 2011). Medicare and Medicaid and graduate medical education (GME) provide financial support for safety net hospitals, but a large amount of funding is at the local level (Meyer, 2004). Since nursing is one of the largest budget items in hospitals, financial strain that safety net hospitals encounter will most likely result in inadequate allocation of nurse resources.

Evidence shows that safety net hospitals have higher 30-day mortality in patients admitted with acute myocardial infarction, heart failure, and pneumonia when compared to non-safety-net hospitals, and that this higher mortality rate persists even after adjustment for patient characteristics (Popescu, Werner, Vaugn-Sarrazin, & Cram, 2009; Ross et al., 2012; Werner, Goldman, & Dudley, 2008). Among these same patients the rate of hospital readmission is higher in safety net hospitals when compared to the same patient types in non-safety net hospitals (Ross et al., 2012).

In New Jersey, there are more than 1.3 million residents who are uninsured and over 560,000 Medicaid recipients (Hospital Alliance of New Jersey, 2006). This health care crisis has resulted into almost one third of New Jersey hospitals being identified as part of the state's health care safety net (see Table 1.1). Despite these data little has been reported on safety net hospitals in terms of the allocation of nurse resources and the quality of surgical care in our nation's most densely populated state – New Jersey.

Table 1.1 New Jersey Safety Net Hospitals by Current Location (n = 18)

| | |
|---|---|
| Cooper Health System | Camden |
| Our Lady of Lourdes Medical Center | Camden |
| East Orange General Hospital | East Orange |
| Trinitas Regional Medical Center | Elizabeth |
| Christ Hospital | Jersey City |
| Jersey City Medical Center | Jersey City |
| St. Barnabas Medical Center | Livingston |
| Southern Ocean Medical Center | Manahawkin |
| Jersey Shore University Medical Center | Neptune |
| Newark Beth Israel Medical Center | Newark |
| St. Michael's Medical Center | Newark |
| UMDNJ – University Hospital | Newark |

| | |
|---|---|
| Palisades Medical Center | North Bergen |
| St. Mary's Hospital | Passaic |
| St. Joseph's Regional Medical Center | Paterson |
| Meadowlands Hospital and Medical Center | Secaucus |
| Capital Health Regional Medical Center | Trenton |
| St. Frances Medical Center | Trenton |

**The Practice Environment.** A hospital's organizational climate has been linked to patient mortality (Aiken, Smith, & Lake, 1994) and has been shown to negate the effect of lowering the patient-to-nurse ratios in hospitals with poor environments (Aiken et al., 2011). Research has shown that Magnet hospitals, those that afforded greater status, autonomy, and control to nurses, have nurse resources that impact the quality of nursing care (Aiken, Clarke, Sloane, Lake, & Cheney, 2008; Aiken et al., 2011). Nurses working in Magnet hospitals have ability to provide high quality care that has been linked to a decrease in mortality and failure-to-rescue in surgical patients (McHugh et al., 2013).

Over the past decade there has been substantial empirical evidence to suggest that better nurse staffing, and better practice environments are associated with improvements in the quality patient care (Aiken et al., 2011; Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken, Sloane, Lake, Sochalski, & Weber, 1999; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Tourangeau et al., 2007). However, the allocation of nurse resources, such as nurse staffing and skill mix, in safety net hospitals and the outcomes of surgical care in the elderly with hip fracture remains largely unexplored.

**Nurse Resources.** Little is known about the relationship between the allocation of nurse resources and in-hospital mortality in elderly patients with hip fractures. Only one report has reported details on the relationship between nurse staffing levels and surgical outcomes in hip fracture (Schilling, Goulet, & Dougherty, 2011). The findings from this report showed that in-hospital mortality decreased by 16% for each additional full-time equivalent (FTE) registered nurse added per patient day.

Two landmark studies linked nursing staffing and skill mix to the quality of care in surgical patients. In 2002, Aiken et al. reported that each patient added to a nurse's workload increased the odds of patient mortality and failure-to-rescue in surgical patients. Needleman et al. (2002) reported a higher proportion of hours of registered nurse care (skill mix) and a greater number of hours of care by registered nurses per day were associated with a decrease in urinary tract infection and failure-to-rescue in surgical patients.

Adequate nurse resources allow for 24-hour surveillance of patients, which has been linked to the quality of care (Kutney-Lee, Lake, & Aiken, 2009). Nurses play a critical role in the safety and well-being of surgical patients. Nurse surveillance and rapid response teams enable early recognition of complications and the ability to "rescue" patients from mortality (Leach, Kagawa, Mayo, & Pugh, 2012).  However, to date, there are no studies that have been published to support or refute the role of nurse resources in mortality, failure-to-rescue, and length of stay in older adults following surgical repair of hip fracture. Further investigation of the relationship between nurse resources and the quality of care in elderly patients admitted for surgical repair of hip fracture is desperately needed.

This study seeks to address the gap in the literature that describes the relationship between the allocation of nurse resources in safety net and non-safety net hospitals and surgical outcomes of elderly adults admitted with a diagnosis of hip fracture. The findings from this study will provide substantial details on safety net hospitals and non-safety-net hospitals, their allocation of nurse resources and the quality of care in elderly adults admitted to acute care hospitals for surgical repair of a hip fracture. This data can then guide policy decisions aimed at improving surgical outcomes for the elderly with hip fracture who rely on our safety net hospitals to provide their surgical care.

**Statement of the Problem**

Do safety net hospitals provide the same quality of care as their non-safety net counterparts and are surgical outcomes in the elderly related to the allocation of nurse resources namely differences in the number of nurses and ancillary staff employed in these hospitals?

**Definition of Terms**

Table 1.2 includes the list of dependent variables, independent variables, and the control variables that were used to analyze data and report the findings in this study.

Table 1.2 Variables that were Examined in this Study

| **Dependent Variables** | **Independent Variables** | **Control Variables** |
|---|---|---|
| In-hospital mortality | Safety net designation | Bed size |
| Failure-to-rescue | Nurse staffing | Teaching status |
| Length of stay | RN skill mix | Technology status |
| Prolonged length of stay | Magnet accreditation | Patient characteristics |

**Sample**

Hip fracture was conceptually defined as a fracture of the neck of the femur and was operationally defined based on the following *International Classification of Diseases, Ninth Revision* (ICD-9-CM) codes 820.00-09, 820.21-22, and 820.8 (Neuman, Fleisher, Even-Shoshan, Mi, & Silber, 2010).

Surgical repair of hip fracture was conceptually defined as a procedure to remove a diseased hip and was operationally defined based on the following ICD-9-CM codes 78.55, 79.15, 79.35, 81.51, and 81.52 (Neuman et al., 2010).

**Dependent Variables (Outcomes)**

**Mortality.** In-hospital mortality was conceptually defined as a hospital outcome of mortality (National Quality Forum, 2009). Hip fracture mortality rate was operationally defined as the number of deaths among patients meeting the inclusion and exclusion rules for a principal diagnosis code for hip fracture divided by all discharges, age 65 years and older, with a principal diagnosis code for hip fracture (AHRQ, 2004).

Failure-to-rescue was conceptually defined as mortality among surgical patients due to treatable serious complications (Silber, Williams, Krakauer, & Schwartz, 1992). Failure-to-rescue was operationally defined as the percentage of patients with hip fracture that experienced a hospital-acquired complication (i.e., sepsis, pneumonia, gastrointestinal bleeding, shock/cardiac arrest, deep vein thrombosis/pulmonary embolism) and died (National Quality Forum, 2004).

**Length of Stay.** Length of stay (LOS) was conceptually defined as the number of acute medical and surgical inpatient days associated with an admission (National Quality Forum, 2013). Two measures of LOS were examined: 1) traditional LOS, and 2) prolonged LOS. Traditional length of stay was operationally defined as the discharge date minus the admission date (AHRQ, 2012). Prolonged length of stay was operationally defined as a length of stay two deviations above the mean (Foer, Ornstein, Soriano, & Dunn, 2012).

**Independent Variables (Predictors)**

**Safety net hospital.** A safety net hospital was conceptually defined as a provider that by mandate or mission organizes and delivers a significant level of health care and other health-related services to the uninsured, Medicaid, and other vulnerable populations (IOM, 2000). Safety net hospital was operationally defined as either a public or private acute care hospital with a federal designation as “safety net.”

**Nurse resources.** Nursing resources were conceptually defined as nurse staffing levels and the skill mix of nurses, and practice environment on nurses (Aiken et al., 2013). Nurse staffing was operationally defined as the number of registered nurse hours per patient day (National Quality Forum, 2004). Skill mix was operationally defined as the percentage of registered nurse care hours to total nursing care hours of all nursing hours (National Quality Forum, 2004).

Magnet hospital, a measure of practice environment, was conceptually defined as a hospital that has been particularly successful in attracting and retaining professional nursing staff and has a reputation as being a good place to work and a hospital that provides good nursing care (McClure, Poulin, Sovie, & Wandelt, 1983). Magnet hospital was operationally defined as a hospital that meets the rigorous standards of accreditation through the American Nurses Credentialing Center (ANCC, 2013).

## Control Variables

Based on the theoretical and empirical literature several control variables were examined as potential confounders in the analyses. Hospital controls were based on previous work (Silber et al., 1992) and include bed size which was stratified into three groups: <100 beds, 101-250 beds, and >251 beds. Teaching status was classified as hospitals with no post graduate medical residents or fellows (non-teaching); 1:4 or smaller trainee-to-bed ratio (minor teaching), and those with higher than 1:4 (major teaching). High technology hospitals were those facilities that provide services for open-heart surgery, organ transplantation, or both. Hospital type will be not-for-profit, for-profit, and government owned.

Patient controls included age, gender, race, income, and source of admission Based on previous work on the elderly with hip fracture (Neuman et al., 2010), age was stratified into three groups: 65-74, 75-84, and 85 and over. Gender was defined as male or female; and race was defined as white, black, Hispanic, and other race. Income was defined as the median household income national quartile based on patient ZIP code. Source of admission was defined as emergency department, hospital transfer, and skilled nursing facility and home. Hip fracture type was defined based on ICD-9 codes as intertrochanteric fracture (820.21), transcervical fracture, other (820.09), unspecified part of neck of femur (820.8), transcervical fracture base of neck (820.03), subtrochanteric fracture (820.22), and other fracture location or multiple fractures. Hip fracture characteristics were defined as pathologic fracture (733.14) or multiple trauma. Multiple trauma was defined based on the presence of one of 11 DRG codes (DRG 280, 418, 444-5, 484-7, 506, 508, 510). Comorbid disease was defined as the mean number of comorbid diseases and the type of comorbid disease was defined as outlined in the Elixhauser Comorbidity Index (Elixhauser, Steiner, Harris, & Coffey, 1998).

**Delimitations**

In this study the hospital sample included all 73 adult acute care hospitals in the state of New Jersey.

The patient sample included all patients 65 years of age and older discharged from a New Jersey acute care hospital between January 1, 2010 and December 31, 2011 for the surgical repair of femoral neck or intertrochanteric hip fracture. Only those patients who underwent subsequent open reduction or internal fixation or both, hemiarthroplasty, or total hip arthroplasty were included. In addition, patient records with coding errors, such as incomplete data, were excluded.

**Significance**

Recent report from the U.S. Census (2012) suggests that poverty in New Jersey has reached a 50-year high, and the City of Camden has been ranked as the poorest city in our nation. This economic crisis has left a third of New Jersey residents 65 years of age or older living at 200% below the poverty level (Levinson, Damico, Cubanski, & Neuman, 2013). How poverty among the elderly translates into health care delivery and health care quality in our nation’s most densely populated state has not been adequately explored. This study was the first to examine how safety net hospitals allocate nurse resources and how these resources are associated with the quality of surgical care in elderly patients admitted to an acute care hospital for surgical repair of hip fracture.

In the Institute of Medicine’s seminal report, *Keeping Patients Safe: Transforming the Work Environment of Nurses* (2004) strong relationships were found between patient outcomes and the availability of nurse resources. This study examined how nurse resources were allocated in safety net hospitals; and whether differences in nurse resources were associated with the quality of care in safety net hospitals and their non-safety net counterparts. Safety net hospitals have been described as "intact but endangered" in the Institute of Medicine (IOM) report: America's *Safety Net Hospitals*

*(IOM, 2000).* Safety net hospital closures and conversions result in loss of local access to vital health services for vulnerable individuals with limited access to health care outside their neighborhoods (Mobley et al., 2011). New Jersey has invested resources into its safety net; however, there is no evidence available that describes the role of nursing in these facilities that serve our most vulnerable patients – the elderly and the poor.

This study examined nurse resources defined as nursing staffing, registered nurse skill mix and the practice environment in all of New Jersey's acute care hospitals, both safety net and non-safety net. It was the first to examine nurse resources and surgical outcomes in elderly patients with hip fracture. The outcomes of interest are the gold standard in health services research – mortality, failure-to-rescue, and length of stay. This study provides the empirical evidence that is necessary to evaluate the relationship between nurse resources and the quality of surgical care by examining New Jersey's investment in the safety net.

The new knowledge generated by this study provides evidence for hospital administrators, accrediting agencies, insurers and regulators on which to base decisions and policies to ensure that nurse resources are given priority in an effort to improve the overall quality of hospital care.

# CHAPTER II. REVIEW OF THE LITERATURE

Chapter II is presented in three sections. The first section is a review the literature relating to the independent variables: hospital structure, nursing resources and the dependent variables: in-hospital mortality, failure-to-rescue, and length of stay. The second section describes the theoretical rational and framework that guided this current study. Lastly, the hypotheses are presented in the third and last section of Chapter II. The hypotheses were based on the literature reviewed and guided by the theoretical framework.

## Independent Variables

**Safety net hospitals**. Safety net hospitals play a vital role as a health service resource provider. Although the mission of safety net hospitals is to provide quality care for the underserved, studies of the quality of care at safety net hospitals compared to non-safety net hospitals have reported mixed results.

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey is a standardized instrument for measuring patients' perspective of hospital care. Chatterjee, Joynt, Orav, and Jha (2012) used HCAHPS data to compare patient experiences in 769 safety net and 2,327 non-safety net hospitals. Safety net hospitals were more likely to be large, teaching hospitals that were publicly owned or for-profit, and cared for significantly more Medicaid and black patients with fewer nurses per 1000 patient days ($p < 0.001$). Patients in safety net hospitals had lowest HCAHPS scores on nearly every measure including adequate nursing services (60.2% versus 62.4%, 2.2 percentage point difference, $p < 0.001$), pain management (67.4% versus 69.5%, 2.1 percentage point difference, $p < 0.001$), and discharge information (80.2% versus 82.8%, 2.8 percentage point difference, $p < 0.001$). Safety net hospitals had 60% lower odds of achieving the recommended performance benchmark ($p < 0.001$) when compared to non-safety net hospitals.

A significant amount of evidence is available that links nurse staffing to the quality of care, but only a few studies have examined nurse staffing in safety net hospitals. In California, where nurse staffing levels are mandated by legislation, it was found that safety net hospitals were staffing below the required minimum ratio of at least 1 nurse per 5 patients when compared to general acute care hospitals (Conway et al., 2008). On average safety net hospitals had a high proportion of Medicaid/uninsured patients (21.7%) were government owned (21.1%), nonteaching (12.0%), urban (11.9%), and provide care in more competitive markets (11.7%). During the period 2003 to 2004, hospitals with a low Medicaid population or non-safety net hospitals were able to achieve decreases in their percentages of hospitals staffing below minimum ratio of at least 1 nurse per 5 patients; however safety net hospitals with their high proportion of Medicaid/uninsured patients were not able to achieve decreases in the percentage of hospitals staffing below minimum ratio.

Similarly, McHugh et al. (2012) compared the effects of California's patient-to-nurse ratio mandate on nurse staffing and skill mix trends in California safety net hospitals from 1998 to 2007. Of the 173 California hospitals included in this study, 28 were designated safety net hospitals. For the initially compliant safety net hospitals the mandate had the effect of reducing patient-to-nurse ratios by 0.46 patients per nurse; however, there was a significant disparity in the magnitude of the change in patient-to nurse-ratio between safety net and non-safety net hospitals (0.27 patients per nurse, $p$ =

0.02). The skill mix in all hospitals increased significantly from the pre-implementation period to the post-implementation period (0.02 patient per nurse; $p = 0.001$); however, the effect of the staffing mandate did not increase skill mix significantly in safety net hospitals (0.01; $p = 0.3$). Nurse staffing tended to be worse in California safety net hospitals where a majority of the poor and minority patients received their care.

Blegen, Goode, Spetz, Vaughn, and Park (2011) examined the relationship between nurse staffing and patient outcomes in 46 safety net hospitals and 8 non-safety net hospitals and reported mixed findings. Over 1 million patients discharged from both adult general and intensive care units and staffing for 872 patient care units were included in the analyses. Staffing was measured as total hours of registered nurse, licensed practical nurse and nursing assistant per inpatient day, and registered nurse skill mix. On adult general units in safety net hospitals, more total hours per inpatient day was associated with significantly higher rates of congestive heart failure mortality ($p < 0.05$), while a higher proportion of registered nurses, that is, better registered nurse skill mix was significantly associated with fewer patients with extended length of stay ($p < 0.01$). On adult intensive care units in safety net hospitals, better registered nurse skill mix was associated with higher rates of congestive heart failure mortality ($p < 0.05$) and lower rates of failure to rescue ($p < 0.05$).

The performance of safety net and non-safety net hospitals were examined as well as disparities in the quality of care (Werner, Goldman, & Dudley, 2008). In these analyses a safety net hospital was defined based on the percentage of patients insured by Medicaid. Safety net hospitals were more likely to be large, government run, and major teaching hospitals. Safety net hospitals when compared to non-safety net hospitals had significantly lower baseline (calendar year 2004) Hospital Compare condition-specific composite performance scores for acute myocardial infarction (84.9 versus 87.7, $p < 0.001$), heart failure (73.7 versus 77.2, $p < 0.001$), and pneumonia (75.7 versus 78.7, $p < 0.001$). Over time (calendar year 2006), the performance gains for safety net hospitals were smaller than for non-safety net hospitals for acute myocardial infarction (2.3 versus 3.8; $p = .03$), heart failure (6.6 versus 8.0; $p = .04$), and pneumonia (8.0 versus 9.3; $p < 0.001$). It should be noted that financing of safety-net hospitals might require subsidies to address the costs of quality improvement. Despite their significant performance gains from 2004 to 2006, safety net hospitals nonetheless continue to be identified as poorly performing hospitals.

Health care quality ranks high on the national agenda, and the quality of hospital care and hospital-acquired conditions are a priority of the Center for Medicare and Medicaid Services (CMS). A recent body of research on surgical outcomes has focused on safety net hospitals and how those hospitals compared to their non-safety counterparts (Boehmer, Harris, Bowen, & Schroy, 2010; Genther & Gourin 2012; Virgo et al., 2011; Whitaker, Reiter, Weinberger, & Stearns, 2013). Whitaker et al. (2013) reported on surgical outcomes and post-operative complication rates for colorectal cancer surgery at safety net and non-safety net hospitals. Patients 40 years of age or older with a primary or secondary diagnosis of non-recurrent, non-metastatic colorectal cancer who had undergone colon or rectal surgery were selected from the National Inpatient Sample. Surgical outcomes data on 62,206 patients hospitalized in 162 safety net hospitals and 1,561 non-safety-net hospitals were compared. Safety net hospitals had higher percentages of Medicaid and uninsured patients when compared to non-safety-net hospitals, and safety net hospitals were more likely to be urban teaching hospitals (66.5% versus 40.2%; $p < 0.001$). Length of stay in safety net hospitals was longer than in non-safety-net hospitals (11.4 versus 9.4 days; NS). Medicaid and uninsured patients in safety net hospitals had a significantly lower rate of post-operative complication when compared to Medicaid and uninsured patients in non-safety net hospitals (27.3 %, CI: .228, .333 versus 34.0%; CI: .313, .365). The 7% reduction in the rate of post-operative complications for Medicaid and uninsured patients at safety net hospitals is almost a 20% reduction from the complication rate at non-safety-net hospitals for vulnerable Medicaid and uninsured patients.

Genther and Gourin (2012) examined the effect of safety net hospital status on short-term outcomes in patients undergoing ablative procedures for head and neck cancer. Data on 123, 662 adult patients age ≥ 18 years who underwent an ablative procedure for head and neck cancer during the years 2001 through 2008 were obtained from the National Inpatient Sample. Safety net burden was calculated as the percentage of patients with head and neck cancer with Medicaid or no insurance, and high and low safety net burden hospitals comprised 31% and 55% of all hospitals, respectively. Patients treated at high safety net burden hospitals were 70 % more likely to be black ($p < 0.02$), 35% more likely to have advanced comorbid disease ($p = .02$), 24% more likely to undergo major surgical procedures ($p = .001$), and 54 % more likely to be admitted urgently or emergently ($p =0.03$). After controlling for all other variables, safety net burden status was associated with a significant increase in length of stay of 1 day ($p < 0.001$). Safety net burden was not significantly associated with in-hospital mortality ($p = 0. 22$), acute medical conditions, or surgical complications

Virgo et al. (2011) examined the relationship between hospital safety net burden and receipt of curative-intent surgery in adult patients. The National Cancer Data Base was used to identify adult patients diagnosed with invasive initial primary early-stage non-small cell lung cancer during 2003-2005. The final analytic cohort contained 52,853 patients. The primary hospital characteristic of interest, hospital safety net burden, was defined as the percent of all treated Medicaid or uninsured cancer patients per Commission on Cancer-accredited hospital throughout the United States during 2003-2005. High safety net burden hospitals served ≥ 16.02 % uninsured or Medicaid patients. Regardless of race, among patients treated at high safety-net burden hospitals there was a 31% decrease in the odds of curative-intent surgery ($p < 0.01$). Among non-Hispanic whites and blacks treated in high safety-net burden facilities there was a 29% and 41% decrease in the odds of curative-intent surgery, respectively ($p < 0.01$).

A longitudinal study of one safety net hospital was conducted to identify whether endoscopic surveillance following diagnosis of non-metastatic colorectal cancer occurred within one and three years of resection (Boehmer et al., 2010). At this safety net hospital, post-resection colorectal cancer surveillance was provided regardless of the client's ability to pay. Both clinical and administrative data were used to identify the 253 patients with a non-metastatic colorectal cancer diagnosis during the study period. Black patients were two times more likely to receive a colonoscopy within three years post-resection when compared to whites, and patients of other race. On average, black patients had significantly more post-resection visits than whites and patients of other race (45.3, 29.6 and 38.8, respectively, $p$ <0 .05).

Using administrative discharge data, Bradley, Dahman, Shickle, and Lee (2012) examined differences in care delivery for patients with breast cancer across safety net and non-safety net hospitals. The Virginia Cancer Registry and Virginia Health Information discharge data were linked and supplemented with American Hospital Association data for the years 1999-2005. Data were gathered on female patients with breast cancer ages 21-64 (n = 6,641) with surgical intervention of mastectomy within 12 months of diagnosis. A higher percent of women in safety net hospitals were uninsured (17.3% versus 4.6%) and on Medicaid (6.2% versus 3.0%, $p < 0.0001$). In addition, women in safety net hospitals traveled further for care. It was reported that 43.6% of the women treated in safety net hospitals lived within 20 miles of the hospital; whereas, 85.3% women treated in non-safety net hospitals lived within 20 miles of the hospital ($p < 0.0001$). Time from diagnosis to mastectomy was longer in safety net hospitals for all patients compared to patients treated in non-safety net hospitals (59.6 days versus 43.5 days; $p < 0.0001$). The uninsured, Medicaid participants, privately insured, and those of black and white race hospitalized in a safety net hospital all experienced time delays to mastectomy when compared to patients in non-safety net hospitals ($p < 0.05$ for all).

**Magnet hospitals.** Magnet hospitals are those noted for good nursing care. McHugh et al. (2013) examined the surgical outcomes of mortality and failure-to-rescue in 641,187 patients hospitalized in 58 Magnet hospitals (109,090 patients) and compared them to patients in 508 non-Magnet hospitals (532,097 patients) in California, Florida, Pennsylvania, and New Jersey. It was reported that Magnet hospitals had significantly better work environments as measured by the Practice Environment Scale (PES) composite score when compared to non-Magnet hospitals (2.86 versus 2.66; $p < 0.001$).

Magnet hospitals also used a significantly lower proportion of supplemental nursing staff (0.04 versus 0.05; $p < 0.03$) and a higher proportion of nurses with specialty-certification (0.40 versus 0.36; $p < 0.03$). Nurses in Magnet hospitals cared for fewer patients when compared to nurses in non-Magnet hospitals (4.82 versus 5.03 patients-to-nurse; $p = 0.056$). Significantly fewer surgical patients died in Magnet hospitals when compared to similar patients in non-Magnet hospitals (1.5% versus 1.8%, $p < 0.001$), and the failure-to-rescue rate was lower in Magnet hospitals when compared to non-Magnet hospitals (3.8% versus 4.6%, $p < 0.001$). Surgical patients were 20% less likely to die and 19 % less likely to die from failure-to-rescue in a Magnet hospital when compared to patients in non-Magnet hospitals.

Aiken, Smith, and Lake (1994) compared Magnet hospitals, those known to be good places to practice nursing, to non-Magnet hospitals to examine differences in Medicare mortality. One hundred ninety five hospitals were used as controls, five for each of the 39 Magnet hospitals by a multivariate matching procedure. Findings included an estimated Magnet effect of -0.048 ($p = 0.034$), which is equivalent to 4.8% decrease in excess mortality in the Magnet hospitals. The reliability of the estimates of hospital-specific excess mortality was 0. 81

Lake, Shang, Klaus, and Dunton (2010) examined nurse staffing on 5,388 nursing units in 636 hospitals, including RN composition, Magnet accreditation, and patient falls using the National Database of Nursing Quality Indicators (NDNQI). The sampled nursing units reported 113,067 patient falls. Hours per patient day were calculated as nursing care hours divided by patient days. Hospital adherence to standards of nursing excellence, which may translate into greater safety and quality, was measured using

Magnet accreditation. Magnet accreditation was associated with a 5% decrease in the likelihood of falls ($p < 0.001$). Each additional RN hour per day was associated with a 2% decrease in the fall rate; each additional hour of LPN hours and NA hours were associated with an increase in falls of 3% ($p < 0.01$) and 1.5% ($p < 0.05$), respectively. RN hours per patient day in Magnet hospitals was significantly higher than non-Magnet hospitals (8.50 versus 7.70, $p < .01$).

**Nurse resources.** In a landmark study, Aiken et al. (2002) examined the association between the patient-to-nurse ratios, and patient mortality and failure-to-rescue in 232,342 patients admitted to 210 Pennsylvania hospitals for general surgery in 1998 and 1999. Of the patients studied 53, 813 (23.2%) experienced a major complication that was not present on admission and 4,535 (2.0%) died within 30 days of admission. The mortality rate among patients with complications (failure-to-rescue) was 8.4%. The effect of nurse staffing was significant for both mortality and failure-to-rescue, where the odds of patient mortality increased by 7% for every additional patient in the average nurse's workload in the hospital. Increasing nurses' workload from 4 to 6 patients increased the odds of mortality by 14%. Increasing a nurses' workload from 4 to 8 patients per nurse increased the odds of mortality by 31%. In the same year, Needleman et al. (2002) reported similar findings. Data from over 6 million medical and surgical patients admitted to 799 hospitals in 11 states were examined to determine if nurse staffing was associated with adverse patient events such as mortality and failure-to-rescue. Staffing measure included hours of nursing care per day and skill mix or the proportion of hours of care per day provided by RNs. Among surgical patients a higher proportion of care hours provided by RNs was associated with a 33% ($p = 0.04$) decrease in rates of urinary tract infection and a greater number of care hours provided by RNs was associated with a decrease of 2% ($p = 0.008$) in the rate of failure-to-rescue. Similar findings were reported among medical patients where a higher proportion of care hours provided by RNs and a greater number of care hours provided by RNs were significantly associated with shorted length of stay (IRR = -1.12, $p = 0.01$; IRR = -0.09, $p < 0.001$), and lower rates of urinary tract infection (IRR = 0.48, $p < 0.001$; IRR = 0.99, $p < 0.003$), gastrointestinal bleeding (IRR = 0.66, $p = 0.03$; IRR = 0.98, $p < 0.007$), hospital-acquired pneumonia (IRR = 0.59, $p = 0.001$; NS), and shock or cardiac arrest (IRR = 0.46, p = 0.007; NS).

Nurse workload and patient turnover have the potential to impair the quality of patient care. Needleman et al. (2011) examined nursing shifts and patient data that were obtained from electronic discharge abstracts from 2003 to 2006. Nursing shifts of 8-hour blocks of time and the final merged data set that included 197,961 admissions and 176,696 nursing shifts in 43 hospital units were analyzed. Nurse staffing was calculated as the difference between target hours for a shift and the actual hours worked on the unit. Patient turnover was calculated for each shift and was equal to the sum of unit admissions, transfers, and discharges and the adjusted or start-of-shift census. A high turnover shift was one where the rate of turnover was greater than or equal to the mean plus one standard deviation. When the patient was exposed to an increased number of below-target shifts for all hospital admissions the risk of mortality increased by 2 % ($p < 0.001$). When counts of below-target shifts were restricted to those in the first 5 days after admission there was a 3% ($p < 0.001$) increase in the risk of mortality. Lastly, there was a 4% increase in the risk of mortality associated with high patient turnover ($p < .001$).

In a study of 283 California acute care hospitals, Harless and Mark (2010) estimated the impact of changes in RN staffing on mortality. Outcomes of care for 11,945,276 adult patients were based on data from 1996 to 2001. Staffing levels were measured as FTEs per 1000 inpatient days. For the mortality ratio at the 25th percentile, 50$^{th}$ percentile, and 75$^{th}$ percentile value of RN staffing, a 1-unit increase in FTEs per 1000 inpatient days was associated with significant decreases in observed mortality of 4.3%, 4.0%, and 3.5%, respectively. For the failure-to-rescue ratio at the 50$^{th}$ and 75$^{th}$ percentile value of RN staffing, a 1-unit increase in RN FTEs per 1000 inpatient days was associated with a 7.0% and an 8.8 % decrease in failure-to-rescue, respectively.

Brooks Carthon, Kutney-Lee, Jarrin, Sloane, and Aiken (2012) examined the association between nurse staffing and surgical outcomes in older minority surgical patients admitted to 599 acute care hospitals using patient discharge data from California, Pennsylvania, New Jersey, and Florida. Included in these analyses were 548,397 general surgery patients aged 65–99. After controlling for hospital and patients characteristics, and socioeconomic status it was found that each additional patient added to the average nurses workload was associated with a 3% (CI: 10.1-1.05) increase in odds of mortality. For those patients who had experienced a postsurgical complication (n = 231,390), each additional patient added to the average nurses workload was significantly associated with a 4% increase in the odds of failure-to-rescue. When compared to whites, patients who were black had higher odds of mortality where each additional patient per nurse was associated with a 10% increase in the odds of mortality.

Schilling, Goulet, and Dougherty (2011) examined data on 13,343 patients 65 years of age or older hospitalized with a primary diagnosis of hip fracture in 2003 and 2006. Hip fracture volume at the hospitals averaged 85 cases per year. Patients in the cohort were mostly women (75%) and the average age was 83 years. Per patient day the nurse staffing levels averaged 3.5 full-time equivalent (FTE) RNs. Overall, in-hospital mortality was 3.6%. After controlling for other variables, for every one unit decrease in the nurse staffing measure of FTE, there was a 16% increase in the odds of mortality for this cohort of hip fracture patients ($p < 0.003$).

## Dependent Variables

**Patient mortality.** Surgical procedures have changed dramatically over the years as has the demographic characteristics of the patients seeking care. Neuman, Donegan, and Mehta (2013) examined a cohort of patients with femoral neck fracture to determine if there were differences in mortality based on the type of surgical procedure performed. The final dataset included discharge abstracts obtained from the Pennsylvania Health Care Cost Containment Council (PHC4) on 12,867 patients that met inclusion criteria of femoral neck fracture, were older than 50 years, and were permanent residents of Pennsylvania. Of these surgical patients 8,896 (69.1%) had joint reconstruction, another 3,866 (30.0%) had internal fixation and 105 (0.08%) had both. Patients were further examined in two age groups: patients aged 50 years and older and patients aged 70 years and older. In the group of patients aged 50 years and older, the average age of patients with joint reconstructive surgery was 81.5 (SD = 8.9) years and patients with internal fixation were on average 79 (SD = 10.9) years old ($p < 0.0001$). In the group of patients aged 70 years and older, the average age of patients with joint reconstructive surgery was

83.7 (SD = 6.2) years and patients with internal fixation were on average 83.2 (SD = 6.4) years old ($p < 0.0001$). In both groups of patients, those with solid tumors were on average more likely to have surgery that included internal fixation (50 and older $p$ = 0.001; 70 and older, $p$ = < 0.0001). After controlling for patient and hospital characteristics it was found that joint reconstruction procedure in the patients 50 years and older was associated with 65% ($p = 0.003$) increase in the odds of in-hospital mortality and a 22% ($p = 0.026$) increase in the odds of 30-day mortality. In the patients 70 years and older joint reconstruction was associated with 71% ($p = 0.002$) increase in the odds of in-hospital mortality and a 20% ($p = 0.048$) increase in the odds of 30-day mortality.

Knowing that anesthesia care always carries a certain degree of risk, Neuman, Silber, Elkassabany, Ludwig, and Fleisher (2012) examined anesthesia-type (regional versus general) and associated mortality risk in hip fracture patients. Data included a cohort of 18,158 patients who had surgery for hip fracture in 126 hospitals in New York in 2007 and 2008.  In-hospital mortality occurred in 435 (2.4%) of the cohort. Regional anesthesia was associated with 29% lower odds of mortality ($p < 0.014$) and 25% lower odds of pulmonary complications ($p < 0.0001$) relative to general anesthesia. The 5,254 patients who received regional anesthesia experienced fewer pulmonary complications when compared to the general anesthesia group at 6.8% versus 8.1% ($p < 0.005$), respectively.

Silber et al. (2009) examined the observed mortality, complications, and failure-to-rescue in orthopedic surgical patients hospitalized in teaching hospitals and non-teaching hospitals. A total of 4,658,594 patients from 3,270 hospitals in 50 states were included in the analyses to determine if patient race and the resident-to-bed ratio were associated with outcomes of surgical care. Outcome measures were risk-adjusted surgical mortality within 30 days of hospital admission, in-hospital complications, and failure-to-rescue. Initial findings suggested that among similar patients undergoing similar procedures at high intensity teaching hospitals there was a 15% ($p < 0.0001$) decrease in the odds of mortality, a finding that did not change when patient income was added to the analytic models. Similarly, there was a 12% ($p < 0.0001$) decrease in the odds of failure-to-rescue in high intensity teaching hospitals. In the risk adjusted models, when compared to whites, blacks had a 4% ($p < 0.0001$) decrease in the odds of mortality in non-teaching hospitals. Differences in mortality were also noted in high intensity teaching hospitals where whites had a 17% ($p < 0.0001$) decrease in the odds of mortality and blacks had a 4% ($p = 0.1080$) increase in odds of mortality. In non-teaching hospitals when compared to whites, blacks had a 14% ($p < 0.0001$) increase in the odds of developing complications. Similar findings were reported for failure-to-rescue where whites had a 17% decrease in the odds of failure ($p < 0.0001$), but blacks had a 3% increase in the odds of failure-to-rescue ($p = 0.2316$) at teaching hospitals when compared to non-teaching hospitals.

In a longitudinal study of total joint arthroplasties using data from the Nationwide Inpatient Sample from 1998 to 2008, Kirksey et al. (2012) reported that over time the average age of patients undergoing total joint arthroplasty decreased by 2 to 3 years ($p < 0.001$); yet comorbid disease increased 30% for total hip arthroplasty patients ($p < 0.0001$). A significant increase in the incidence of major complications was reported including a 0.03 increase in pulmonary embolism ($p = 0.001$), 0.060 increase in sepsis ($p$

= 0.001), 0.040 increase in cardiac complications ($p < 0.0001$), and a 0.039 increase in pneumonia ($p < 0.0001$). Despite these findings there was a -0.068 decrease in in-hospital mortality ($p < 0.001$). This is evidence to suggest that over the past decade health care systems have the established networks and resources necessary to “rescue” patients from serious complications that often result in mortality. In a similar type of study, Cram et al. (2011) reported on the characteristics and outcomes of 1,453,493 Medicare patients who underwent primary total hip arthroplasty and 348,596 who underwent revision hip arthroplasty in an 18-year (1991-2008) longitudinal study. Similar demographic changes were noted in both groups over time. For the primary total hip arthroplasty group mean age increased from 74.1 (SD = 6.0) to 75.1 (SD = 6.5) years ($p = 0.01$), and the prevalence of diabetes and obesity increased 7.1% to 15.5% and 2.2% to 7.6%, respectively ($p = 0.001$ for both). For the revision hip arthroplasty mean age increased from 75.8 (SD = 6.9) to 77.3 (SD = 7.2) years ($p < 0.001$), and the prevalence of diabetes and obesity increased 7.2% to 15.7% and 1.4% to 4.7%, respectively ($p = 0.001$ for both). For the primary total hip arthroplasty LOS declined from 9.1 to 3.7 days ($p < 0.001$), risk-adjusted 30-day mortality and 90-day mortality decreased from 0.7% to 0.4% and 1.2% to 0.8%, respectively ($p < 0.001$ for both). However, 30-day and 90-day readmission rates increased from 5.9% to 8.5% and 9.8% to 11.9% ($p < 0.001$), respectively. Although LOS declined for patients with revision hip arthroplasty from 12.3 to 6.0 days ($p < 0.001$), risk-adjusted 30-day mortality and 90-day mortality increased from 2.0% to 2.4% ($p < 0.004$) and 4.0% to 5.2% ($p < 0.001$), respectively. However, 30-day and 90-day readmission rates increased from 8.7% to 14.1% and 15.1% to 21.2% ($p < 0.001$), respectively.

**Length of stay.** FitzGerald, Weng, Soohoo, and Ettner (2013) analyzed changes in regional variations in hospital length of stay among Medicare patients undergoing surgical repair for hip fracture or elective joint replacement surgery between 1996 and 2001. Using data from the Centers for Medicare and Medicaid Services (CMS) Medical Provider Analysis and Review file (MedPAR) a total of 1,232,427 were identified based on discharge summaries. Residual variations in length of stay for hospitalizations were analyzed based on CMS regions of New York (NY), New Jersey (NJ), Pennsylvania (PA), New England (NE: Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut) and California. Mean length of stay for hip fracture surgery in NY, CA, NJ, PA and NE was 8.8, 6.5, 7.7, 6.5 and 6.2 days, respectively. There were no significant differences in age of patients noted across regions. Comorbid disease among joint replacement surgical patients varied slightly by region; the proportion of patients with diabetes was lower in CA (11.5%) than in NJ (14.3%), PA (16.4%), and the NE (13.6%) and higher in PA than all other states ($p < 0.0001$). A significantly larger proportion of joint replacement surgical patients from CA (20.6%) were on state Medicaid, when compared to all other states (NY = 17.2%, NJ = 9.2%, PA 7.2%, NE 9.9%, $p < 0.0001$) In New York and New Jersey length of stay was significantly longer than in all other states ($p < 0.0001$). New Jersey had the fewest registered nurses and licensed practical nurses (1.87 per 1000 capita) when compared to other states (NY = 3.43, CA = 8.79, PA = 4.37, NE = 8.29). For those patients with hip fracture surgery length of stay was significantly longer in New York (8.8 days) and NJ (7.7 days) when compared to other states (CA and PA = 6.5 days, NE = 6.2 days, $p < 0.0001$). For patients with elective joint replacement length of stay was significantly longer in New York (5.2 days, $p < 0.0001$) than all other states, and California had a significantly longer length of stay than Pennsylvania (5.2 days versus 4.1 days, $p < 0.0001$).

Using data from the Medicare Patient Monitoring System, Vorhies, Wang, Herndon, Maloney, and Huddleston (2011) examined length of hospital stay and 30-day readmission in total hip arthroplasty patients for the years 2002 to 2007. Data were divided into two subperiods 2002 to 2004 and 2005 to 2007. Demographic differences were identified between the subperiods of time where patients in the 2005 to 2007 cohort were on average younger (73.3 years versus 74.1 years, $p = 0.02$) and more likely to be obese (13.6% versus 10.5%, $p = 0.04$) when compared to the 2002 to 2004 cohort. The overall mean length of stay was over the study period was 4.2 (± 2.2) days. There was a significant 28% ($p < 0.0001$) increase in the likelihood of a reduced length of stay from the year 2002 to 2004 (4.4 ± 2.5 days) and from 2005 to 2007 (3.8 ± 1.7 days). There were no statistically significant changes noted in 30-day all-cause readmission during the study period.

The National Surgical Quality Improvement Program database identifies orthopedic procedures associated with adverse events and O'Malley, Fleming, Gunzler, Messing, and Kates (2012) used these data to identify factors associated with increased hospital stay and postoperative complications in total hip arthoplasty. A total of 4,281 patient records were identified and included in the analyses. On average patients were 64.8 (SD = 12.7) years of age and 43.7% were classified as obese. The total number of patients with major complications was 180 (4.2%), and total number of major complications was reported at 232. The total number of minor complications was 144. Those factors that significantly affected postoperative length of stay included: age:

+0.013 days ($p < 0.0001$), dependent functional status: +0.463 days ($p < 0.0005$). Preoperative co morbidities also had significant effects on postoperative length of stay, these included: cardiac: +0.255 days ($p <$ 025), pulmonary + 0.339 days ($p < .03$); renal +1.26 days ($p < .014$); hepatic 3.472 days ($p < 0.019$); and bleeding disorder, +0.487 days ($p < 0.015$). In-hospital complication was associated with a mean increased length of stay of 2.57 days ($p < 0.0001$) for a minor complication and an increased 6.24 days ($p < 0.0001$) for a major complication. The development of a pre-discharge complication had a significant association with a pre discharge incisional infection ($p <$ 0 .0001) (superficial and deep).

There is evidence to suggest that specialized units and models of care for the elderly have overall positive outcomes (Arbaje et al., 2010; Fox et al., 2013; Samus et al., 2008). Menzies, Mendelson, Kates, and Friedman (2012) used the Geriatric Fracture Center (GFC) model of care to determine if patients with a higher burden of comorbid disease are at risk of two perioperative outcomes: postoperative complications, and longer length of stay. The GFC operates a 231-bed community hospital where each patient is co-managed by orthopedic surgeons and geriatricians. Included in this study were 1,077 patients aged 60 years and older who were treated at the GFC for surgical intervention for a proximal femur fracture between 2005 and 2010. In-hospital mortality was 2.5% and the mean length of stay was 4.19 days. The overwhelming majority of patients in the sample were white (95.6%) and women (76.9%), and the average age of a patient was 85 years. Residence prior to admission to the GFC included community dwelling (48.9%), nursing home (35.7%), and assisted living (13.6%). Nursing home residents had a significantly higher Charlson Comorbidity score when compared to community dwellers (3.4 versus 2.8, $p < 0.0001$). The most common co morbidity was dementia (47.8%). The most common postoperative complications were delirium (32%) and renal insufficiency (16%). Peripheral vascular disease was associated with a 57% increase in the odds of delirium, and any solid tumor was associated with a 45% increase in the odds of delirium and a 69% increase in the odds of renal insufficiency. Peptic ulcer disease was associated with a 32% increase in the odds of delirium and a 41% increase in the odds of renal insufficiency. None of the other comorbid diseases were associated with post-operative complications. There were no factors associated with to time to surgery. A residence of assisted living prior to admission was the only factor significantly associated with length of stay (mean LOS = 4.3 days, SD = 2.1 days, $p = 0.003$).

Similarly, Friedman et al. (2009) compared a Geriatric Fracture Center (GFC) with a local hospital that provided usual care to determine if there were differences in the process care and clinical outcome. Patients were 60 years of age or older and admitted from 2005 to 2006 with a proximal femur fracture. On average at baseline patients in the GFC group (n = 193) were significantly older than the usual care group (n = 121) at 84.7 years and 81.6 years, respectively ($p = 0.002$). The patients in the GFC were significantly less likely to reside in the community prior to admission (39.4% versus 81.8%, $p < 0.001$) and more likely to have dementia (53.9% versus 21.5%, $p < 0.001$) when compared to patients provided usual care. Time to surgery was significantly shorter in the GFC when compared to usual care (24.1 hours versus 37.4 hours, $p = 0.02$), and length of stay was significantly shorter in the GFC compared to usual care (4.6 days versus 8.3 days, $p < 0.001$). GFC patients had higher mean Charlson comorbidity scores compared to usual care patients (3.4 versus 2.8, $p < 0.001$). GFC patients had fewer overall postoperative complications (30.6% versus 46.3%, $p = 0.001$), with significantly lower risk of delirium ($p <0.001$), infection ($p < 0.001$), cardiac complication ($p = 0.03$), hypoxia ($p =0.001$), and thrombo embolism ($p = 0.03$). Rates of urinary tract infection were significantly lower in the GFC group when compared to the group that received usual care (1.0% versus 14.1%, $p <0.001$). Similar findings were reported for pneumonia (1.6% versus 6.6%, $p = 0 .02$).

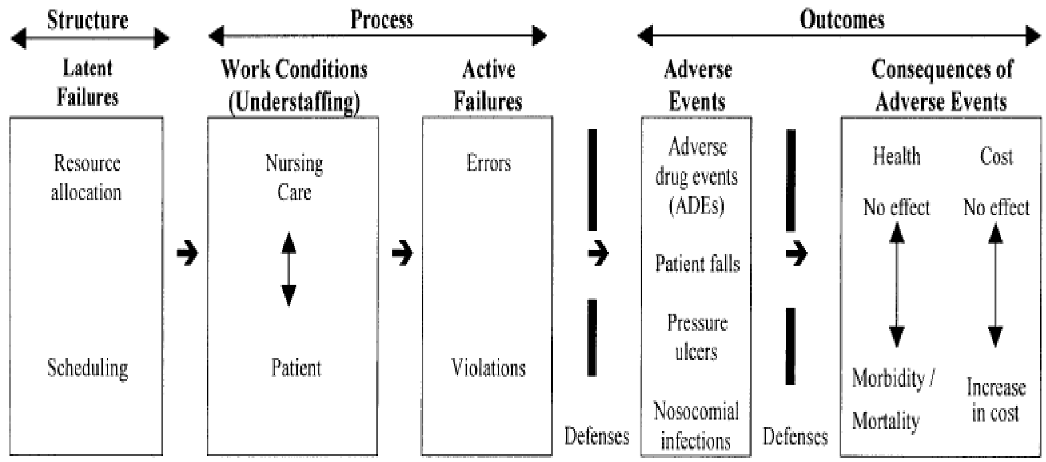
In a retrospective chart review that included data on patient-controlled analgesia, Pizzi et al. (2012) examined the incidence of opioid-related adverse effects among surgical patients at two sites of one urban teaching hospital. The primary study outcome of interest was the postoperative length of stay. Patients were at least 18 years of age and were identified based on ICD-CM-9 codes as having undergone orthopedic surgery of the hip, knee, shoulder, or spine and had received peri-operative opioids. A total of 6,204 patients were identified as having had the surgeries of interest and 402 of them were randomly selected and stratified equally to represent four orthopedic surgery groups: spine, hip, knee, and shoulder. The mean age of patients was 60.2 (SD = 14.8) years, with males and females evenly distributed. Patients reported 1.6 (SD = 1.4) comorbid conditions the most common being arthritis (47.5%) followed by hypertension (46.8%), gastroesophageal reflux disease (27.4%), diabetes (14.2%), depression (12.4%), asthma (10.4%), and heart disease (7.7%). The mean total hospital length of stay was 3.2 (SD = 2.4) days. At least one adverse effect was experienced by more than half (54.2%) of the patients. Nearly one (18.4%) of five patients' experienced two adverse effects and 7.2% experienced three or more. Three adverse events were associated with post-operative length of stay. Constipation was associated with a 49% ($p < 0.0001$) increase in length of stay, as well as, confusion (38% increase in length of stay, $p = 0.0038$), and emesis (25% increase in length of stay, $p = 0.0008$).

Kerr et al. (2010) examined length of stay in older patients admitted to the hospital for a surgical hip procedure between 1998 and 2002. Data included 568 episodes of hospitalization of 523 adult patients age 60 years and older. The average patient age for the 568 hospitalizations was 74.5 years (SD = 8.9). Sixty-two percent were female, 33% had fractures, 42% suffered non-traumatic joint disorders and 18% were complications of a device. The mean length of stay was 8.02 days (SD = 6.19), and the median length of stay was 6.19 days. The length of stay increased by approximately 0.46 day ($p < 0.001$) as the total number of units the patient resided on increased by one, and length of stay increased by 0.44 day ($p < 0.05$) as the total number of days the patient remained in the ICU increased by one. In hospitals with units in the highest quartiles of staffing the mean registered nurse hours per patient day of 6.3 hours and the related average length of stay was 1.63 fewer days ($p < 0.001$). Post hoc analyses of the registered nurses-to-patients drops in proportion were significant: length of stay increased, on average, by 0.92 day with each 20% decrement in registered nurse staffing below the average. In addition to staffing ratios, as the total number of procedures or the total number of medications increased by one, length of stay increased by 0.39 ($p < 0.001$) and 0.18 ($p < 0.001$) days, respectively. On average, length of stay increased by 0.78 days in patients receiving a pain management intervention at least once during their hospitalization when compared to those who did not receive it ($p = 0.05$). Other nursing interventions associated with increases in length of stay included: blood product administration (2.34 days, $p < 0.001$), nutrition management (4.26 days, $p < 0.05$), pressure ulcer prevention (5.79 days, $p < 0.05$), skin surveillance (2.93 days, $p < 0.05$), and teaching (1.58 days, $p < 0.05$).

**Theoretical Rationale**

The Nurse Staffing and Patient Outcomes Model (NSPOM) provided the overarching framework for this dissertation study (see Figure 2.1) (Cho, 2001). The NSPOM synthesizes Reason's (2001) generic error modeling system and the cause of organizational accidents with the structure-process-outcome perspective of Donabedian (1966). The NSPOM modifies Reason's (2001) theoretical error-modeling system and the causes of organizational accidents to accommodate nursing practice in the hospital setting. The generic error-modeling system introduces three basic distinctions useful in the investigation of human errors: latent versus active failures, errors versus violations, and slips and lapses versus mistakes. Latent failures are the delayed-action consequences of top management decisions and organizational processes. In contrast, active failures are unsafe clinical acts that are immediately apparent. Active failures are further subdivided into violations and errors. Violations refer to deviations from safe operating practices, procedures, rules, or standards. Errors are defined as actions that do not achieve the intended outcomes. Errors are further classified into skill-based slips and lapses and knowledge based mistakes. Reason (2001) conceptualizes organizational accidents as having their origins in a wide variety of latent failures that are transmitted to specific workplaces thus creating the local conditions for the commission of errors and violations that penetrate the existing defense barriers and safeguards of a hospital.

Figure 2.1 The Nurse Staffing and Patient Outcomes Model. (Cho, 2001). Reprinted with permission




There are two lines of defense that prevent foreseeable injuries and damages in the NSPOM. One defense occurs between active failure and an adverse event.  If this defense is penetrated errors and violations will result.  The second defense prevents an existing adverse event from resulting in further morbidity or mortality.  Failure to rescue a patient from an adverse occurrence that then results in mortality is an example of a failure of this second type of defense.

The NSPOM also incorporates Donabedian's (1966) structure-process-outcome model. Structure in the NSPOM indicates the organizational structures and processes that influence the occurrence of latent failures. The NSPOM refers to processes as those nursing interventions that interact with patient characteristics under unsafe work conditions and produce errors and violations during the provision of nursing care. Patient outcomes have been modified for this study to include mortality, failure to rescue and prolonged length of stay.

The NSPOM proposes that when nurse staffing, the process of determining the appropriate number and mix of nurse resources needed to meet the workload demand, is inadequate, an unsafe work condition precipitates errors and violations. According to Cho (2001) latent failures resulting in inadequate nurse staffing originate in organizational decisions about resources allocation and scheduling at either the top management or nursing department level. Latent failures are also influenced by internal environments such as teaching status or bed size and external environment factors such as government policy or insurance reimbursement issues, as in the case of the disproportionate burden of uninsured care provided by safety net hospitals. This study conceptualized the hospital structure of the safety net hospital as a latent failure decision associated with inadequate nurse staffing and poor patient outcomes. In addition, top management's decision not to pursue and acquire Magnet status for its hospital was conceptualized as a latent failure decision associated with inadequate nurse resources, unsafe work conditions, and poor patient outcomes.

**Hypotheses**

1. Hospitals with safety net status will have fewer nurse resources - lower registered nurse hours per patient day, lower registered nurse skill mix, and poor organizational climate - when compared to non-safety net hospitals.

2. Fewer hospital nurse resources, magnet accreditation, registered nurse hours per patient day and registered nurse skill mix in New Jersey safety net hospitals will be associated with higher rates of adverse outcomes (i.e., in-hospital mortality,

failure-to-rescue, length of stay, and prolonged length of stay) in elderly surgical patients

3. Magnet accreditation will moderate the effect of nurse resources (registered nurse hours per patient day and registered nurse skill mix) on the odds of in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay in elderly patients admitted to a hospital for surgical repair of hip fracture.

Table 2.1 Table of Evidence

| Year | Investigators | Sample/Setting | Findings |
|---|---|---|---|
| 1994 | Aiken, L.H.<br>Smith, H. L.<br>Lake, E. T. | 39 Magnet hospitals; 195 control hospitals | 4.8% less mortality in Magnet hospitals ($p = 0.034$). |
| 2002 | Aiken, L.H.<br>Clarke, S. P.<br>Sloane, D. M.<br>Sochalski, J.<br>Silber, J. H. | 232, 342 surgical patients; 10,184 nurses; 168 hospitals | 7% increase in the odds of dying within 30 days of admission; and 7% increase in odds of failure to rescue associated with 1 patient increase per nurse workload. |
| 2010 | Arbaje, A.I.<br>Maron, D. D.<br>Yu, Q.<br>Wende, V.I.<br>Tanner, E.<br>Boult, C.<br>Eubank, K.J.<br>Durso, S.C. | 717 inpatients ≥ 70 years; 2 Geriatric Floating Interdisciplinary Transition Team Service Models (Geri-Fitt) and 2 usual care models | Geri-Fitt associated with slightly higher quality care transitions and greater patient satisfaction with hospital care (not statistically significant). |
| 2011 | Blegen, M. A.<br>Goode, C. J.<br>Spetz, J.<br>Vaughn, T.<br>Park, S.H. | 1.1 million adult discharges; 872 patient care units; 8 hospitals; 46 safety-net | In the safety-net hospitals RN skill mix associated with shorter length of stay ($p < 0.05$); in adult ICU RN skill mix associated with mortality ($p < 0.05$) and failure to rescue ($p < 0.05$). |
| 2010 | Boehmer, U.<br>Harris, J.<br>Bowen, D. J.<br>Schroy III, P. C. | Black patients ($n = 74$), White ($n = 137$), and Other race ($n = 42$); 1 safety-net hospital | Black patients had more mean post-resection visits than both other racial groups ($p < 0.05$). |
| 2012 | Bradley, C.J.<br>Dohman, B.D.<br>Shickle, L.M.<br>Lee, W. | 3,272 Breast Cancer patients; Virginia Health Information discharge data & American Hospital Association data; 2 safety net hospitals; 59 non-safety net hospitals from 1999 to 2005 | Time from diagnosis to mastectomy was longer in safety-net hospitals $p < 0.0001$; more women uninsured or on Medicaid in safety-net hospitals ($p < 0.0001$). |

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|---|---|---|---|
| 2012 | Carthon, B.<br>Margo, J.<br>Kutney-Lee, A.<br>Jarrin, O.<br>Sloane, D.<br>Aiken, L.H. | 548,397 surgical patients; 599 hospitals; AHA data & U.S. census data | Additional patient in average nurse's workload increased odds of death by 3% and failure to rescue by 4%. |
| 2012 | Chatterjee, P.<br>Joynt, K. E.<br>Orav, E. J.<br>Jha, A. K. | 2327 non-safety hospitals; 769 safety net hospitals | Patients rated safety net hospital experience worse ($p < 0.001$); lower nurses per 1000 patient-days ($p < 0.001$). |
| 2008 | Conway, P. H.<br>Tamara<br>Konetzka, R.<br>Zhu, J.<br>Volpp, K. G.<br>Sochalski, J. | yr: 2003 342 hospitals; yr: 2004 332 hospitals | Safety net hospitals (84% of sample) below mandated staffing ratios in 2004 ($p < 0.05$). |
| 2011 | Cram, P.<br>Lu, X.<br>Kaboli, P. J.<br>Vaughan-<br>Sarrazin, M. S.<br>Cai, X.<br>Wolf, B. R.<br>Li, Y. | 1,802,089 hip surgery patients | Mean hospital LOS 3.7 days ($p = 0.002$) unadjusted in hospital mortality 0.2%<br>($p < 0.001$). |
| 2013 | FitzGerald, J. D.<br>Weng, H.<br>Soohoo, N. F.<br>Ettner, S. L. | 1, 232, 427 hip surgery patients; Centers for Medicare and Medicaid Services (CMS) Medical Provider Analysis and Review file (MedPAR) | Mean LOS 7.7 days in NJ significantly longer than CA and PA ($p > 0.0001$). |
| 2013 | Fox, M. T.<br>Sidani, S.<br>Persaud, M.<br>Tregunno, D.<br>Maimets, I.<br>Brooks, D.<br>O'Brien, K. | 6,839 adults mean age 81; acute care geriatric units | Medical review, early rehabilitation and patient centered care appear optimal for overall positive outcomes. |
| 2009 | Friedman, S. M.<br>Mendelson, D.<br>A.<br>Bingham, K. W.<br>Kates, S. L. | 193 Geriatric Fracture Center, 121 usual care; 1 hospital Geriatric Fracture Center | Geriatric Fracture Center patients had approx. 4 day shorter LOS ($p < 0.001$). |
| 2012 | Genther, D. J.<br>Gourin, C. G. | 123,662 surgical patients; stratified sample of 20% U.S. hospitals using the NIS database | Safety-net status associated with a mean increase in LOS of 24 hours ($p > 0.001$). |
| 2010 | Harless, D. W.<br>Mark, B. A. | 11, 945, 276 adult patients; 283 hospitals | Increase in RN staffing associated with reduction in mortality ($p < 0.05$). |

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|---|---|---|---|
| 2010 | Kerr, P.<br>Shever, L.<br>Titler, M. G.<br>Qin, R.<br>Kim, T.<br>Picone, D. M. | 568 hospitalization of patients for hip; 523 procedures | Each 20% decrease in RN staffing associated with 0.92 day increase in LOS, on average.<br><br>0.39* and 0.18* day increase in LOS associated with number of procedures and number of medications [*p < 0.001]. |
| 2012 | Kirksey, M.<br>Chiu, Y.L.<br>Ma, Y.<br>Della Valle, A.G.<br>Poultsides, L.<br>Gerner, P.<br>Memtsoudis, S.G. | Stratified sample of 469, 013 total hip arthroplasty (THA) patients;<br>NIS data files;<br>each year between 1998 and 2008 | Co morbid disease in THA patients increased 30% (p < 0.0001); in-hospital mortality decreased by 56% from 1998 (p < 0.001). |
| 2010 | Lake, E. T.<br>Shang, J.<br>Klaus, S.<br>Dunton, N. E. | 108 Magnet hospitals; 528 non-Magnet hospitals | Average fall rates 8.3% lower in Magnet hospitals (p < 0.001); RN staffing 1 hour higher (p < 0.01). |
| 2012 | McHugh, M. D.<br>Brooks Carthon, M.<br>Sloane, D. M.<br>Wu, E.<br>Kelly, L.<br>Aiken, L. H. | 145 hospitals; 28 safety-net hospitals | Disparity in magnitude of change in patient to nurse ratio (0.27 patients per nurse [p = 0.02]). |
| 2013 | McHugh, M. D.<br>Kelly, L. A.<br>Smith, H. L.<br>Wu, E. S.<br>Vanak, J. M.<br>Aiken, L. H. | All nurses in setting California<br>145 hospitals<br>28 safety net hospitals | One fewer patient per nurse (-0.98 [p < 0.001]) effect of California AB 39. |
| 2012 | Menzies, I. B.<br>Mendelson, D. A.<br>Kates, S. L.<br>Friedman, S. M. | 1, 077 Geriatric Fracture Center patients | In-hospital mortality was 2.5%. |
| 2002 | Needleman, J.<br>Buerhaus, P.<br>Mattke, S.<br>Stewart, M.<br>Zelevinsky, K. | 1,104,659 surgical patients; 799 hospitals; 11 states | Lower rates of failure to rescue associated with greater number of RN care hours per day<br>(p = 0.008). |
| 2011 | Needleman, J.<br>Buerhaus, P.<br>Pankratz, V. S.<br>Leibson, C. L.<br>Stevens, S. R.<br>Harris, M. | 197,961 admissions; 176, 696 nursing shifts; 43 units;<br>1 Tertiary Academic Center | Risk of death increased by 2% for each shift staffed below target (p < 0.0001). |

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| 2012 | Neuman, M. D.<br>Silber, J. H.<br>Elkassabany, N. M.<br>Ludwig, J. M.<br>Fleisher, L. A. | 18,158 patients undergoing hip fracture surgery;<br>5,254 regional anesthesia;<br>12,904 general anesthesia;<br>126 New York hospitals;<br>2007 and 2008 | Regional anesthesia associated with 30% lower chance of death ($p < 0.014$). |
| 2013 | Neuman, M. D.<br>Donegan, D. J.<br>Mehta, S. | 12,867 orthopedic surgery patients | Joint reconstruction patients were 69% more likely than internal fixation patients to die in hospital ($p < 0.002$). |
| 2012 | O'Malley, N. T.<br>Fleming, F. J.<br>Gunzler, D. D.<br>Messing, S. P.<br>Kates, S. L. | 4,281 surgical patients;<br>National Surgical Quality Improvement Program database | Increase LOS of approximately 6 days associated with pre-discharge major complication<br>($p < 0.0001$). |
| 2012 | Pizzi, L. T.<br>Toner, R.<br>Foley, K.<br>Thomson, E.<br>Chow, W.<br>Kim, M.<br>Viscusi, E. | 402 orthopedic surgery patients;<br>Large academic medical center | Constipation ($p < 0.0001$), confusion ($p = 0.0038$) and emesis ($p = 0.0008$) associated with prolonged LOS. |
| 2008 | Samus, Q.M.<br>Mayer, L.<br>Baker, A.<br>McNabney, M.<br>Brandt, J.<br>Onyike, C.U.<br>Rabins, P.V.<br>Lyketos, C.G.<br>Rosenblatt, A. | 110 assisted living (AL) residents in non-dementia specific units (NDSCU);<br>24 AL residents in dementia-specific care units (DSCU) | DSCU residents had comparable quality of life, nursing home discharge risk, and perceived caregiver burden. DSCU residents spent approx 32 more hours in group activities ($p < 0.001$) and were more cognitively impaired ($p= 0.04$). |
| 2011 | Schilling, P.<br>Goulet, J. A.<br>Dougherty, P. J. | 13,343 hip fracture patients;39 hospitals | 16% increase in risk of death for 1 decrease in RN FTE ($p < 0.003$). |
| 2009 | Silber, J. H.<br>Rosenbaum, P. R.<br>Romano, P. S.<br>Rosen, A. K.<br>Wang, Y.<br>Teng, Y.<br>Volpp, K. G. | 4,658,954 surgical patients; 3, 270 hospitals | 15% lower odds of death* and a 15% lower odds of death after complications (failure to rescue*) at teaching hospitals with higher resident-to-bed ratio (benefit not experienced by black patients);<br>*($p > 0.001$). |
| 2011 | Virgo, K. S.<br>Little, A. G.<br>Fedewa, S. A.<br>Chen, A. Y.<br>Flanders, W. D.<br>Ward, E. M. | 52,853 patients | High safety-net burden associated with reduced likelihood of curative-intent surgery<br>($p < 0.0001$). |

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|---|---|---|---|
| 2011 | Vorhies, J. S.<br>Wang, Y.<br>Herndon, J.<br>Maloney, W. J.<br>Huddleston, J. I. | 1,802 hip surgery patients; from 2002 to 2007 | 0.6 days reduction in LOS ($p < 0.0001$). |
| 2008 | Werner, R. M.<br>Goldman, L. E.<br>Dudley, R. A. | 3, 665 hospitals | Safety-net hospitals had smaller gains in quality performance measures over 3 years ($p < 0.001$). |
| 2013 | Whitaker, R. G.<br>Reiter, K. L.<br>Weinberger, M.<br>Stearns, S. C. | 62,206 patients; 1561 hospitals; 162 safety-net | Safety-net hospitals had 1.79 days longer LOS [95% CI (0.13, 3.40)]. |

# CHAPTER III. METHODS

Chapter III is a summary of the research methodology that includes the study design, the setting and sample, and analytic methods that were used to examine the research question, and the hypotheses. The analytic methods include a description of how datasets were merged and provides details on the multiple regression models that were used to examine relationships between the variables of interest: safety net hospitals, nurse resources, hospital and patient characteristics, and the outcomes of care (mortality, failure-to-rescue, and length of stay) in elderly surgical patients admitted to an acute care hospital for surgical repair of hip fracture.

## The Research Setting

The study setting included all adult acute care hospitals in the state of New Jersey. A total of 73 facilities were identified that meet the inclusion criteria.

## The Sample

The sample consisted of all adult patients 65 years of age or older admitted to an acute care hospital in New Jersey from January 1, 2010 to December 31, 2011with a principal or secondary *International Classification of Diseases, Ninth Revision* (ICD-9-CM) hip fracture diagnosis codes of 820.00-09, 820.21-22, and 820.8. Patients with a principal or secondary ICD-9-CM procedure code of 78.55, 79.15 or 79.35 were classified as undergoing internal fixation with closed or open reduction. Patients with a principal or secondary ICD-9-CM procedure code of 81.52 (hemiarthroplasty) or 81.51 (total hip arthroplasty) were classified as undergoing joint reconstruction. Patients were excluded if they were younger than 65 years of age, and/or had a discharge record that did not indicate surgical intervention (fixation or joint reconstruction).

## Measures

### Dependent Variables (Outcomes)

**Patient outcomes.** Patient outcomes of in-hospital mortality (yes or no), failure-to-rescue (yes or no) and length of stay were obtained from the State Inpatient Database (SID). Prolonged length of stay was computed as a length of stay two standard deviations above the mean.

### Independent Variables (Predictors)

**Hospital characteristics.** The New Jersey Hospital Association data were used to create measures of hospital structural characteristics that include: 1) safety-net designation (yes or no); 2) bed size which will be stratified as < 100 beds, 101-250 beds, and > 251 beds; 3) hospitals without any post graduate medical residents or fellows (non-teaching) will be distinguished from 1:4 or smaller trainee-to-bed ratio (minor teaching) and those with higher than 1:4 (major teaching); 4) high technology hospitals will be those facilities that provide services for open-heart surgery, organ transplantation, or both; and 4) Magnet accreditation (yes or no) (data available from ANCC).

**Patient characteristics.** Data on patient characteristics were obtained from the SID and include age in years at admission, sex, race and ethnicity, ZIP code of residence, and payer. All demographic variables were defined as per AHRQ criteria.

**Nurse resources.** Nurse staffing was computed as the number of registered nurse hours per patient day. Registered nurse skill mix was computed as the percentage of registered nurse care hours to total nursing care hours of all nursing hours.

**Procedures for Collecting Data**

This study was a retrospective cross-sectional study using administrative data obtained from five sources: 1). Data on nurse resources was obtained from the New Jersey Department of Health and Senior Services (NJDHSS); 2). Data on hospital characteristics from the New Jersey Hospital Association; 3). Data on hip fracture patients discharged from a New Jersey acute care hospital were obtained from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID); 4). Data on Magnet accreditation was obtained from the American Nurses Credentialing Center; and 5). Hospital safety net status was identified through hospital membership in the Hospital Alliance of New Jersey, a coalition of safety-net providers that serve a significant portion of New Jersey's most indigent patients. Institutional Review Board approval was obtained from the Office of Research and Sponsored Programs at Rutgers, The State University of New Jersey prior to the collection and analysis of data.

**State Inpatient Database.** The SID contains the universe of patients from New Jersey. It contains a core set of clinical and non-clinical variables including principal and secondary diagnosis codes, principal and secondary procedure codes, admission and discharge status, patient demographics (i.e., gender, age, race), expected payment source (i.e., Medicare, Medicaid, private insurance), total charges, and length of stay.

**Plan for Data Analysis**

**Construction of datasets.** Data sets were constructed using information from the previously mentioned sources. The first step was to assemble patient-level data sets for each surgical procedure. Data sets included all patients 65 years of age and older discharged from hospitals with the conditions and/or procedures of interest, plus additional patient characteristics, hospital characteristics, and measures of nurse resources.

**Preliminary analyses.** After measures of nurse resources were created and merged with data on hospital characteristics and patient datasets, preliminary analyses were performed to determine if nurse resources differed between safety net and non-safety net hospitals. Little is known about the allocation of nurse resources in safety net hospitals and these analyses help to understand how we are providing care to some of the most vulnerable patients. Linear regression models were used to estimate the effect of safety net on the allocation of nursing resources. This model took on the following form:

$$\gamma = \beta_0 + \beta_1\mathcal{X}_1 + \beta_2\mathcal{X}_2 + \beta_3\mathcal{X}_3 \in$$

where y was the specific outcome of interest (nurse staffing and skill mix), $\mathcal{X}_1$ was an indicator variable for safety net, $\mathcal{X}_2$ was a vector of variables representing hospital characteristics (Magnet accreditation, bed size, teaching status, and technology), $\mathcal{X}_3$ was a vector of variables representing patient characteristics (i.e., demographic characteristics, and comorbidities), a was the constant, $\in$ was a random disturbance, and $\beta_1$, $\beta_2$, and $\beta_3$ were vectors of coefficients. Of particular interest in these models was the coefficient $\beta_1$ that represented safety net designation.

**Multiple comparison.** Several patient demographic variables (i.e., age, race, and median income) were categorized into more than two groups. When these variables were statistically significant it was difficult to determine where the significance difference actually occurred. In these cases a multiple comparison procedure was used to examine the differences between these groups. The Bonferroni multiple comparison procedure was chosen since it is the most conservative analytic procedure.

**Primary analyses.** Analyses of patient outcomes used both hospital-level and patient-level data. Outcomes of interest included in-hospital mortality, failure-to-rescue, and length of stay (mean and prolonged). To estimate length of stay and additional patient outcomes the models took on the following general form:

$$\gamma_i = \beta_0 + \beta_1 \mathcal{X}_{1i} + \beta_2 \mathcal{X}_{2i} + \beta_3 \mathcal{X}_{3i} + \in$$

where y was the outcome of interest (i.e., length of stay) or in the case or mortality and other dichotomous outcomes the natural logarithm of the odds on that outcome for patient i, $\mathcal{X}_1$ was a vector of variables describing the effects of nurse resources (i.e., staffing and skill mix), $\mathcal{X}_2$ was a vectors of variables describing hospital characteristics (i.e., safety net designation, Magnet accreditation, bed size, teaching status, and technology), $\mathcal{X}_3$ was a vector of patient characteristics (i.e., demographic characteristics, and comorbidities), $\in$ was a random disturbance, and $\beta_1$, $\beta_2$, and $\beta_3$ were vectors of coefficients. In a final model an interaction term was constructed to estimate the moderating effect of Magnet accreditation and nurse resources on the outcomes of interest. In all regression models robust procedures were used to adjust for the clustering of patients within hospitals, and computations were performed using Stata/MP 12.0 (StataCorp LP, College Station, TX).

**Risk adjustment.** The Agency for Healthcare Research and Quality (AHRQ) reports that administrative data are highly reliable and recommended for research that examines health care quality. AHRQ further recommends risk adjustment procedures that are comorbidity-based. Based on this recommendation, risk adjustment covariates included all ICD-9-CM primary and secondary diagnosis and procedure codes, age, sex, race, ethnicity, emergent admission, and insurance type. The risk adjustment method used in this study was based on a model developed by Elixhauser, Steiner, Harris, and Coffey

(1998). The Elixhauser method includes a comprehensive set of 30 comorbidities (see Table 3.1) and has been shown to outperform other approaches (Stukenborg, Wagner, & Connors, 2001).

Table 3.1 Elixhauser Comorbidity Table

| Comorbidity | Inclusion Criteria | Evaluation Criteria v25 |
|---|---|---|
| 1. Alcohol abuse | 291.0-291.3, 291.5, 291.8, 291.81, 281.82, 291.89, 291.9, 303.00-303.93, 305.00-305.03 | Alcohol or drug: 894-897 |
| 2. Blood Loss anemias | 280.0, 648.20-648.24 | Anemia: 808-812 |
| 3. Chronic pulmonary disease | 490-492.8, 493.00-493.92, 494-494.1, 495.0-505, 506.4 | COPD asthma: 190-192, 202-203 |
| 4. Coagulopathy | 2860-2869, 287.1, 287.3-287.5 | Coagulation: 397 |
| 5. Congestive heart failure | 398.91, 402.01. 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0-428.9 | Cardiac: 001-002, 215-238, 242-251, 253-254, 258-262, 280-293, 296-298, 302-303, 306-313 |
| 6. Deficiency anemias | 280.1-280.9, 285.21-285.29, 285.9 | Anemia: 808-812 |
| 7. Depression | 300.4, 301.12, 309.00, 309.1, 311 | Depressive neuroses: 881 |
| 8. Diabetes uncomplicated | 250.00-250.33, 648.00-648.04 | Diabetes: 637-639 |
| 9. Diabetes, complicated | 250.40-250.93, 775.1 | Diabetes: 637-639 |
| 10. Drug abuse | 292.0, 292.82-292.89, 292.9, 304.00-304.93, 305.20-305.93, 648.30-648.34 | Alcohol or drug: 894-897 |
| 11. Fluid and electrolytes disorders | 276.0-276.9 | Nutrition/Metabolic: 296-298 |
| 14. HIV and AIDS | 042-044.9 | HIV: 969-970, 974-977 |
| 15. Hypertension (combined uncomplicated and complicated) | 401.0, 401.1, 401.9, 402.00-405.99, 437.2, 642.00-642.04, 642.10-642.24, 642.70-642.94 | Cardiac: 001-002, 215-238, 242-251, 253-254, 258-262, 280-293, 296-298, 302-303, 306-313 or hypertension: 077-079, 304-305 |
| 16. Hypothyroidism | 243-244.2, 244.8, 244.9 | Thyroid endocrine: 625-627, 643-645 |
| 17. Liver disease | 070.22, 070.23, 070.33, 070.44, 070.54, 456.0, | Liver: 420-425, 432-434, 441-446 |

| | | |
|---|---|---|
| | 456.1, 456.20, 256.21, 571.0, 571.2, 571.3, . 571 40-571 49, 571.5, 571.6, 571.9, 572.3, 572.8, V42.7 | |
| 18. Lymphoma | 200.00-202. 38, 202.50-203.01, 203.8-203.81, 238.6, 273.3 | Leukemia/Lymphoma: 820-830, 834-849 |
| 19. Metastatic cancer | 196.0-199.1, 789.51 | Cancer Lymphoma : 054, 055, 146-148, 180-182, 374-376. 435-437, 542-544, 582-583, 597-599, 656-658, 686-688, 715-716, 722-724, 736-741, 754-756, 826-830, 843-849 |
| 20. Obesity | 278.0, 278.00, 278.01, 649.10-649.14, 793.91, V85.30-V85.4, V85.54 | Nutrition/metabolic: 619-621, 640-641 |
| 21. Other neurological disorders | 330.1-331.9, 332.0, 333.4, 333.5, 333.71-333.79, 333.85, 333.94, 334.0-335.9, 338.0, 340, 341.1-341.9, 345.00-345.11, 345.2-345.3, 345.40-345.91, 347.00-347.01, 347.10-347.11, 649.40-649.44, 768.7, 780.3, 780.31, 780.32, 780.39, 780.97, 784.3 | Nervous system: 020-042, 052-103 |
| 22. Paralysis | 342.0-344.9, 438.20-438.53 | Cerebrovascular: 020-022, 034-038, 064-072 |
| 23. Peptic ulcer disease excluding bleeding | 531.70, 531.90, 532.70,532.90, 533.70, 533.90, 534.70, 534.90, V12.71 | GI Hemorrhage or Ulcer 174-178 |
| 24. Peripheral vascular disorders | 440-440.9, 441.00-441.9, 442.0-442.9, 443.1-443.9, 444.21, 447.1, 4449, 557.1, 557.9, V43.4 | Peripheral vascular: 299- 301 |
| 25. Psychoses | 295.00-298.9, 299.10, 299.11 | Psychoses: 885 |
| 26. Pulmonary circulation disorders | 415.11-415.19, 416.0-416.9, 417.9 | Cardiac: 001-002, 215-238, 242-251, 253-254, 258-262, 280-293, 296-298, 302-303, 306-313 or COPD asthma: 190-192, 202-203 |
| 27. Renal failure | 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 585.3, 585.4, 585.5, 585.6, 585.9, 586, V42.0, V45.1, V56.0-56.32, V56.8 | Kidney transplant, Renal failure/dialysis: 652, 682-685 |

| | | |
|---|---|---|
| 28. Rheumatoid arthritis/ collagen vascular diseases | 701.0, 710.0-710.9, 714.0-714.9, 720.0-720.9, 725 | Connective Tissue: 545-547 |
| 29. Solid Tumor without metastasis | 140.0-172.9, 174.0-175.9, 179-195.8, 258.01-258.03 | Cancer Lymphoma: 054, 055, 146-148, 180-182, 374-376, 435-437, 542-544, 582-583, 597-599, 656-658, 686-688, 715-716, 722-724, 736-741, 754-756, 826-830, 843-849 |
| 30. Valvular disease | 093.20-093.24, 394.0-397.1, 397.9, 424.0-424.99, 746.3-746.6, V42.2, V43.3 | Cardiac: 001-002, 215-238, 242-251, 253-254, 258-262, 280-293, 296-298, 302-303, 306-313 |
| 31. Weight loss | 260-263.9, 783.21, 783.22 | Nutrition/metabolic: 640-641 |

**Power.** This study examined all patients admitted to a New Jersey acute care hospital with a diagnosis of surgical repair of hip fracture and provided ample statistical power. As expected that data were available on over 10,000 hip fracture patients admitted to 73 hospitals. Through a priori power analysis it was determined that if a true difference existed of at least 10 percent and the probability of a Type 1 error was set at 0.05, it was estimated that 80% power would detect an outcome with a probability of .10 (mortality) and would require a sample of ~8,200 cases. Therefore, it was estimated that 80% power to detect a 10 percent difference in an outcome with the probability of .40 (prolonged LOS) would require a sample of ~660 cases. Taking into account all the controls and cofounders and small effect size, the outcome failure-to-rescue required a larger sample size; however, overall there was sufficient power and sample to detect differences when they in fact existed. All of the above estimates were derived from tables described by Hsieh (1989).

# CHAPTER IV. ANALYSIS OF THE DATA

The purpose of the study was to expand our understanding of nurse resource utilization in safety net hospitals and how these resources (or lack of them) were associated with outcomes of care for elderly patients admitted to an acute care New Jersey hospital for surgical repair of hip fracture. This retrospective cross-sectional study used administrative data obtained from five sources: 1) the New Jersey Department of Health and Senior Services (NJDHSS) and the New Jersey Hospital Association (NJHA) supplied the nurse staffing data; 2) the Healthcare Cost and Utilization Project (HCUP) provided the New Jersey hospital patient data, 3) The American Nurses Credentialing Center provided data on hospital Magnet accreditation, and 4) Hospital safety net status was identified through hospital membership in the Hospital Alliance of New Jersey, a coalition of safety-net providers that serve a significant portion of New Jersey's most indigent patients. The nurse resources of interest included registered nurse hours per patient day, patient-to-nurse ratio, registered nurse skill mix, and organizational climate. Surgical patient outcomes of interest included in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay. The study sample consisted of adult patients 65 years of age or older admitted to a New Jersey adult acute care hospital with principal or secondary *International Classification of Diseases, Ninth Revision (ICD9-CM)* hip fracture diagnosis codes of 820.00-09, 820.21-22, and 820.8. The construction of the administrative data sets used in these analyses at both the patient-level and hospital-level were described in preceding chapter. The analytic findings reported in this chapter are organized by hypothesis tested and the type of regression model used to estimate patient outcomes of interest.

## Descriptive Statistics

**Patient Characteristics**. Patients included in this study were 65 years of age or older and discharged from an adult acute care New Jersey hospital between January 1, 2010 and December 31, 2011 with a diagnosis of surgical repair of hip fracture. Table 4.1 lists the DRG classification of the patients included in this study. Patients were categorized by age with slight more than half (n = 5550; 51.88%) of these patients reported to be 85 years of age or older, a finding that was statistically significantly ($p$ = 0.011). Slightly more than a third (n = 3769; 35.23%) of these surgical patients were 75-84 years of age, and 12.89% (n = 1,379) were 65-74 years of age. The percent of surgical patient by age was similar in safety net and non-safety net hospitals; however the patients in safety net hospitals were slightly younger (see Table 4.2). Overwhelmingly, surgical hip fracture patients were female (n = 8035; 75.11%) and there were no significant differences in the sex of surgical patients admitted to safety net and non-safety hospitals (75.88% and 74.94%, respectively; $p$ = 0.395). The overwhelming majority of hip fracture admissions were from the patients home (97.50% and 95.71, $p$ = 0.002) and these admissions were overwhelmingly classified as emergent (89.77% and 88.10%, $p$ = 000). Surgical hip fracture patients admitted to a safety net hospital had, on average, a higher number of chronic conditions (5.62 versus 5.31) when compared to patients admitted to a non-safety hospital, a finding was statistically significant ($p$ = 0.000). Only a small percent of hip fractures were diagnosed as complex and there was no significant difference between safety net and non-safety hospitals on the percent of patient admitted with complex fracture (2.56% versus 2.57%, $p$ = 0.839). A slightly higher percent of surgical hip fracture patients admitted to safety net hospitals were diagnosed as multiple trauma patients when compared to patients admitted to non-safety net hospitals (2.88% versus 1.85%, $p = 0.004$), a finding that was statistically significant. Pathologic fractures were reported to be at less than 1% in both safety net and non-safety hospitals (0.11% versus 0.09%, $p = 0.839$).

Patient race was categorized based on data from the Agency for Healthcare Research and Quality (AHRQ) as white, black, Hispanic, and other. The overwhelming majority of surgical hip fracture patients in this study were white (n = 9,446; 88.60%) followed by Hispanic, black and other (4.07%, 3.63%, and 3.41%; respectively). A slightly smaller percent of white (76.22% versus 91.60%) patients received care in safety net hospitals, while a larger percent of black (9.48% versus 2.39%) and Hispanic (9.64% versus 2.88%) patients received care in safety net hospitals, a finding that was statistically significant ($p = 0.00$). Significant differences were also noted in patient income, where a larger percent of surgical patients from the two lowest quartiles of income ($1-38,999 and $39,000-47,999) were admitted to safety net hospitals (13.15% versus 6.38% and 17.14% and 6.30%, respectively); whereas the largest percent of patients in the highest quartile of income ($64,000 and greater) were admitted to non-safety net hospitals (65.21% versus 39.03%, $p = 0.000$).

For elderly patients admitted for surgical repair of hip fracture the source of payment for surgical services was overwhelmingly Medicare (91.31%) followed by Medicaid (0.44%), private insurance (6.95%) and other sources (1.30%). There were no significant differences in source of payment for surgical services when patients admitted to safety net hospitals were compared to patients admitted to non-safety net hospitals ($p = 0.189$).

Table 4.1 Diagnostic Related Groups (DRGs) Reported for the Surgical Patients in this Study

| MS-DRG | MDC | TYPE | MS-DRG TITLE | FREQUENCY | PERCENTAGE |
|---|---|---|---|---|---|
| 003 | Pre | Surg | Ecmo or trach w mv 96+ hrs or pdx exc face, mouth & neck w maj o.r. | 19 | 0.18 |
| 025 | 01 | Surg | Craniotomy & endovascular intracranial procedures w mcc | 1 | 0.01 |
| 040 | 01 | Surg | Periph/cranial nerve & other nerv syst proc w mcc | 4 | 0.04 |
| 163 | 04 | Surg | Major chest procedures w mcc | 1 | 0.01 |
| 166 | 04 | Surg | Other resp system o.r. procedures w mcc | 3 | 0.03 |
| 216 | 05 | Surg | Cardiac valve & oth maj cardiothoracic proc w card cath w mcc | 1 | 0.01 |
| 224 | 05 | Surg | Cardiac defib implant w cardiac cath w/o ami/hf/shock w mcc | 1 | 0.01 |
| 233 | 05 | Surg | Coronary bypass w/o cardiac cath w mcc | 1 | 0.01 |
| 235 | 05 | Surg | Coronary bypass w/o cardiac cath w mcc | 1 | 0.01 |
| 237 | 05 | Surg | Major cardiovasc procedures w mcc or thoracic aortic aneurysm repair | 1 | 0.01 |
| 238 | 05 | Surg | Major cardiovasc procedures w/o mcc | 1 | 0.01 |
| 240 | 05 | Surg | Amputation for circ sys disorders exc upper limb & toe w cc | 1 | 0.01 |
| 242 | 05 | Surg | Permanent cardiac pacemaker implant w mcc | 9 | 0.08 |
| 246 | 05 | Surg | Perc cardiovasc proc w drug-eluting stent w mcc or 4+ vessels/stents | 1 | 0.01 |
| 248 | 05 | Surg | Perc cardiovasc proc w non-drug-eluting stent w mcc or 4+ ves/stents | 4 | 0.04 |
| 250 | 05 | Surg | Perc cardiovasc proc w/o coronary artery stent w mcc | 3 | 0.03 |
| 252 | 05 | Surg | Other vascular procedures w mcc | 4 | 0.04 |
| 329 | 06 | Surg | Major small & large bowel procedures w mcc | 2 | 0.02 |
| 353 | 06 | Surg | Hernia procedures except inguinal & femoral w mcc | 1 | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| 356 | 06 | Surg | Other digestive system o.r. Procedures w mcc | 3 | 0.03 |
| 462 | 08 | Surg | Bilateral or multiple major joint procs of lower extremity w/o mcc | 19 | 0.18 |
| 463 | 08 | Surg | Wnd debrid & skn grft exc hand, for musculo-conn tiss dis w mcc | 11 | 0.10 |
| 464 | 08 | Surg | Wnd debrid & skn grft exc hand, for musculo-conn tiss dis w cc | 6 | 0.06 |
| 466 | 08 | Surg | Revision of hip or knee replacement w mcc | 9 | 0.08 |
| 467 | 08 | Surg | Revision of hip or knee replacement w cc | 12 | 0.11 |
| 468 | 08 | Surg | Revision of hip or knee replacement w/o cc/mcc | 3 | 0.03 |
| 469 | 08 | Surg | Major joint replacement or reattachment of lower extremity w mcc | 620 | 5.80 |
| 470 | 08 | Surg | Major joint replacement or reattachment of lower extremity w/o mcc | 2120 | 19.82 |
| 474 | 08 | Surg | Amputation for musculoskeletal sys & conn tissue dis w mcc | 1 | 0.01 |
| 475 | 08 | Surg | Amputation for musculoskeletal sys & conn tissue dis w cc | 1 | 0.01 |
| 477 | 08 | Surg | Biopsies of musculoskeletal system & connective tissue w mcc | 4 | 0.04 |
| 478 | 08 | Surg | Biopsies of musculoskeletal system & connective tissue w cc | 13 | 0.12 |
| 479 | 08 | Surg | Biopsies of musculoskeletal system & connective tissue w/o cc/mcc | 5 | 0.05 |
| 480 | 08 | Surg | Hip & femur procedures except major joint w mcc | 1364 | 12.75 |
| 481 | 08 | Surg | Hip & femur procedures except major joint w cc | 4217 | 39.42 |
| 482 | 08 | Surg | Hip & femur procedures except major joint w/o cc/mcc | 1855 | 17.34 |
| 573 | 09 | Surg | Skin graft &/or debrid for skn ulcer or cellulitis w mcc | 1 | 0.01 |
| 617 | 10 | Surg | Amputat of lower limb for endocrine, nutrit & metabol dis w cc | 1 | 0.01 |
| 628 | 10 | Surg | Other endocrine, nutrit & metab o.r. Proc w mcc | 5 | 0.05 |
| 629 | 10 | Surg | Other endocrine, nutrit & metab o.r. Proc w cc | 2 | 0.02 |
| 669 | 11 | Surg | Transurethral procedures w cc | 1 | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| 673 | 11 | Surg | Other kidney & urinary tract procedures w mcc | 1 | 0.01 |
| 820 | 17 | Surg | Lymphoma & leukemia w major o.r. Procedure w mcc | 1 | 0.01 |
| 853 | 18 | Surg | Infectious & parasitic diseases w o.r. Procedure w mcc | 19 | 0.18 |
| 854 | 18 | Surg | Infectious & parasitic diseases w o.r. Procedure w cc | 1 | 0.01 |
| 856 | 18 | Surg | Postoperative or post-traumatic infections w o.r. Proc w mcc | 1 | 0.01 |
| 907 | 21 | Surg | Other o.r. Procedures for injuries w mcc | 3 | 0.03 |
| 956 | 24 | Surg | Limb reattachment, hip & femur proc for multiple significant trauma | 216 | 2.02 |
| 981 | | Surg | Extensive o.r. Procedure unrelated to principal diagnosis w mcc | 94 | 0.88 |
| 982 | | Surg | Extensive o.r. Procedure unrelated to principal diagnosis w cc | 25 | 0.23 |
| 983 | | Surg | Extensive o.r. Procedure unrelated to principal diagnosis w/o cc/mcc | 5 | 0.05 |

Note. DRG=Diagnostic Related Groups ECMO=Extracorporeal Membrane Oxygenation MV=Mechanical Ventilation PDX=Principal Diagnosis MCC=Major Complications and Comorbid Conditions CC=Complications and Comorbid Conditions AMI=Acute Myocardial Infarction HF=Heart Failure

Table 4.2 Characteristics of Elderly Patients Admitted for Surgical Repair of Hip Fracture (n = 10,686*)*

| | Safety net hospital | | Non-safety net hospital | | |
|---|---|---|---|---|---|
| | n | % | n | % | *p* |
| Age | | | | | 0.011 |
| 65-74 | 272 | (14.48) | 1107 | (12.55) | |
| 75-84 | 685 | (36.47) | 3084 | (34.97) | |
| 85 + | 921 | (49.04) | 4629 | (52.48) | |
| Sex | | | | | 0.395 |
| Male | 453 | (24.12) | 2210 | (25.0) | |
| Female | 1425 | (75.88) | 6610 | (74.94) | |
| Race | | | | | 0.00 |
| White | 1423 | (76.22) | 8023 | (91.60) | |
| Black | 177 | (9.48) | 209 | (2.39) | |
| Hispanic | 180 | (9.64) | 252 | (2.88) | |
| Other | 87 | (4.66) | 275 | (3.14) | |
| Median income | | | | | 0.000 |
| 1-38,999 | 244 | (13.15) | 558 | (6.38) | |
| 39,000-47,999 | 329 | (17.14) | 551 | (6.30) | |

| | | | | | |
|---|---|---|---|---|---|
| 48,000-63,999 | 558 | (30.08) | 1,933 | (22.10) | |
| 64,000+ | 724 | (39.03) | 5,703 | (65.21) | |
| Admission source | | | | | 0.002 |
| Emergency department | 40 | (2.23) | 278 | (3.15) | |
| Hospital transfer | 1 | (0.05) | 7 | (0.08) | |
| Skilled nursing facility | 6 | (0.32) | 93 | (1.05) | |
| Home | 1,878 | (97.50) | 8,442 | (95.71) | |
| Admission type | | | | | |
| Emergent | 1684 | (89.77) | 7770 | (88. 10) | 0.000 |
| Urgent | 133 | (7. 09) | 606 | (6. 87) | |
| Payer | | | | | 0.189 |
| Medicare | 1703 | (90.68) | 8065 | (91.44) | |
| Medicaid | 9 | (0.48) | 38 | (0.43) | |
| Private insurance | 132 | (7.03) | 612 | (6.94) | |
| Other | 34 | (1.81) | 105 | (1.19) | |
| Fracture type | | | | | 0.965 |
| Simple fracture | 1830 | (97.43) | 8593 | (97.43) | |
| Complex fracture | 48 | (2.56) | 227 | (2.57) | |
| Pathologic fracture | 2 | (0.11) | 8 | (0.09) | 0.839 |
| Multiple trauma | 54 | (2.88) | 163 | (1.85) | 0.004 |
| Chronic conditions, mean | 5.31 | (2.85) | 5.62 | (2.82) | 0.000 |
| Patient outcomes | | | | | |
| In-hospital mortality | 54 | (2) | 175 | (1) | 0.015 |
| Failure-to-rescue | 2 | (3) | 3 | (1) | 0.383 |
| Length of stay, mean | 7.02 | (5.34) | 5.96 | (4.07) | 0.000 |

**Comorbid disease.** A total of 29 different comorbid diseases were identified among the surgical patients included in this study and these were used to risk adjust the regression models (see Table 4.3). The most prevalent surgical patient comorbidity was hypertension (n = 8004; 74.83%). This was followed by deficiency anemia (n = 3,647; 34.09%), fluid and electrolyte disorders (n = 3,043; 28.44%), chronic pulmonary disease (n = 2,149; 20.09%), other neurological disorder (n = 1,985; 18.55%), diabetes uncomplicated (n = 2,014; 18.83%), hypothyroidism (n = 1,926; 18.00%), valvular disease (n = 1,912; 17.87%), congestive heart failure (n = 1,766; 16.51%), renal failure (n = 1,561; 14.59%), depression (n = 1,288; 12.04%), peripheral vascular disorders (n =

798; 7.46%), coagulopathy (n = 738; 6.90%), and pulmonary circulation disorders (n = 688; 6.43%). Acquired immune deficiency syndrome, alcohol abuse, chronic blood loss anemia, diabetes with complications, drug abuse, liver disease, lymphoma, metastatic cancer, obesity, paralysis, peptic ulcer disease excluding bleeding, psychosis, rheumatoid arthritis/collagen vascular diseases, solid tumor without metastasis, and weight loss were reported for less than five percent of the surgical hip fracture patients in this study.

Table 4.3 Comorbid Diseases Reported for Surgical Patients in this Study

| | Safety Net Hospital | Percent | Non Safety Net Hospitals | Percent | *p* |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Acquired immune deficiency syndrome | 5 | (0.27) | 2 | (.02) | .003 |
| Alcohol abuse | 123 | (1.39) | 27 | (1.44) | 0.885 |
| Chronic blood loss anemia | 74 | (3.94) | 325 | (3.68) | 0.596 |
| Chronic pulmonary disease | 364 | (19.38) | 1785 | (20.24) | 0.401 |
| Coagulopathy | 150 | (7.99) | 588 | (6.67) | 0.04 |
| Congestive heart failure | 346 | (18.42) | 1420 | (16.10) | 0.014 |
| Deficiency anemias | 687 | (36.58) | 2960 | (33.56) | 0.012 |
| Depression | 168 | (8.95) | 1120 | (12.70) | 0.000 |
| Diabetes uncomplicated | 381 | (20.29) | 1633 | (18.51) | 0.074 |
| Diabetes w/ chronic complications | 56 | (2.98) | 256 | (2.90) | 0.853 |
| Drug abuse | 6 | (0.32) | 20 | (0.23) | 0.459 |
| Fluid and electrolyte disorders | 547 | (29.13) | 2496 | (28.30) | 0.471 |
| Hypertension | 1401 | (74.60) | 6603 | (74.86) | 0.811 |
| Hypothyroidism | 265 | (14.11) | 1661 | 18.83 | 0.000 |
| Liver disease | 21 | (1.12) | 93 | (1.05) | 0.807 |
| Lymphoma | 15 | (.80) | 86 | (.98) | 0.473 |
| Metastatic cancer | 22 | (1.17) | 98 | (1.11) | 0.822 |
| Obesity | 61 | (3.25) | 197 | (2.23) | 0.009 |
| Other neurological disorders | 315 | (16.77) | 1670 | (18.93) | 0.029 |
| Paralysis | 37 | (1.97) | 185 | (2.10) | 0.725 |
| Peptic ulcer disease excluding Bleeding | 0 | (0.00) | 2 | (0.02) | 1.00 |
| Peripheral vascular disorders | 126 | (6.71) | 672 | (7.62) | 0.173 |

| | | | | | |
|---|---|---|---|---|---|
| Psychoses | 51 | (2.72) | 272 | (3.08) | 0.397 |
| Pulmonary circulation disorders | 124 | (6.60) | 564 | (6.39) | 0.738 |
| Renal failure | 287 | (15.28) | 1274 | (14.44) | 0.350 |
| Rheumatoid arthritis/ collagen vascular diseases | 309 | (3.50) | 59 | (3.14) | 0.435 |
| Solid tumour without metastasis | 41 | (2.18) | 192 | (2.18) | 0.986 |
| Valvular disease | 345 | (18.37) | 1567 | (17.77) | 0.535 |
| Weight loss | 136 | (7.24) | 384 | (4.35) | 0.00 |

**Hospital Characteristics.** The characteristics of the New Jersey adult acute care hospitals included in these analyses are shown in Table 4.4. There are currently 72 adult acute care hospitals in New Jersey, but five of these hospitals submitted consolidated reporting data to the American Hospital Association Annual Survey and had to be excluded from the analyses. The final sample included 67 New Jersey adult acute care hospitals that were included in these analyses. Slightly more than half (n = 36; 53.73%) of these New Jersey hospitals were large in size (> 250 beds). Though there was a larger percent of safety net hospitals that were classified as large, there were no statistically significant differences noted when safety net hospitals were compared to non-safety net hospitals based on bed size (61.11 versus 51.02%, respectively; $p$ = 0.579). Of the hospitals included in these analyses, 41 out of 67 (61.19%) were teaching hospitals. A higher percent of safety net hospitals were teaching hospitals when compared to non-safety net hospitals, but this finding was not statistically significant (77.78% versus 55.10%, $p$ = 0.159). A larger percent of safety net hospitals were classified as high technology (open heart surgery, organ transplantation or both) when compared to non-safety net (61.19% versus 12.24%) hospitals, a finding that was statistically significant ($p$ = 0.000). A total of 23 (34.33%) of the adult acute care hospitals in this study had achieved magnet accreditation. A smaller percent of safety net hospitals had received magnet accreditation when compared to non-safety net hospitals (22.22% versus 38.78%), but this finding was not statistically significant ($p$ = 0.255).

The average number of patients assigned to a nurse was higher in safety net hospitals when compared to non-safety net hospitals (5.01 versus 4.83, respectively), but this finding was not statistically significant ($p$ = 0.156). However, overall, patients in safety net hospitals received on average slightly more hours of registered nurse care per patient day, when compared to patients in non-safety net hospitals (16.33 versus 15.81), but this finding was not statistically significant ($p$ = 0.148). In addition, registered nurse skill mix or the percent of all nursing staff that were registered nurses was slightly higher in safety net hospitals when compared to non-safety net hospitals (77.2% versus 73.9%), but again this finding was not statistically significant ($p$ = 0.108).

Table 4.4 Characteristics of the Hospitals used in this Study by Safety Net Status

| | Safety Net (n = 18) | Percent % | Non -Safety Net (n = 49) | Percent % | $p$ |
|---|---|---|---|---|---|
| Bed Total | | | | | 0.579 |
| <250 beds | 7 | (38.89) | 24 | (48.98) | |
| >250 beds | 11 | (61.11) | 25 | (51.02) | |
| Teaching Hospital | | | | | 0.159 |
| Yes | 14 | (77.78) | 27 | (55.10) | |
| No | 4 | (22.22) | 22 | (44.90) | |
| High Technology | | | | | 0.00 |
| Yes | 11 | (61.11) | 6 | (12.24) | |
| No | 7 | (38.89) | 43 | (87.76) | |
| Magnet | | | | | 0.225 |
| Yes | 4 | (22.22) | 19 | (38.78) | |
| No | 14 | (77.78) | 30 | (61.22) | |
| RN Hours PPD, mean | 16.33 | (2.14) | 15.81 | (1.64) | 0.148 |
| RN Skill Mix, mean | .772 | (.095) | .739 | (.093) | 0.108 |

**Inferential Statistics**

**Hypothesis 1.** Hospitals with safety net status will have fewer nurse resources - lower registered nurse hours per patient day, lower registered nurse skill mix, and poor organizational climate - when compared to non-safety net hospitals.

The availability of nurse resources in safety net hospitals were mixed, when compared to non-safety net hospitals, and none of the findings were statistically significant ($p$ = 0.156). Table 4.4 shows that safety net hospitals provided slightly more registered nurse hours per patient day (16.33 hours; SD = 2.14 versus 15.81 hours; SD 1.64)., and a higher registered nurse skill mix (0.77 versus 0.74), when compared to non-safety net hospitals. Safety net hospitals were more likely to be organizations with poorer practice climates based on the absence of Magnet accreditation, when compared to non-safety net hospitals (22.2% versus 38.7%).

**Hypothesis 2.** Fewer hospital nurse resources, magnet accreditation, registered nurse hours per patient day and registered nurse skill mix, will be associated with higher rates of adverse outcomes - in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay - in elderly patients admitted to a hospital for surgical repair of hip fracture.

***In-hospital mortality.*** Three logistic regression models were fit to estimate the odds of in-hospital mortality in elderly patients admitted to an acute care hospital for surgical repair of hip fracture. Logistic regression models were used to estimate the association between in-hospital mortality and hospital nurse resources - registered nurse hours per patient day, registered nurse skill mix, and organizational climate - controlling for a number of patient and hospital characteristics. All models were estimated using a

Huber White sandwich estimator to adjust the standard errors. Table 4.5 shows the full logistic model that included all available study variables.

***In-hospital mortality full regression model.*** In a full regression model those patients 85 of age or older had a 2-fold increase in the odds of in-hospital mortality, when compared to patients 65-74 years of age (*p* = 0.018; 95% CI: 1.13, .3.79), and patients 75-84 years of age had a 94% increase in the odds of in-hospital mortality, when compared to patients 65-74 years of age (*p*= 0.024; 95% CI: 1.08, 3.47), findings that were statistically significant. When compared to white patients, Hispanic patients admitted to a hospital for surgical repair of hip fracture had an 85% increase in the odds of in-hospital mortality, a finding that was statistically significant (*p* = 0.027; 95% CI: 1.07, 3.19). When compared to males, females had a 34% decrease in the odds of in-hospital mortality (*p* = 0.003; 95% CI: .503, .867), and each additional chronic illness reported by a patient was significantly associated with an 8% increase in the odds of in-hospital mortality (*p* = 0.04; 95% CI: 1.00, 1.17).

Several comorbid diseases were significantly associated with an increase in the odds of in-hospital mortality among elderly patients admitted for surgical repair of hip fracture. As one might expect, there was a 3.8-fold increase in the odds of in-hospital mortality in patients with metastasis when compared to patients without metastasis, a finding that was statistically significant (*p* = 0.000; 95% CI: 1.93, 7.55). Weight loss was also associated with a 3-fold increase in the odds of in-hospital mortality (*p* = 0.000; 95% CI: 2.06, 4.76), as was fluid and electrolyte disorders with a 2.4-fold increase (*p* = 0.000, 95% CI: 1.80 3.23). Having a tumor was associated with 2.4-fold increase in the odds of in-hospital mortality (*p* = 0.002; 95% CI: 1.39, 4.43), and pulmonary circulation disorders were associated with a 2.1-fold increase in the odds of in-hospital mortality (*p* = 0.001; 95% CI: 1.34, 3.35). Congestive heart failure was associated with a 2-fold increase in the odds of in-hospital mortality (*p* = 0.000; 95% CI: 1.44, 2.77), coagulopathy was associated with a 66% increase in the odds of in-hospital mortality (*p* = 0.006; CI: 1.16, 2.39), and there was a 56% increase in the odds of in-hospital mortality in patients with renal failure (*p* = 0.005; 95% CI: 1.14, 2.14).

Four comorbid diseases were statistically associated with a decrease in the odds of in-hospital mortality. Patients with psychoses had an 80% decrease in the odds of in-hospital mortality (*p* = 0.012; 95% CI: .059, .707). Patients with hypertension had a 52% decrease in the odds of in-hospital mortality (*p* = 0.000; 95% CI: .353, .669), patients with valvular disease had a 40% decrease in the odds of in-hospital mortality (*p* = 0.009; 95% CI: .416, .883), and patient with deficiency anemia had a 36% decrease in the odds of in-hospital mortality (*p* = 0.004; 95% CI: .479, .871).

Patients admitted to a teaching hospital for surgical repair of hip fracture had a 46% increase in the odds of in-hospital mortality, when compared to patients admitted to a non-teaching hospital (*p* = 0.038; 95% CI: 1.02, 2.09), a finding that was statistically significant. Safety net status, registered nurse hours per patient day, registered nurse skill mix, and organizational climate were not significant predictors of in-hospital mortality in the full regression model.

Table 4.5 In-Hospital Mortality Estimated in a Full Logistic Regression Model

| | Odds Ratio | Robust Std. Err. | 95% C I | | *p* |
|---|---|---|---|---|---|
| 65-74 years | * | * | * | * | * |
| 75-84 years | 1.9 | .57 | 1.08 | 3.47 | 0.024 |
| 85 years and older | 2.07 | .64 | 1.13 | 3.79 | 0.018 |
| Female | .66 | .09 | .50 | .86 | 0.003 |
| White | * | * | * | * | * |
| Black | 1.37 | .39 | .78 | 2.40 | 0.264 |

| | | | | | |
|---|---|---|---|---|---|
| Hispanic | 1.85 | .51 | 1.07 | 3.19 | 0.027 |
| Other race | .90 | .39 | .38 | 2.14 | 0.824 |
| $1-38,999 | * | * | * | * | * |
| $39,000-$47,999 | .91 | .23 | .54 | 1.51 | 0.724 |
| $48,000-$63,999 | 1.02 | .25 | .63 | 1.65 | 0.913 |
| $64,000 and over | .98 | .21 | .63 | 1.52 | 0.948 |
| Emergency department | * | * | * | * | * |
| Hospital transfer | 1 | (omitted) | .26 | | |
| Skilled nursing facility | .85 | .50 | .26 | 2.69 | 0.786 |
| Home | 1.06 | .40 | .51 | 2.22 | 0.859 |
| Emergent/urgent | 1 | (omitted) | | | |
| Medicare | * | * | * | * | * |
| Medicaid | 1 | (omitted) | | | |
| Private insurance | .91 | .26 | .51 | 1.61 | 0.763 |
| Other payer | .41 | .43 | .05 | 3.21 | 0.396 |
| Complex fracture | .60 | .33 | .20 | 1.76 | 0.357 |
| Multiple trauma | 1.71 | .66 | .79 | 3.68 | 0.167 |
| Chronic conditions | 1.08 | .04 | 1.00 | 1.17 | 0.038 |
| Acquired immune deficiency syndrome | 1 | (omitted) | | | |
| Alcohol abuse | .49 | .36 | .11 | 2.08 | 0.335 |
| Deficiency anemias | .64 | .09 | .47 | .87 | 0.004 |
| Rheumatoid arthritis/collagen vascular diseases | .86 | .32 | .41 | 1.79 | 0.692 |
| Chronic blood loss anemia | .40 | .18 | .16 | 1.01 | 0.053 |
| Chronic pulmonary disease | 1.07 | .16 | .79 | 1.45 | 0 .640 |
| Coagulopathy | 1.66 | .30 | 1.16 | 2.39 | 0.006 |
| Congestive heart failure | 2.00 | .33 | 1.44 | 2.77 | 0.000 |
| Depression | .73 | .17 | .46 | 1.16 | 0.184 |
| Diabetes uncomplicated | .79 | .18 | .50 | 1.26 | 0.329 |
| Diabetes w/chronic complications | .69 | .27 | .31 | 1.52 | 0.369 |
| Drug abuse | 1 | (omitted) | | | |
| Hypertension | .48 | .07 | .35 | .66 | 0.000 |
| Hypothyroidism | .87 | .16 | .60 | 1.26 | 0.471 |
| Liver disease | 1.24 | .63 | .45 | 3.36 | 0.672 |
| Lymphoma | 1.20 | .84 | .30 | 4.75 | 0.786 |
| Fluid and electrolyte | 2.41 | .36 | 1.80 | 3.23 | 0.000 |
| Metastatic cancer | 3.82 | 1.32 | 1.93 | 7.55 | 0.000 |
| Other neurological disorders | .79 | .16 | .53 | 1.19 | 0.271 |
| Obesity | .69 | .35 | .25 | 1.89 | 0.481 |
| Paralysis | 1.47 | .59 | .66 | 3.26 | 0.342 |
| Peripheral vascular disorders | .99 | .25 | .60 | 1.63 | 0.986 |
| Psychoses | .20 | .12 | .05 | .70 | 0.012 |
| Pulmonary circulation disorders | 2.12 | .49 | 1.34 | 3.35 | 0.001 |
| Renal failure | 1.56 | .25 | 1.14 | 2.14 | 0.005 |
| Solid mumor without Metastasis | 2.48 | .73 | 1.39 | 4.43 | 0.002 |
| Peptic ulcer disease excluding bleeding | 1 | (omitted) | | | |

| | | | | | |
|---|---|---|---|---|---|
| Valvular disease | .60 | .11 | .41 | .88 | 0.009 |
| Weight loss | 3.13 | .66 | 2.06 | 4.76 | 0.000 |
| >250 beds | .92 | .18 | .62 | 1.36 | 0.685 |
| Teaching hospitals | 1.46 | .26 | 1.02 | 2.09 | 0.038 |
| High technology | .84 | .16 | .57 | 1.24 | 0.386 |
| Magnet accreditation | .85 | .17 | .58 | 1.27 | 0.447 |
| Safety net hospitals | 1.29 | .31 | .80 | 2.08 | 0.287 |
| RN hours per patient day | 1.01 | .06 | .89 | 1.15 | 0.824 |
| RN skill mix | .55 | .71 | .04 | 6.91 | 0.648 |

***In-hospital mortality stepwise regression model***. In patients admitted to a hospital for the surgical repair of hip fracture, those 85 years of age and older and those 75-84 years of age had a 2.2-fold and 2-fold increase in the odds of in-hospital mortality, respectively ($p$ = 0.005; 95% CI: 1.27, 4.00 and $p$ = 0.016; 95% CI: 1.14, 3.67), when compared to patients who were 65-74 years of age. There was a 36% decrease in the odds of in-hospital mortality for females admitted for surgical repair of hip fracture ($p$ = 0.001; 95% CI: .497, .846).

Hispanic patients had a 75% increase in the odds of in-hospital mortality when compared to whites ($p$ = 0.035; 95% CI: 1.04, 2.94), and each additional chronic illness reported by a patient was associated with a 6% increase in the odds of in-hospital mortality ($p$= 0.035; 95% CI: 1.00, 1.12). Metastatic cancer was associated with a 4.1 fold increase in the odds of in-hospital mortality ($p$ = 0.000, 95% CI: 2.06, 8.33). Weight loss was associated with a 3.2-fold increase in the odds of in-hospital mortality ($p$ = 0.000; 95% CI: 2.12, 4.95), and a tumor was associated with a 2.5 fold increase in the odds of in-hospital mortality ($p$ = 0.002; 95% CI: 1.41, .4.47). Patients with the fluid and electrolyte disorders had a 2.4-fold increase in the odds of in-hospital mortality ($p$= 0.000; 95% CI: 1.82, 3.25). Congestive heart failure was associated with a 2-fold increase in the odds of in-hospital mortality ($p$ = 0.000; 95% CI: 1.53, 2.86) and patients with pulmonary circulation had a 2.1-fold increase in the odds of in-hospital mortality ($p$ = 0.001; 95% CI: 1.37, 3.37). Patients with coagulopathy had a 78% increase in the odds of in-hospital mortality ($p$ = 0.001; 95% CI: 1.27, 2.50), renal failure was associated with a 59% increase in the odds of in-hospital mortality ($p$= 0.005; 95% CI: 1.14, 2.21).

Patients with psychoses had an 81% decrease in the odds of in-hospital mortality ($p$= 0.012; 95% CI: .054, .694). The odds of in-hospital mortality decreased by 60% in patients with blood loss anemia; ($p$= 0.053, 95% CI: .165, 1.01); and by 51% in patients with hypertension ($p$ = 0.000; 95% CI: .369, .652). In those patients with valvular disease there was a 39% decrease in the odds of in-hospital mortality ($p$= 0.008; 95% CI: .432, .884), and patients with deficiency anemia had a 35% decrease in the odds of in-hospital mortality ($p$ = 0.004; 95% CI: .486, .873)

Patients admitted to a safety net hospital for surgical repair of hip fracture had a 44% increase in the odds of in-hospital mortality ($p$ = 0.065; 95% CI: .977, 2.14), there was a 41% increase in the odds of in-hospital mortality in patients admitted to a teaching hospitals ($p$ = 0.048; 95% CI: 1.00, 2.00), and there was a 25% decrease in the odds of in-hospital mortality in patients admitted to a high technology hospital ($p$ = 0.084; 95% CI: .552, 1.03). Table 4.6 lists the findings from the stepwise mortality model.

Table 4.6 In-Hospital Mortality Estimated with Stepwise Regression Model

| | Odds Ratio | Robust SE | 95% CI | | *p* |
|---|---|---|---|---|---|
| 75-84 years | 2.05 | .60 | 1.14 | 3.67 | 0.016 |
| 85 years and older | 2.25 | .65 | 1.27 | 4.00 | 0.005 |
| Female | .64 | .08 | .49 | .84 | 0.001 |
| Hispanic | 1.75 | .46 | 1.04 | 2.94 | 0.035 |
| Chronic conditions | 1.06 | .03 | 1.00 | 1.12 | 0.035 |
| Deficiency nemia | .65 | .09 | .48 | .87 | 0.004 |

| | | | | | |
|---|---|---|---|---|---|
| Chronic blood loss anemia | .40 | .18 | .16 | 1.00 | 0.053 |
| Coagulopathy | 1.78 | .30 | 1.27 | 2.50 | 0.001 |
| Congestive heart failure | 2.09 | .33 | 1.53 | 2.86 | 0.000 |
| Hypertension | .49 | .07 | .36 | .65 | 0.000 |
| Fluid and electrolyte disorders | 2.43 | .36 | 1.82 | 3.25 | 0.000 |
| Metastatic cancer | 4.14 | 1.47 | 2.06 | 8.33 | 0.000 |
| Psychoses | .19 | .12 | .05 | .69 | 0.012 |
| Pulmonary circulation disorders | 2.15 | .49 | 1.37 | 3.37 | 0.001 |
| Renal Failure | 1.59 | .26 | 1.14 | 2.21 | 0.005 |
| Solid Tumor w/o metastasis | 2.51 | .74 | 1.41 | 4.47 | 0.002 |
| Valvular disease | .61 | .11 | .43 | .88 | 0.008 |
| Weight loss | 3.24 | .70 | 2.12 | 4.95 | 0.000 |
| Teaching hospitals | 1.41 | .25 | 1.00 | 2.00 | 0.048 |
| High technology hospitals | .75 | .12 | .55 | 1.03 | 0.084 |
| Safety net hospitals | 1.44 | .29 | .97 | 2.14 | 0.065 |

**Failure-to-rescue.** As noted in Table 4.2 only 2 patients died from failure-to-rescue in safety net hospitals and 3 patients died from failure-to-rescue in non-safety net hospitals. Due to the small sample size, the regression models could not be estimated.

**Length of stay.** As expected, data on length of stay were skewed to the right (see Figure 4.1 and Figure 4.2). In such a situation transformations are typically applied so that the data appear to more clearly meet the assumption of normality.  The following paragraphs present findings from two measure of length of stay: 1) log length of stay, and 2) prolonged length of stay. As shown in Table 2.1, elderly patients admitted to a safety net hospital for surgical repair of hip fracture had on average a longer length of stay when compared to patients admitted to a non-safety net hospital (7.02 days versus 5.96 days, $p$=0.000), a finding that was statistically significant.

Figure 4.1 Histogram Showing Distribution of Length of Stay

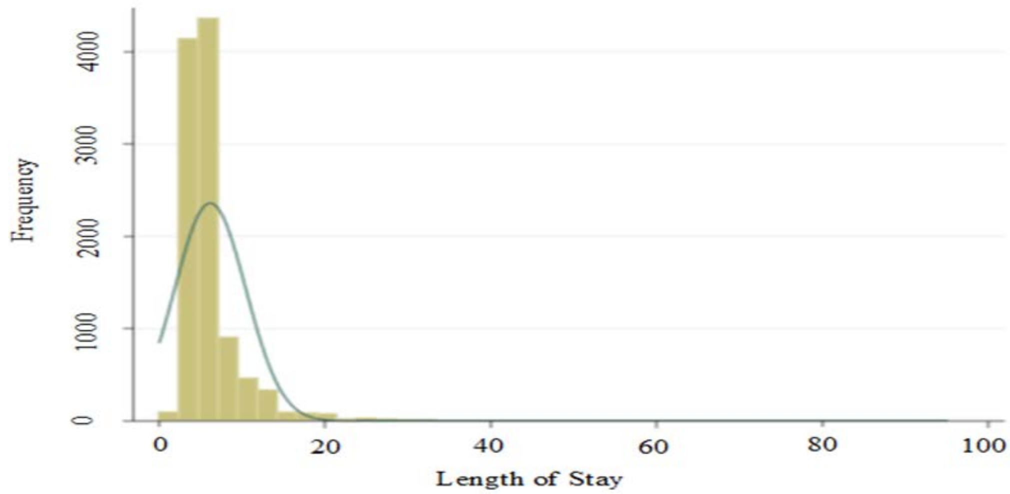
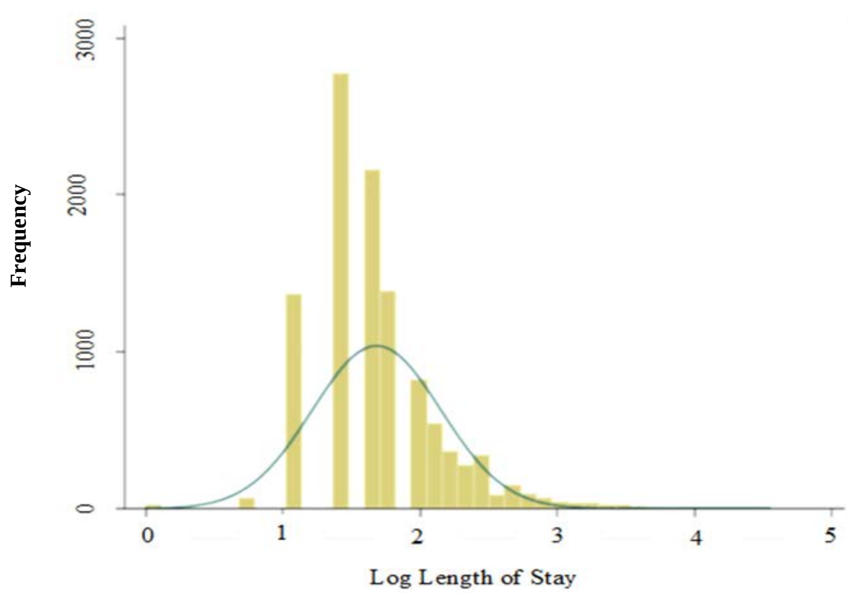



Figure 4.2 Histogram Showing Distribution of Log Length of Stay



***Log length of stay full regression model.*** Findings from this full model (see Table 4.7) suggest that surgical patients 75-84 years of age had a 3% increase in length of stay when compared to the surgical patients who were 65-74 years of age, a finding that was statistically significant ($p$ = 0.018; 95% CI: .006, .063). When compared to males, female patients had a 5% decrease in length of stay ($p$ = 0.000). When compared to white surgical patients, black patients had a 10% increase and Hispanic surgical patients had an 8% increase in length of stay ($p$ = 0.003; 95% CI: .038, .174 and $p$ = 0.017; .014, .145). Patients who identified with other race had a 6% increase in length of stay ($p$ = 0.027; 95% CI: .008, .130)

A complex fracture was associated with a 7% increase in length of stay ($p$ = 0.011; 95% CI: .017, .128) and multiple trauma was associated with a 25% increase in length of stay ($p$ = 0.000; 95% CI: .181, .315). Each additional chronic condition reported by a patient was associated with a 2% increase in length of stay ($p$ = 0.000; 95% CI: .017, .032). Weight loss was associated with a 27% increase in length of stay ($p$ = 0.000; 95% CI: .173, .361), congestive heart failure was associated with a 18% increase in length of stay ($p$ = 0.000; 95% CI: .156, .204), fluid and electrolyte disorders was associated with a 16% increase in length of stay ($p$ = 0.000; 95% CI: .141, .188), metastatic cancer was associated with a 14% increase in length of stay (p = 0.018; 95% CI: .025, .258), pulmonary circulation disorders was associated with a 11% increase in length of stay ($p$ = 0.000; 95% CI: .059, .160), solid tumor without metastasis was associated with a 7% increase in length of stay ($p$ = 0.026; 95% CI: .008, .132), coagulopathy was associated with a 6% increase in length of stay (p = 0.000; 95% CI: .034, .100), chronic blood loss anemia was associated with a 5% increase in length of stay ($p$ = 0.016; 95% CI: .010, .098), renal failure was associated with a 4% increase in length of stay ($p$ = 0.002; 95% CI: .017, .076), deficiency anemia was associated with a 2% increase in length of stay ($p$ = 0.015; 95% CI: .005, .051), and other neurologic disorders was associated with a 1% increase in length of stay ($p$ = 0.047; 95% CI: -.001, .041).

Peptic ulcer disease excluding bleeding was associated with a 13% decrease in length of stay ($p$ = 0.046; 95% CI: -.267, -.002), hypertension was associated with a 7% decrease in length of stay ($p$ = 0.000; 95% CI: -.096, -.053), rheumatoid arthritis/collagen vascular diseases was associated with a 6% decrease in length of stay ($p$ = 0.002; 95% CI: -.112, -.026), depression was associated with a 4% decrease in length of stay ($p$ = 0.000; 95% CI: -.063, -.021), and hypothyroidism was associated with a 4% decrease in length of stay ($p$ = 0.001; 95% CI: -.068, -.018),

Hospitals identified as teaching hospitals had a 5% increase in length of stay ($p$ = 0.051; 95% CI: -.0003, .108). Safety net status, registered nurse hours per patient day, registered nurse skill mix, and organizational climate were not significantly associated with length of stay in the full model.

Table 4.7 Log Length of Stay Estimated in a Full Linear Regression Model

| | Coefficient | Robust Std. Err. | 95% Conf. Interval | | *p* |
|---|---|---|---|---|---|
| 65-74 years | * | * | * | * | * |
| 75-84 years | .03 | .01 | .00 | .06 | 0.018 |
| 85 years and older | .02 | .01 | -.00 | .05 | 0.155 |
| Female | -.05 | .01 | -.07 | -.03 | 0.000 |
| White | * | * | * | * | * |
| Black | .10 | .03 | .04 | .17 | 0.003 |
| Hispanic | .08 | .03 | .01 | .14 | 0.017 |
| Other | .06 | .03 | .00 | .13 | 0.027 |
| $1-38,999 | * | * | * | * | * |
| $39,000-$47,999 | .05 | .03 | -.02 | .13 | 0.199 |
| $48,000-$63,999 | -.01 | .03 | -.08 | .05 | 0.648 |
| $64,000 and over | .00 | .03 | -.06 | .08 | 0.804 |
| Emergency department | * | * | * | * | * |

| | | | | | |
|---|---|---|---|---|---|
| Hospital transfer | .02 | .12 | -.22 | .26 | 0.840 |
| Skilled nursing facility | .00 | .09 | -.17 | .19 | 0.917 |
| Home | -.06 | .04 | -.15 | .01 | 0.101 |
| Emergent/urgent | 0 | (Omitted) | | | |
| Medicare | * | * | * | * | * |
| Medicaid | .14 | .09 | -.04 | .33 | 0.137 |
| Private insurance | .03 | .02 | -.00 | .07 | 0.067 |
| Other payer | .15 | .04 | .07 | .24 | 0.000 |
| Complex fracture | .07 | .02 | .01 | .12 | 0.011 |
| Multiple trauma | .25 | .03 | .18 | .32 | 0.000 |
| Chronic conditions | .02 | .00 | .01 | .03 | 0.000 |
| Acquired immune deficiency syndrome | -.11 | .19 | -.50 | .28 | 0.575 |
| Alcohol abuse | -.00 | .04 | -.08 | .07 | 0.888 |
| Deficiency anemias | .02 | .01 | .00 | .05 | 0.015 |
| Rheumatoid arthritis/collagen vascular diseases | -.06 | .02 | -.11 | -.02 | 0.002 |
| Chronic blood loss anemia | .05 | .02 | .01 | .09 | 0.016 |
| Chronic pulmonary disease | .00 | .01 | -.02 | .03 | 0.557 |
| Coagulopathy | .06 | .01 | .03 | .10 | 0.000 |
| Congestive heart failure | .18 | .01 | .15 | .20 | 0.000 |
| Depression | -.04 | .01 | -.06 | -.02 | 0.000 |
| Diabetes uncomplicated | .00 | .01 | -.02 | .02 | 0.940 |
| Diabetes w/chronic complications | -.03 | .02 | -.08 | .02 | 0.241 |
| Drug abuse | -.02 | .11 | -.25 | .20 | 0.823 |
| Hypertension | -.07 | .01 | -.09 | -.05 | 0.000 |
| Hypothyroidism | -.04 | .01 | -.06 | -.01 | 0.001 |
| Liver disease | .04 | .04 | -.03 | .13 | 0.283 |
| Lymphoma | -.01 | .05 | -.12 | .09 | 0.777 |
| Fluid and electrolyte | .16 | .01 | .14 | .18 | 0.000 |
| Metastatic cancer | .14 | .05 | .02 | .25 | 0.018 |
| Other neurological disorders | .01 | .01 | -.00 | .04 | 0.074 |
| Obesity | .00 | .02 | -.04 | .05 | 0.940 |
| Paralysis | .15 | .03 | .08 | .22 | 0.000 |
| Peripheral vascular disorders | -.00 | .01 | -.03 | .03 | 0.893 |
| Psychoses | .01 | .02 | -.03 | .06 | 0.639 |
| Pulmonary circulation disorders | .11 | .02 | .05 | .16 | 0.000 |
| Renal failure | .04 | .01 | .01 | .08 | 0.002 |
| Solid tumor without Metastasis | .07 | .03 | .00 | .13 | 0.026 |
| Peptic ulcer disease excluding bleeding | -.13 | .06 | -.26 | -.00 | 0.046 |
| Valvular disease | -.02 | .01 | -.05 | .00 | 0.053 |
| Weight loss | .26 | .04 | .17 | .36 | 0.000 |
| >250 beds | -.02 | .03 | -.07 | .04 | 0.581 |
| Teaching hospitals | .05 | .02 | -.00 | .11 | 0.052 |
| High technology hospitals | .02 | .03 | -.04 | .09 | 0.548 |
| Magnet hospitals | -.03 | .03 | -.10 | .04 | 0.353 |
| Safety net hospitals | .09 | .05 | -.02 | .20 | 0.140 |
| RN hours per patient day | -.01 | .00 | -.02 | .01 | 0.303 |
| RN skill mix | -.09 | .20 | -.49 | .31 | 0.647 |

***Log length of stay stepwise regression model.*** Patients 75-84 years of age admitted to a hospital for surgical repair of hip fracture had a 1% increase in length of stay, when compared to patients 65-74 year of age, a finding that was statistically significant ($p$ = 0.042; 95% CI: .0006, .034). Females had a 5% decrease in length of stay ($p$ = 0.000; 95% CI: -.073, -.029). When compared to white surgical patients, blacks had a 10 % increase in length of stay and Hispanics had a 7% increase length of stay ($p$ = 0.004; 95% CI: .032, .171 and $p$ = 0.022; 95% CI: .011, .147, respectively). Patients who were identified as race other had a 7% increase length of stay ($p$ = 0.011; 95% CI: .017, .133). Surgical patients with a reported income of $39,000 - $49,999 had a 4% increase in length of stay (p = 0.032; 95% CI: .004, .090). Patients with an admission diagnosis of multiple trauma had a 25% increase in length of stay ($p$ = 0.000; 95% CI: .181, .328) and a complex fracture was associated with a 6% increase in length of stay (p = 0.014; 95% CI: .014, .124). Each additional reported patient chronic condition was associated with a 2% increase in length of stay ($p$ = 0.000; 95% CI: .019, .031).

Surgical patients with a comorbid disease of weight loss had a 26% increase in length of stay ($p$ = 0.000; 95% CI: .166, .367). Patients with congestive heart failure had a 18% increase in length of stay ($p$ = 0.000; 95% CI: .157, .205) and those with fluid and electrolyte disorders had a16% increase in length of stay ($p$ = 0.000; 95% CI: .142, .190). Paralysis was associated with a 15% increase in length of stay ($p$ = 0.000; 95% CI: .089, .221). Patients with metastatic cancer had a14% increase in length of stay and those with solid tumors without metastasis had a 6% increase in length of stay ($p$ = 0.016; 95% CI: 0.26, .255 and $p$ = 0.033, 95% CI: .005, .126, respectively). Patients with pulmonary circulation disorders had a 10% increase in length of stay ($p$ = 0.000; 95% CI: .057,

.157), coagulopathy was associated with a 6% increase in length of stay (*p* = 0.000; 95% CI: .038, .101), and chronic blood loss anemia was associated with a 5% increase in length of stay (*p* = 0.030; 95% CI: .005, .097). Renal failure was associated with a 4% increase in length of stay (*p* = 0.004; 95% CI: .014, .073) and deficiency anemia was associated with a 2% increase in length of stay (*p* = 0.010; 95% CI: .007, .051)

Three comorbid conditions were associated with a statistically significant decrease length of stay. Surgical patients with hypertension and those with rheumatoid arthritis/collagen vascular disease had on 7% decrease in length of stay (*p* = 0.000; 95% CI: -.098, -.053 and *p* = 0.001; 95% CI: -.111, -.028, respectively). Patient with valvular disease had a 2% decrease in length of stay (p = 0.050; 95% CI: -.056, -.000).

Safety net status was associated with a 9% increase in length of stay, and teaching status was associated with a 4% increase in length of stay (p = 0.063; 95% CI: -.005, .201 and p = 0.093; 95% CI: -.008, .107). Each additional registered nurse hour per patient day was associated with a 1% decrease in length of stay (*p* = 0.058; 95% CI: -.027, .0004). Registered nurse skill mix and organizational climate were not significantly associated with length of stay in the stepwise regression model (see Table 4.8).

Table 4.8 Log Length of Stay Estimated in a Stepwise Regression Model

| | Coefficient | Robust SE | 95% C I | | *p* |
|---|---|---|---|---|---|
| 75-84 years | .01 | .00 | .00 | .03 | 0.042 |
| Female | -.05 | .01 | -.07 | -.02 | 0.000 |
| Black | .10 | .03 | .03 | .17 | 0.004 |
| Hispanic | .07 | .03 | .01 | .14 | 0.022 |
| Other race | .07 | .02 | .01 | .13 | 0.011 |
| $39,000 - $49,999 | .04 | .02 | .00 | .09 | 0.032 |
| Home | -.08 | .03 | -.16 | -.00 | 0.031 |
| Other payer | .14 | .04 | .06 | .23 | 0.001 |
| Complex fracture | .06 | .02 | .01 | .12 | 0.014 |

| | | | | | |
|---|---|---|---|---|---|
| Multiple trauma | .25 | .03 | .18 | .32 | 0.000 |
| Chronic conditions | .02 | .00 | .01 | .03 | 0.000 |
| Deficiency anemia | .02 | .01 | .00 | .05 | 0.010 |
| Rheumatoid arthritis/ collagen vascular diseases | -.07 | .02 | -.11 | -.02 | 0.001 |
| Chronic blood loss anemia | .05 | .02 | .00 | .09 | 0.030 |
| Coagulopathy | .06 | .01 | .03 | .10 | 0.000 |
| Congestive heart failure | .18 | .01 | .15 | .20 | 0.000 |
| Depression | -.04 | .01 | -.06 | -.02 | 0.000 |
| Hypertension | -.07 | .01 | -.09 | -.05 | 0.000 |
| Hypothyroidism | -.04 | .01 | -.06 | -.01 | 0.001 |
| Fluid and electrolyte disorders | .16 | .01 | .14 | .19 | 0.000 |
| Metastatic cancer | .14 | .05 | .02 | .25 | 0.016 |
| Other neurological disorders | .02 | .01 | -.00 | .04 | 0.079 |
| Paralysis | .15 | .03 | .08 | .22 | 0.000 |
| Pulmonary circulation disorders | .10 | .02 | .05 | .15 | 0.000 |
| Renal failure | .04 | .01 | .01 | .07 | 0.004 |
| Solid tumor w/o metastasis | .06 | .03 | .00 | .12 | 0.033 |
| Valvular disease | -.02 | .01 | -.05 | -.00 | 0.050 |
| Weight loss | .26 | .05 | .16 | .36 | 0.000 |
| Teaching hospitals | .04 | .02 | -.00 | .10 | 0.093 |
| Safety net hospitals | .09 | .05 | -.00 | .20 | 0.063 |
| RN hours per patient day | -.01 | .00 | -.02 | .00 | 0.058 |

***Prolonged length of stay full regression model.*** In a full regression model that included all available variables of interest (see Table 4.9), those patient 85 years of age and older had a 31% decrease in the odds of prolonged length of stay, when compared to patients 65-74 years of age ($p$ = 0.047, 95% CI: .49, .99), a finding that was statistically significant. Female patients had a 23% decrease in the odds of prolonged length of stay ($p$ = 0.045; 95% CI: .60, .99) and black surgical patients had a 93% increase in the odds of prolonged length of stay, when compared to white patients ($p$ = 0.005; 95% CI: 1.21, 3.07). Other payer was associated with a 2-fold increase in the odds of prolonged length of stay ($p$ = 0.053; 95% CI; .99, 4.26).

Patients with an admission diagnosis of multiple trauma had a 3.8-fold increase in the odds of prolonged length of stay ($p$ = 0.000; 95% CI: 2.46, 5.92), and each additional chronic condition reported by patients was associated with a 14% increase in the odds of prolonged length of stay ($p$ = 0.000; 95% CI: 1.08, 1.20).

Surgical patients with a comorbid disease of weight loss had a 3.2-fold increase in the odds of prolonged length of stay ($p$ = 0.000; 95% CI: 2.22, 4.64). Congestive heart failure was associated with a 2.6-fold increase in the odds of prolonged length of stay and fluid and electrolyte disorders was associated with a 2.4-fold increase in the odds of prolonged length of stay ($p$ = 0.000; 95% CI: 2.10, 3.25 and $p$ = 0.000; 95% CI: 1.90, 3.19, respectively). Paralysis was associated with a 92% increase in the odds of prolonged length of stay and renal failure was associated with a 44% increase in the odds of prolonged length of stay ($p$ = 0.023; 95% CI: 1.09, 3.38 and $p$ = 0.024; 95% CI: 1.04, 1.97, respectively).

A number of reported comorbid conditions were significantly associated with a decrease in the odds of prolonged length of stay. Uncomplicated diabetes was associated with a 27% decrease in the odds of prolonged length of stay and diabetes with complications was associated with a 56% decrease in the odds of prolonged length of stay ($p$ = 0.032; 95% CI: .55, .97 and $p$ = 0.016; 95% CI: .23, .85, respectively). Hypertension was associated with a 47% decrease in the odds of prolonged length of stay and valvular disorders were associated with a 32% decrease in the odds of prolonged length of stay (p = 0.000; 95% CI: .42, .65 and p = 0.017; 95% CI: .49, .93, respectively). Depression was associated with 35% decrease in the odds of prolonged length of stay (p = 0.008; 95% CI: .47, .89).

Each additional registered nurse hour per patient day was associated with a 10% decrease in the odds of prolonged length of stay (*p* = 0.051; 95% CI: .81, 1.00), a finding that was statistically significant. Safety net status, registered nurse skill mix and organizational climate were not associated with prolonged length of stay.

Table 4.9 Prolonged Length of Stay Estimated in A Full Logistic Model

| | Odds Ratio | Robust SE | 95% C I | | P |
|---|---|---|---|---|---|
| 65-74 years | * | * | * | * | * |
| 75-84 years | 1.00 | .15 | .73 | 1.36 | 0.970 |
| 85 years and older | .69 | .12 | .49 | .99 | 0.047 |
| Female | .77 | .09 | .60 | .99 | 0.045 |
| Black | 1.93 | .45 | 1.21 | 3.07 | 0.005 |
| Hispanic | 1.13 | .24 | .74 | 1.72 | 0.557 |
| Other race | 1.49 | .47 | .80 | 2.80 | 0.207 |
| $1-38,999 | * | * | * | * | * |
| $39,000-$47,999 | 1.13 | .27 | .70 | 1.81 | 0.612 |
| $48,000-$63,999 | .83 | .19 | .53 | 1.32 | 0.451 |
| $64,000+ | .72 | .14 | .48 | 1.06 | 0.102 |
| Emergency department | * | * | * | * | * |
| Hospital transfer | 1 | (Omitted) | | | |
| Skilled nursing facility | 1.11 | .63 | .36 | 3.38 | 0.845 |
| Home | .79 | .21 | .47 | 1.34 | 0.398 |
| Emergent/urgent | 1 | (Omitted) | | | |
| Medicare | * | * | * | * | * |
| Medicaid | 2.31 | 1.69 | .55 | 9.67 | 0.249 |
| Private insurance | 1.01 | .25 | .61 | 1.67 | 0.960 |
| Other payer | 2.05 | .76 | .99 | 4.26 | 0.053 |
| Complex fracture | 1.31 | .42 | .69 | 2.48 | 0.405 |
| Multiple trauma | 3.82 | .85 | 2.46 | 5.92 | 0.000 |
| Chronic conditions | 1.14 | .02 | 1.08 | 1.20 | 0.000 |
| Acquired immune deficiency syndrome | .74 | .78 | .09 | 5.81 | 0.779 |
| Alcohol abuse | 1.18 | .44 | .56 | 2.46 | 0.655 |
| Deficiency anemias | .84 | .10 | .67 | 1.07 | 0.172 |
| Rheumatoid Arthritis/collagen vascular diseases | .58 | .21 | .28 | 1.19 | 0.140 |
| Chronic blood loss anemia | .96 | .24 | .58 | 1.58 | 0.887 |
| Chronic pulmonary disease | 1.01 | .16 | .74 | 1.39 | 0.917 |

| | | | | | |
|---|---|---|---|---|---|
| Coagulopathy | 1.23 | .22 | .86 | 1.76 | 0.252 |
| Congestive heart failure | 2.61 | .29 | 2.10 | 3.25 | 0.000 |
| Depression | .65 | .10 | .47 | .89 | 0.008 |
| Diabetes uncomplicated | .73 | .10 | .55 | .97 | 0.032 |
| Diabetes w/chronic complications | .44 | .14 | .23 | .85 | 0.016 |
| Drug abuse | .35 | .30 | .06 | 1.94 | 0.235 |
| Hypertension | .53 | .05 | .42 | .65 | 0.000 |
| Hypothyroidism | .74 | .13 | .53 | 1.06 | 0.108 |
| Liver disease | .98 | .37 | .46 | 2.08 | 0.963 |
| Lymphoma | 1.52 | .75 | .57 | 4.03 | 0.398 |
| Fluid and Electrolyte | 2.46 | .32 | 1.9 | 3.19 | 0.000 |
| Metastatic cancer | 1.33 | .62 | .53 | 3.33 | 0.531 |
| Other neurological disorders | 1.04 | .12 | .82 | 1.32 | 0.733 |
| Obesity | 1.22 | .32 | .72 | 2.05 | 0.455 |
| Paralysis | 1.92 | .55 | 1.09 | 3.38 | 0.023 |
| Peripheral vascular disorders | .96 | .19 | .64 | 1.43 | 0.848 |
| Psychoses | 1.17 | .36 | .63 | 2.15 | 0.612 |
| Pulmonary circulation disorders | 1.70 | .33 | 1.15 | 2.50 | 0.007 |
| Renal failure | 1.44 | .23 | 1.04 | 1.97 | 0.024 |
| Solid tumor without metastasis | 1.22 | .38 | .66 | 2.25 | 0.522 |
| Peptic ulcer disease excluding bleeding | 1 | (Omitted) | | | |
| Valvular disease | .68 | .11 | .49 | .93 | 0.017 |
| Weight loss | 3.21 | .60 | 2.22 | 4.64 | 0.000 |
| >250 beds | 1.05 | .19 | .73 | 1.51 | 0.772 |
| Teaching hospitals | 1.24 | .19 | .91 | 1.68 | 0.162 |
| High technology hospitals | 1.09 | .22 | .72 | 1.64 | 0.670 |
| Magnet accreditation | .99 | .21 | .66 | 1.49 | 0.981 |
| Safety net hospitals | 1.41 | .32 | .91 | 2.19 | 0.118 |
| Registered nurse hours per patient day | .90 | .04 | .81 | 1.00 | 0.051 |
| Registered nurse skill mix | 1.23 | 1.46 | .11 | 12.66 | 0.860 |

***Prolonged length of stay stepwise regression model***. In elderly patients admitted to an acute care hospital for surgical repair of hip fracture, those patients 85 years of age and older had a 33% decrease in the odds of prolonged length of stay, when compared to patients 65-74 years of age ($p$ = 0.012; 95% CI: .84, .97). When compared to white patients, black patients had an 89% increase in the odds of prolonged length of stay ($p$ = 0.019; 95% CI: 1.22, 2.99). Female surgical patients had a 26% decrease in the odds of prolonged length of stay, when compared to males patients ($p$ = 0.015; 95% CI: .58, .94), and other payer was associated with a 2.2-fold increase in the odds of prolonged length of stay (*p* = 0.030; 95% CI: 1.08, 4.50). Surgical patients with an income of $64,000 and higher had a 23% decrease in the odds of prolonged length of stay (*p* = 0.030; 95% CI: .61, .97), when compared to the lowest income group.

Elderly surgical patients admitted with a diagnosis of multiple trauma had a 3.8 fold increase in the odds of prolonged length of stay (*p* = 0.000; 95% CI: 2.46, 5.92). Each additional chronic illness reported by surgical patients was associated with a 13% increase in the odds of prolonged length (*p* = 0.000, 95% CI: 1.09, 1.18).

In surgical patients with a reported comorbid disease of weight loss there was an associated 3.3-fold increase in the odds of prolonged length of stay (*p* = 0.000; 95% CI: 2.27, 4.82). Congestive heart failure had a 2.5 fold increase in the odds of prolonged length of stay (*p* = 0.000; 95% CI: 2.07, 3.20) and those with fluid and electrolyte disorders had a 2.4 fold increase in the odds of prolonged length of stay (*p* = 0.000; 95% CI: 1.92, 3.18). Paralysis was associated with a 97% increase in the odds of prolonged length of stay (*p* = 0.013; 95% CI: 1.15, 3.38). Pulmonary circulation disorders was associated with a 70% increase in the odds of prolonged length of stay (*p* = 0.007; 95% CI: 1.15, 2.51) and renal failure was associated with a 44% increase in the odds of prolonged length of stay (*p* = 0.024, 95% CI: 1.04, 1.97). Weight loss was associated with a 3.2-fold increase in the odds of a prolonged length of stay (*p* = 0.000; CI: 2.22, 4.64).

In surgical patients with a comorbid disease of depression there was a 35% decrease in the odds of a prolonged length of stay (p 0.008; 95% CI: .47, .89). Surgical patients with diabetes mellitus and diabetes mellitus with complications had a 27% and

55% decrease in the odds of a prolonged length of stay, respectively (*p* = 0.032; 95% CI: .55, .97 and *p* = 0.016; 95% CI: .23, .85). Hypertension was associated with a 47% decrease in the odds of prolonged length of stay in surgical patients (*p* = 0.000; 95% CI: .43, .65). Valvular disease was associated with a 32% decrease in the odds of a prolonged length of stay (*p*= 0.017; 95% CI: .50, .93).

Hospital safety net status was associated with a 51% increase in the odds of prolonged length of stay (*p* = 0.041; 95% CI: 1.07, 2.26), and teaching status was associated with a 30% increase in the odds of prolonged length of stay (*p* = 0.093; 95% CI: .021, .257). Each additional registered nurse hour per patient day was associated with a 9% decrease in the odds of prolonged length of stay (*p* = 0.012; 95% CI: .84, .97). Registered nurse skill mix and organizational climate were not significantly associated with prolonged length of stay (see Table 4.10).

Table 4.10 Prolonged Length of Stay Estimated in a Stepwise Regression Model

| | Odds Ratio | Robust SE | 95% C I | | *p* |
|---|---|---|---|---|---|
| 85 years and older | .67 | .08 | .53 | .86 | 0.002 |
| Female | .74 | .08 | .58 | .94 | 0.015 |
| Black | 1.89 | .44 | 1.19 | 2.99 | 0.007 |
| $64,000 and over | .77 | .09 | .61 | .97 | 0.030 |
| Other payer | 2.20 | .80 | 1.08 | 4.50 | 0.030 |
| Multiple trauma | 3.89 | .84 | 2.54 | 5.95 | 0.000 |
| Chronic conditions | 1.13 | .02 | 1.09 | 1.18 | 0.000 |
| Congestive heart failure | 2.57 | .28 | 2.07 | 3.20 | 0.000 |
| Depression | .64 | .10 | .47 | .88 | 0.007 |
| Diabetes uncomplicated | .75 | .10 | .56 | 1.00 | 0.051 |
| Diabetes w/ chronic complications | .46 | .14 | .25 | .84 | 0.013 |
| Hypertension | .51 | .05 | .42 | .64 | 0.000 |
| Hypothyroidism | .72 | .13 | .51 | 1.03 | 0.079 |
| Fluid and electrolyte disorders | 2.47 | .31 | 1.92 | 3.18 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| Paralysis | 1.97 | .54 | 1.15 | 3.38 | 0.013 |
| Pulmonary circulation disorders | 1.69 | .33 | 1.14 | 2.50 | 0.008 |
| Renal failure | 1.40 | .21 | 1.04 | 1.89 | 0.023 |
| Valvular disease | .67 | .10 | .49 | .92 | 0.014 |
| Weight loss | 3.31 | .63 | 2.27 | 4.82 | 0.000 |
| Teaching hospitals | 1.30 | .04 | .95 | 1.77 | 0.093 |
| Safety net hospitals | 1.51 | .31 | 1.01 | 2.26 | 0.041 |
| RN hours per patient day | .91 | .03 | .84 | .97 | 0.012 |

**Hypothesis 3.** Magnet accreditation will moderate the effect of hospital staffing (registered nurse hours per patient day and registered nurse skill mix) on the odds of in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay in elderly patients admitted to a hospital for surgical repair of hip fracture.

**Stepwise interaction models.** Interaction terms were included in the stepwise models to test Hypothesis 3. As expected, all of the variables retained in the final stepwise model remained constant in the interaction model and were reported as found in the tables and in the text above.

***In-hospital mortality stepwise interaction model.*** In a stepwise model that estimated the odds of in-hospital mortality (see Table 4.11) and included all study variables and the two interaction terms (magnet * registered nurse hours per patient day and magnet * registered nurse skill mix) it was found that magnet accreditation significantly moderated the effect of registered nurse skill mix and was associated with a 33% decrease in the odds of in-hospital mortality ($p$ = 0.059; 95% CI: .44, 1.01). An interaction model for the outcome of failure-to-rescue was not estimated based on the previously reported small numbers of surgical patients with this outcome.

Table 4.11 In-Hospital Mortality Estimated with Interaction Terms in a Stepwise Regression Model

| | Odds Ratio | Robust SE | 95% Confidence Interval | | *p* |
|---|---|---|---|---|---|
| Magnet*RN skill mix | .67 | .14 | .44 | 1.01 | 0.059 |
| 75-84 years | 2.04 | .61 | 1.13 | 3.67 | 0.016 |
| 85 years and older | 2.21 | .65 | 1.24 | 3.94 | 0.007 |
| Female | .64 | .08 | .49 | .84 | 0.001 |
| Hispanic | 1.80 | .51 | 1.03 | 3.14 | 0.038 |
| Chronic conditions | 1.05 | .03 | .99 | 1.11 | 0.079 |
| Deficiency anemia | .65 | .09 | .48 | .88 | 0.005 |
| Chronic blood loss anemia | .41 | .19 | .16 | 1.02 | 0.058 |
| Coagulopathy | 1.80 | .31 | 1.28 | 2.53 | 0.001 |
| Congestive heart failure | 2.13 | .34 | 1.54 | 2.92 | 0.000 |
| Hypertension | .49 | .07 | .37 | .66 | 0.000 |
| Fluid and electrolyte disorders | 2.40 | .35 | 1.79 | 3.21 | 0.000 |
| Metastatic cancer | 4.04 | 1.43 | 2.02 | 8.11 | 0.000 |
| Psychoses | .19 | .12 | .05 | .69 | 0.011 |
| Pulmonary circulation disorder | 2.19 | .50 | 1.40 | 3.43 | 0.001 |
| Renal failure | 1.60 | .26 | 1.15 | 2.23 | 0.004 |
| Solid tumor w/o metastasis | 2.54 | .75 | 1.43 | 4.53 | 0.001 |
| Valvular disease | .62 | .11 | .43 | .89 | 0.010 |
| Weight loss | 3.33 | .68 | 2.23 | 4.97 | 0.000 |
| Teaching hospitals | 1.46 | .25 | 1.04 | 2.05 | 0.027 |

***Length of stay interaction model.*** In a stepwise model that estimated length of stay (see Table 4.12) and included all study variables and the two interaction terms (magnet * registered nurse hours per patient day and magnet * registered nurse skill mix) it was found that magnet accreditation significantly moderated the effect of registered nurse skill mix and was associated with a 67% decrease in length of stay ($p$ = 0.000; 95% CI: -1.03, -.31). In this interaction model safety net status was associated with an 8% increase in length of stay.

Table 4.12 Length of Stay Estimated with Interaction Terms in a Stepwise Regression Model

| | Coefficient | Robust SE | 95% Confidence Interval | | *p* |
|---|---|---|---|---|---|
| Magnet*RN skill mix | -.67 | .18 | -1.03 | -.312 | 0.000 |
| 75-84 years | .03 | .01 | .007 | .065 | 0.016 |
| 85 years and older | .02 | .01 | -.0003 | .05 | 0.052 |
| Female | -.05 | .01 | -.075 | -.029 | 0.000 |
| Black | .10 | .03 | .03 | .17 | 0.004 |
| Hispanic | .08 | .03 | .02 | .15 | 0.006 |
| Other Race | .07 | .03 | .12 | .135 | 0.019 |
| $39,000 - $47,999 | .05 | .02 | .008 | .091 | 0.019 |
| Home | -.08 | .04 | -.170 | -.006 | 0.035 |
| Medicaid | .15 | .09 | -.02 | .33 | 0.092 |
| Private insurance | .03 | .02 | -.005 | .081 | 0.089 |
| Other payer | .15 | .04 | .06 | .23 | 0.001 |
| Complex fracture | .07 | .02 | .01 | .125 | 0.008 |
| Multiple trauma | .25 | .03 | .18 | .33 | 0.000 |
| Chronic conditions | .03 | .003 | .027 | .040 | 0.000 |
| Deficiency anemia | .02 | .01 | .003 | .049 | 0.023 |
| Rheumatoid arthritis/ collagen vascular diseases | -.09 | .02 | -.134 | -.046 | 0.000 |
| Chronic blood loss anemia | .04 | .02 | .005 | .09 | 0.029 |
| Coagulopathy | .05 | .01 | .02 | .09 | 0.000 |
| Depression | -.05 | .01 | -.075 | -.034 | 0.000 |
| Diabetes w/ chronic complications | -.04 | .02 | -.09 | .006 | 0.089 |
| Hypertension | -.09 | .01 | -.114 | -.070 | 0.000 |
| Hypothyroidism | -.05 | .01 | -.080 | -.029 | 0.000 |
| Fluid and electrolyte disorders | .171 | .012 | .146 | .195 | 0.000 |
| Metastatic cancer | .12 | .05 | .007 | .238 | 0.038 |
| Paralysis | .14 | .03 | .07 | .21 | 0.000 |
| Pulmonary circulation disorder | .12 | .02 | .07 | .17 | 0.000 |
| Renal failure | .05 | .01 | .027 | .085 | 0.000 |
| Solid tumor w/o metastasis | .06 | .03 | .002 | .125 | 0.041 |
| Peptic ulcer disease excluding Bleeding | -.20 | .08 | -.373 | -.037 | 0.017 |

| | | | | | |
|---|---|---|---|---|---|
| Weight loss | .25 | .04 | .16 | .35 | 0.000 |
| Teaching hospitals | .05 | .02 | .001 | .115 | 0.044 |
| Magnet accreditation | .47 | .13 | .20 | .73 | 0.001 |
| Safety net hospitals | .08 | .04 | -.01 | .17 | 0.098 |

***Prolonged length of stay interaction model.*** In a stepwise model that estimated prolonged length of stay (see Table 4.13) and included all study variables and the two interaction terms (magnet * registered nurse hours per patient day and magnet * registered nurse skill mix) it was found that magnet accreditation significantly moderated the effect of registered nurse skill mix was associated with a 99 % decrease in the odds of a prolonged length of stay ($p$ = 0.001; 95% CI: .0000003, -.02). In addition, it was found that magnet accreditation significantly moderated the effect of registered nurse hours per patient day and was associated with a 53% increase in the odds of a prolonged length of stay (p = 0.001; 95% CI: 1.19, 1.97).

Table 4.13 Prolonged Length of Stay Estimated with Interaction Terms in a Stepwise Regression Model

| | Odds Ratio | Robust SE | 95% C I | | $p$ |
|---|---|---|---|---|---|
| Magnet*RN skill mix | .00008 | .0002 | .0000003 | .02 | 0.001 |
| Magnet*RN hours PPD | 1.53 | .19 | 1.19 | 1.97 | 0.001 |
| 85 years and older | .66 | .08 | .52 | .84 | 0.001 |
| Female | .76 | .09 | .60 | .96 | 0.024 |
| Black | 2.03 | .49 | 1.26 | 3.26 | 0.003 |
| $64,000 and over | .76 | .08 | .61 | .95 | 0.017 |
| Other payer | 2.26 | .83 | 1.09 | 4.67 | 0.027 |
| Multiple trauma | 3.83 | .85 | 2.48 | 5.93 | 0.000 |
| Chronic conditions | 1.13 | .02 | 1.09 | 1.18 | 0.000 |
| Rheumatoid arthritis/ collagen vascular diseases | .55 | .19 | .27 | 1.11 | 0.099 |
| Congestive heart failure | 2.56 | .28 | 2.06 | 3.18 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| Depression | .64 | .10 | .46 | .88 | 0.007 |
| Diabetes uncomplicated | .75 | .10 | .57 | 1.00 | 0.052 |
| Diabetes w/ complications | .45 | .14 | .24 | .83 | 0.011 |
| Hypertension | .51 | .05 | .42 | .63 | 0.000 |
| Hypothyroidism | .70 | .12 | .50 | 1.00 | 0.054 |
| Fluid and electrolyte disorders | 2.42 | .31 | 1.88 | 3.13 | 0.000 |
| Paralysis | 1.93 | .52 | 1.13 | 3.29 | 0.015 |
| Pulmonary circulation disorders | 1.70 | .33 | 1.15 | 2.50 | 0.007 |
| Renal failure | 1.41 | .21 | 1.05 | 1.89 | 0.020 |
| Valvular disease | .67 | .10 | .49 | .92 | 0.013 |
| Weight loss | 3.31 | .60 | 2.30 | 4.7 | 0.000 |
| Teaching hospital | 1.43 | .21 | 1.06 | 1.92 | 0.017 |

# CHAPTER V. DISCUSSION OF THE FINDINGS

The purpose of this study was to examine the availability of nurse resources – registered nurse hours per patient day, registered nurse skill mix, and organizational climate - in safety net hospitals and non-safety net hospitals and to determine if these resources were associated with the quality of care in elderly patients admitted for surgical repair of hip fracture. The patient outcomes of interest were in-hospital mortality, failure-to-rescue, and length of stay. The findings from this study were organized and discussed per the specific hypotheses identified in Chapter 2. Evidence to support or refute the findings from this study was outlined based on previous work published in the scientific literature. This study on surgical outcomes in the elderly hospitalized patients was analytic intensive and included numerous regression models to estimate the patient outcomes of interest – in-hospital mortality, failure-to-rescue, and length of stay. In an effort to provide valid and robust estimates of patient outcomes it was necessary to control for a large number of patient and hospital characteristics. The detailed findings from the regression models brought to light fundamental issues that were not included in the study hypotheses, namely disparities in health care. In the name of social justice, a section has been added to the end discussion and prior to the study limitations that will outline the evidence that shows that patients from under-represented racial and ethnic groups and those from low income groups were more likely to have poor health care outcomes. In other words, these vulnerable surgical patients were more likely to die in the immediate post-operative period and to have longer lengths of stay, when compared to surgical patients identified as white and those with substantial income.

**Hypothesis 1**

Hospitals with safety net status will have fewer nurse resources - lower registered nurse hours per patient day, lower registered nurse skill mix, and poor organizational climate - when compared to non-safety net hospitals.

**Safety net hospitals.** The findings from this study suggest that nurse resources in safety net hospitals are similar to nurse resources in non-safety net hospitals. Specifically, safety net hospitals provided slightly more registered nurse hours per patient day and a higher registered nurse skill mix when compared to non-safety net hospitals, but this finding was not statistically significant. This finding differs from what has been previously reported. Conway, Tamara Konetzka, Zhu, Volpp, & Sochalski (2008) reported that most safety net hospitals were staffing below acceptable staffing ratios. Blegen et al. (2011) found that in safety net hospitals total nurse hours per patient day were lower in general units, but higher in the intensive care units, when compared to non-safety net hospitals. Registered nurse skill mix was slightly higher in safety net hospitals on both general units and intensive care units. Wakeam et al. (2014) compared high safety-net burden hospitals to low safety net burden hospitals and reported that lower registered nurse skill mix, but higher number of respiratory therapists to beds was reported in high safety net burden hospitals, when compared to low safety net burden hospitals.

Based on the findings from this current study Hypothesis 1 was not supported.

**Hypothesis 2**

Fewer hospital nurse resources, magnet accreditation, registered nurse hours per patient day and registered nurse skill mix, will be associated with higher rates of adverse outcomes - in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay - in elderly patients admitted to a hospital for surgical repair of hip fracture.

**In-hospital mortality and failure-to-rescue.** In this current study nurse resources defined as registered nurse hours per patient day, registered nurse skill mix, and organizational climate were not associated with in-hospital mortality or failure-to-rescue. These findings are contrary to what has been reported in the literature for decades. There is an abundance of scientific evidence to suggest that a variety of nurse workload measures and the organization of nursing care are significantly associated with both in-hospital mortality and 30-day patient mortality.

It has been reported that 30-day mortality varies significantly across hospitals; however, the availability of nurse resources can explain these variations (Estabrooks, 2005). Estabrooks et al. (2005) reported that a richer nurse skill mix was associated with a 17% decrease in the odds of 30-day mortality in patients admitted with circulatory and pulmonary disorders and that a higher percent of casual or temporary nurses was associated with a 26% increase in patient 30-day mortality. It has been reported that an increase in the percent of care provided by licensed practical nurses was associated with a 4% increase in the odds of patient mortality (Glance et al. 2012). Additional findings suggest that an increase in licensed hours per patient day (registered nurse and licensed practical nurse) and registered nurse skill mix were associated with a 2% and 49% decrease in the odds of patient mortality (Needleman, Buerhaus, Vanderboom, & Harris, 2013). Similarly, Harless and Mark (2010) reported that a 1 unit increase in registered nurse full-time equivalent (FTE) per 1,000 inpatient days was associated with a 4.3% decrease in the observed mortality ratio and a 5.5% decrease in the observed failure-to-rescue ratio. Wiltse Nicely, Sloane and Aiken (2012) reported that good nurse staffing and favorable work environments were associated with lower mortality and failure-to-rescue in patients admitted for surgical repair of aortic aneurysm. Higher nurse workload was associated with a 12% increase in the odds of mortality and an 8% increase in the odds of failure-to-rescue; and better practice environments decreased the odds of mortality and failure-to-rescue by 15% and 12%, respectively. The organization of leadership style has been linked to patient mortality where it was reported that high-resonant leadership was significantly associated with a 23% decrease in the odds of 30-day patient mortality (Cummings, Midodzi, Wong, & Estabrooks, 2011).

An organizational climate that supports excessive work by nurses has been linked to poor outcomes. In hospitals where nurses report working long hours there was a 42% increase in the odds of patient mortality, and the lack of time away from the work environment was associated with a 24% increase in the odds of patient mortality (Trinkoff et al., 2011). How patient care outcomes and organizational climate and resources vary by day of week has been reported. Patients admitted on weekends have a 10% increase in the odds of mortality, but an increase in the number of nurses and physicians per bed was associated with a 10% decrease in the odds of mortality; however, an increase in the number of medical trainees was associated with a 5% increase in mortality (Ricciardi et al., 2014).

Based on the mortality findings reported from this current study Hypothesis 2 was not supported. Nurse resources included in the analyses were not associated with in-hospital mortality in elderly patients admitted for surgical repair of hip fracture. It should be noted, however, that hospital safety net status was significantly associated with a 44%

increase in the odds of in-hospital mortality in these elderly surgical patients. This leads one to hypothesize that in this current study there were unmeasured workforce-related factors that could have been associated with safety net hospitals such as the educational preparation of the nurses, the availability of electronic medical records and labor management issues within the individual safety net hospitals (Wakeam et al., 2014); workforce factors that could lead to poor patient care outcomes.

**Length of stay.** In this current study nurse resources were significantly associated with length of stay in elderly patients admitted for surgical repair of hip fracture. In a linear regression model it was noted that each additional hour of registered nurse hours per patient day was associated with a decrease in the log length of stay. Similarly, each additional hour of registered nurse hours per patient day was associated with a decrease in the odds of a prolonged length of stay. Nurse resources defined as registered nurse skill mix and organizational climate were not associated with the log length of stay or prolonged length of stay. In both of these models hospital safety net status was associated with an increase in length of stay, findings that were statistically significant.

The seminal report of Needleman et al. (2002) has linked nurse workload to length of stay. Needleman et al. (2002) reported that in medical patients an increase in registered nurse skill mix and a greater number of care hours per day provided by registered nurses were associated with a significantly shorter length of hospital stay ($p = 0.01$). More recently, Frith et al. (2010) reported a similar finding that an increase in registered nurse skill mix was associated with a 3% decrease in the log length of stay ($p < 0.01$). An increase in total nursing hours per patient day and an increase in registered nurse skill mix have been linked to shorter lengths of stay in medical-surgical hospital-based units (Esparza, Zoller, White, & Highfield, 2012).

The organization of care has also been linked to length of stay. Romagnuolo et al. (2005) reported that a simple post- endoscopy checklist developed by nurses and physicians resulted in a significant decrease in length of stay (8.3 days versus 4.5 days, $p = 0.003$) among patients admitted for gastrointestinal bleeding, a finding that was statistically significant. There is evidence to suggest that when nurses have access to information, support and resources patients will have a decrease in length of stay following cardiac catheterization (Hatler, 2006). Continuity of care or providing consistency of nurse caregivers was reported to be associated with a 30% decrease in length of stay, a finding that was statistically significant ($p = 0.000$) (Mefford & Alligood, 2011). Control over nursing practice and the care environment; and access to information, support, and resources is fundamental to the concept of “magnet” and the quality of patient care.

Based on the findings related to in-hospital mortality and length of stay Hypothesis 2 was partially supported.

**Hypothesis 3**

Magnet accreditation will moderate the effect of nurse resources (registered nurse hours per patient day and registered nurse skill mix) on the odds of in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay in elderly patients admitted to a hospital for surgical repair of hip fracture.

The findings from this current study suggest that organizational climate, as measured by magnet accreditation, moderates the effect of nurse staffing resources on the quality of care provided to elderly patients admitted to acute care hospitals for surgical repair of hip fracture.

**In-hospital mortality.** As noted previously, in this study there was no significant independent association between nurse resources measured as registered nurse hours per patient day, registered nurse skill mix, organizational climate, and in-hospital mortality in elderly patients admitted to an acute care hospital for surgical repair of hip fracture. These findings remained constant in both full regression models and the stepwise regression models. In a third stepwise regression model that included interaction terms for organizational climate and registered nurse hours per patient day and registered nurse skill mix, a significant finding was reported. Indeed, magnet accreditation significantly moderated the relationship between registered nurse skill mix and in-hospital mortality with a finding to suggest that this moderating effect was associated with a decrease in the odds of in-hospital mortality. This finding highlights the importance of organizational climate as well as workload in the delivery of quality patient care.

There is evidence to suggest that surgical patients cared for in magnet accredited hospitals have significantly lower odds of mortality and failure-to-rescue than those cared for in non-magnet facilities (Aiken et al., 2008; McHugh et al., 2013). As early as 1994, Aiken et al. reported that the same factors that led hospitals to be effective from an organizational standpoint also were associated with lower mortality among elderly patients. These "magnet" hospitals that were attractive to nurses had mortality rates 7.7% lower than the matched control hospitals. It has also been reported (Aiken et al., 2011) that organizational climate can have a moderating effect on nurse workload. Better organizational climate lowered the odds of in-hospital mortality and failure-to-rescue across a range of possible staffing scenarios, but the effect was most pronounced in hospitals where the patient-to-nurse ratios were below average. That is, the moderating effect of organizational climate is most pronounced in the best-staffed hospitals. It has been noted that improving organizational climate and the quality of care requires changing inter-professional culture and devolving managerial decisions to those closer to the bedside. Magnet accredited hospitals tend to provide an organizational climate that embodies these qualities.

**Length of stay.** In this current study of elderly patients admitted to an acute care hospital for surgical repair of hip fracture, it was noted in a stepwise regression model that an increase in registered nurse hours per patient day was independently associated with a decrease in both the log length of stay and prolonged length of stay, findings that were statistically significant. To further examine this association a second stepwise regression model was fit and included interaction terms for organizational climate and registered nurse hours per patient day and registered nurse skill mix. As reported, magnet accreditation moderated the relationship between registered nurse skill mix and length of stay and this moderating effect was associated with a decrease in the average length of stay, a finding that was statistically significant. Similarly, magnet accreditation moderated the relationship between registered nurse skill mix and prolonged length of stay and this moderating effect was associated with a minimal decrease in prolonged of stay, but the finding was statistically significant. Magnet accreditation moderated the relationship between registered nurse hours per patient day and prolonged length of stay and this moderating effect was associated with a significant increase in the odds of a prolonged length of stay.

Little is known about length of stay in magnet-accredited hospitals. Goode, Blegen, Park, Vaughn, & Spetz (2011) compared magnet and non-magnet hospitals on a variety of outcomes including length of stay. The findings from this study were mixed and the investigators reported that there was no significant difference in patient length of stay when magnet hospitals were compared to non-magnet hospitals. There is, however, evidence to suggest that hospitals with better organizational climate are associated with nurse reports of higher quality care (Aiken et al., 2008), which ultimately could translate into shorter patient lengths of stay. Despite the lack of evidence on length of stay in magnet-accredited hospitals, it should be emphasized that in an elderly surgical patient population such as those represented in this study many will be at high risk of a longer than average or prolonged length of stay based on the fact that they live with underlying conditions that pre-dispose them to issues with hemodynamic instability and respiratory compromise (Deiner, Westlake, & Dutton, 2014).

The findings from the stepwise interaction models estimated in this current study suggest that organizational climate, as measured by Magnet accreditation, moderates the effects of nurse workload on in-hospital mortality and length of stay. Specifically, findings from this current study suggest that organizational climate moderates the effects of registered nurse skill mix on in-hospital patient mortality and registered nurse hours per patient day and registered nurse skill mix on length of stay. Based on these findings, Hypothesis 3 was supported.

**Understanding Disparities in Surgical Care**

The multiple regression models described above were analytically intense and included a large number of controls that included patient characteristics and hospital characteristics. Typically, control variables are not of interest and, therefore, not reported in the analytic findings. In this current study patient characteristics of race, ethnicity, and income continued to be significant predictors of in-hospital mortality and length of stay. Based on the fact that these are the most vulnerable patients served by the New Jersey safety net, it was decided to include an additional section to the discussion on this finding of health care disparities.

**In-hospital mortality.** In this study of elderly patients admitted for surgical repair of hip fracture it was noted that after controlling for a large number of possible confounding factors in a fully adjusted regression model, Hispanic patients had a 75% increase in the odds of in-hospital mortality when compared to white patients. In this same model hospital safety net status was associated with a 44% increase in the odds of in-hospital mortality; both of these findings were statistically significant. Jha, Orav, Zheng, & Epstein (2008) notes ethnic groups tend to receive care in sites that are mostly segregated. Safety net hospitals tend to be these segregated sites by virtue of their mission to serve the poor, vulnerable and underserved.

Genther & Gourin (2012) reported that patients in safety net hospitals tend to be more complex patients who require more care. These patients treated for a surgical procedure at high-safety net burden hospitals presented for surgery with advanced disease suggesting access to primary care was limited. In addition, patients at high-safety net burden hospitals underwent more extensive surgical procedures. The differences in mortality between white and nonwhite patients found in safety net hospitals has been reported as a lack of access to high-quality hospitals and a tendency of black and Hispanic patients to go to higher-mortality hospitals (Rangrass, Ghaferi & Dimick, 2014).

Black and Hispanic patients may choose high mortality, safety net hospitals due to the proximity of these hospitals to their places of residence. Poverty may also limit access to the care provided in hospitals with better health care outcomes.

In a nationwide report on hospital use, Jha et al. (2008) reported that those hospitals that care for a high proportion of elderly Hispanic patients had fewer patients on Medicare and more on Medicaid and that proportion of Medicaid to Medicare reimbursement was similar to the proportion found in the safety net hospital reimbursement profile. Furthermore, hospitals that care for a high proportion of elderly Hispanic patients were more than three times more likely to be for profit and less likely to have medical or cardiac intensive care units. There were much lower nurse staffing levels at hospitals that care for a high proportion of elderly Hispanic patients; and the relative risk of death compared to patients admitted to hospitals that care for a low proportion of elderly Hispanic patients was reported to be 1-10 percent higher.

**Length of stay.** In the stepwise regression model that estimated the log length of stay, again a disparity was noted where surgical patients from all racial and ethnic groups had a significantly longer log length of stay when compared to white patients. In this model blacks had a 10% increase in the log length of stay, Hispanics had a 7% increase in the log length of stay, and those of other race had a 7% increase in the log length of stay, when compared to white patients. Hospital safety net status was associated with an 8% increase in the log length of stay. In the stepwise regression model that estimated prolonged length of stay, black surgical patients had an 89% increase in the odds of a prolonged length of stay when compared to white patients.  Hospital safety net status was associated with a 51% increase in the odds of a prolonged length of stay. The finding that the uninsured in this study had a 2.2-fold increase in a prolonged length of stay supports previous work that suggests that there is a substantial problem with hospital longer stays in the uninsured (LaPar et al., 2010; LaPar et al., 2011; LaPar et al., 2012).

Similar, findings suggest that black patients have a longer length of stay for surgical repair of hernia repair (Fullum et al., 2013), surgical care for prostate cancer (Barocas et al., 2012) and surgery for oropharyngeal cancer (Gourin et al., 2011). Jha, Orav, Li, & Epstein (2007) reported that elderly black patients receive hospital care with a high degree of concentration: just 5% of hospitals care for nearly 45% of all black patients. In addition, 25% of hospitals cared for nearly 90% of elderly black patients. Hospitals with either a high volume or a high proportion of black patients were more often large urban teaching hospitals - characteristics also found in safety net hospitals.

The disparities noted in this study, namely an increase in mortality and length of stay in patients of color and those of Hispanic descent may represent an unrecognized provider bias in the provision of evidence-based best practice. In which case complications and delays for procedures increase the odds of mortality and failure-to-rescue, and prolong the length of hospital stay. The longer length of stay may well be related to discharge planning issues related to socio-economic factors and limited resources such as housing and social support, which delay the discharge of the patient and indirectly prolong the length of stay (La Par et al., 2010). Lastly, patient-provider communication barriers may impede the continuum of care process.

**Limitations**

This study had several limitations. First, it was limited to elderly patients admitted to a New Jersey acute care hospital for surgical repair of hip fracture and the findings might not be generalizable to patients undergoing different surgical procedures and to the patients admitted to acute care hospitals in other states. Second, this study used administrative data and these data could be subjected to coding errors, but recent work with administrative data shows that these errors are minimal. Third, nurse resources were not available at the patient level; however, this was a study of hospitals, the nurse resources available in these hospitals, and the quality of hospital care. Fourth, there is always the possibility that unmeasured variables could have contributed to findings reported above. Fifth, this study was cross-sectional and associations between variables of interest were examined and estimated, but causality could not be established.

# CHAPTER VI. SUMMARY, CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS

## Summary

This study was developed to address the gap in knowledge surrounding the allocation of nurse resources in safety net and non-safety net hospitals and the care outcomes of elderly adults admitted to these hospitals for surgical repair of hip fracture. This study intended to answer the question: Do safety net hospitals have the necessary resources to provide the same quality of care as their non-safety net counterparts and are surgical outcomes in the elderly related to differences in the number of nurses and ancillary staff, skill mix, and the organizational climate in these hospitals? The study sample consisted of all adult patients 65 years of age or older admitted to New Jersey acute care hospitals with a principal or secondary of hip fracture. Patients were identified based on *International Classification of Diseases, Ninth Revision (ICD9-CM)* hip fracture diagnosis codes of 820.00-09, 820.21-22, and 820.8. Administrative data sources included: 1) the New Jersey Department of Health and Senior Services (NJDHSS) which supplied the nurse resource data and the New Jersey Hospital Association (NJHA) which supplied data on hospital characteristics, 2) the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) which provided the New Jersey hip fracture patient data, and 3) the American Nurses Credentialing Center data on hospital Magnet accreditation was used for as a proxy for organizational climate. Hospitals with safety net status were identified through membership in the Hospital Alliance of New Jersey, a coalition of safety-net providers that serve a significant portion of New Jersey's most indigent patients. Data sets were merged to create patient-level and hospital-level variables that were used to estimate the patient care outcomes of interest – in-hospital mortality, failure-to-rescue, and length of stay.

The Nurse Staffing and Patient Outcomes Model (NSPOM) provided the overarching framework for this dissertation study (Cho, 2001). Hip fracture mortality rate was defined as the number of deaths among patients meeting the inclusion and exclusion rules for a principal diagnosis code for hip fracture divided by all discharges, age 65 years and older, with a principal diagnosis code for hip fracture (AHRQ, 2004). Two measures of length of stay were estimated due to the non-normal distribution of the data: 1) log length of stay, and 2) prolonged length of stay that was operationally defined as a length of stay two deviations above the mean (Foer, Ornstein, Soriano, & Dunn, 2012).

Three hypotheses were derived from the NSPOM and tested in the current study. The hypotheses were as follows:

1. Hospitals with safety net status will have fewer nurse resources - lower registered nurse hours per patient day, lower registered nurse skill mix, and poor organizational climate - when compared to non-safety net hospitals.
2. Fewer hospital nurse resources, magnet accreditation, registered nurse hours per patient day and registered nurse skill mix, will be associated with higher rates of adverse outcomes - in-hospital mortality, failure-to-rescue, length of stay, and prolonged length of stay -in elderly patients admitted to a hospital for surgical repair of hip fracture.
3. Magnet accreditation will moderate the effect of nurse resources (registered nurse hours per patient day and registered nurse skill mix) on the odds of in-hospital

mortality, failure-to-rescue, length of stay, and prolonged length of stay in elderly patients admitted to a hospital for surgical repair of hip fracture.

Magnet accreditation was a proxy for organizational climate and it was operationally defined as a hospital that met the rigorous standards of accreditation through the American Nurses Credentialing Center (ANCC, 2013). Nurse staffing was operationally defined as the number of registered nurse hours per patient day and registered nurse skill mix was defined as the percentage of registered nurse care hours to total nursing care hours of all nursing hours.

After data were merged and all patient and hospital measures, including nurse resources, were created preliminary analyses were performed to provide a detailed description of the patients included in the analyses. Patient characteristics included age, race, gender, insurance status and numerous other characteristics that could possibly be associated with poor health care outcomes, including 29 comorbid diseases.

Simple Chi Square and Fisher exact tests were used to describe categorical variables and t-tests were used for continuous variables and to determine if the variables of interest differed between safety net and non-safety net hospitals. Three types of regression models were fit to estimate the effects of nurse resources on the outcome of care. These models included: 1) full regression models, 2) stepwise regression models, and 3) stepwise regression models that included two interaction terms (magnet * registered nurse hours per patient day and magnet * registered nurse skill mix). Logistic regression models were fit to estimate the effects of nurse resources on the two binary outcomes of interest, in-hospital mortality and prolonged length of stay. Linear regression models were fit to estimate the effect of nurse resources on the log length of stay. To achieve a model that consisted of the strongest variables associated with the outcomes of interest, a stepwise elimination process was used. Individual variables with p values >.10 were removed in order of the largest *p*-value. At the completion of the stepwise elimination process, all the variables that remained in the model were significant at *p* <.10. In all regression models risk adjustment procedures were implemented and robust procedures were used to adjust for the clustering of patients within hospitals.

Safety net hospitals provide on average the same amount of registered nurse hours per patient day and registered nurse skill mix as their non-safety net counterparts. Despite this finding, elderly surgical patients admitted to safety net hospitals for surgical repair of hip fracture had an increase in the odds of in-hospital mortality during the immediate post-operative period when compared to patients at non-safety net hospitals. Furthermore, elderly Hispanic surgical patients had an increase in the odds of in-hospital mortality when compared to white surgical patients. Hispanic, black, and patients other races had an increase in the odds of a prolonged length of stay when compared to white patients. Magnet accreditation was not significant in predicting the odds of patient in-hospital mortality; however, in an interaction model magnet accreditation did moderate the effect of registered nurse hours per patient day on in-hospital mortality. Magnet accreditation and its moderating effect on registered nurse skill mix decreased the odds of in-hospital mortality in elderly surgical patients. Magnet accreditation and its moderating effect on registered nurse skill mix decreased the odds of a prolonged length of stay. Magnet accreditation and its moderating effect on registered nurse hours per patient day increased the odds of prolonged length of stay.

**Conclusions**

Elderly patients admitted to a New Jersey safety net hospital for the surgical repair of hip fracture are at higher risk of a poor outcome when compared to similar patients admitted to a non-safety net hospital. In this study it was found that nurse resources were not independently associated with in-patient mortality, but the number of registered nurse hours per patient day was significantly associated with a decrease in the log length of stay and a prolonged length of stay.

It appears then, that it is more than nurse resources alone; it is nurse resources in combination with an organizational climate that offers older surgical patients the best odds of better outcomes following hip surgery. This study shows that surgical patients admitted to safety net hospitals had an increase in the odds of in-hospital mortality when compared to patients admitted to non-safety net hospitals, but that magnet accreditation in combination with registered skill mix decreased odds of in-hospital mortality. One must conclude that the organization climate of safety net hospitals may be interacting with nurse resources to render the effects of nurse resources insignificant on mortality in elderly patients admitted for surgical repair of hip fracture.  Striving to increase registered nurse staffing is perhaps not the only solution for the New Jersey safety net hospitals, and administrators should seek to focus their efforts on improving the organizational climate within their facilities.

**Implications for nursing**

Safety net hospitals have higher odds of in-hospital mortality than non-safety net hospitals; yet, the safety net mission is to care for the most vulnerable. Substandard care threatens to take the life of surgical patients who entrust themselves to safety net system.

Although this study cannot precisely identify the cause of the in-hospital mortality disparity, it may relate to safety net hospital culture, teamwork, and the population of patients with complicated conditions. It is unclear how the financial viability of the safety net hospital impacts these disparities. Safety net hospitals have a range of financial and economic health and burdens; therefore, it is best not to generalize about all safety net hospitals in New Jersey. The most financially struggling safety net hospitals may be unable to support heath information technology services, invest in infrastructure improvements, quality improvement programs and clinical education programs that all may contribute to increased odds of mortality. The fact remains, those safety net hospitals underperform on the most important measure of quality care for hospitalized patients: in-hospital mortality.

The findings from this study suggest that health care equity is lacking in New Jersey. The significant increase in the odds of in-hospital mortality for Hispanic patients is a cause for serious concern. Elderly Hispanic patients may have language barriers that must be overcome by translator services; however, language alone cannot account for the mortality disparity. The quality of hospital care provided to Hispanic patients undergoing surgical repair of hip fracture is not equal to the care provided to patients of other races and ethnicities.

Our nation has struggled to eliminate disparities in the care of racial and ethnic minorities for decades yet those disparities remain a challenge. In this study black, Hispanic and patients of other races had increased likelihood of a poor care outcome when compared to white patients. The disparity in in-hospital mortality and length of stay may be associated with provider bias in the provision of evidence-based best practice. In addition, providers may not anticipate case complications specific to particular races. Delays for procedures may be overlooked when certain races are involved. The on average longer lengths of stay may also be related to discharge planning issues related to socio-economic factors such as housing and social support which delay the discharge of the patient and indirectly prolong the length of stay. In conclusion, in addition to other possible explanations for the differences in outcomes for people of color, this study demonstrates that certain New Jersey hospitals have disparities in patient outcomes.

**Recommendations**

The Institute of Medicine report: *America's Safety Net: Intact but Endangered* recommends that steps be taken to improve the nation's ability to monitor and assess the safety net's capacity, structure and financial ability. Of particular importance is the need to link existing data systems and the development of new data systems to assess the status of the safety net and health outcomes for vulnerable populations. It has been fourteen years since this recommendation, and no progress has been made toward national coordinated data systems (Lewin & Baxter, 2007). Without such systems, there is no capacity to assess the status of the safety net. Furthermore, there is no national data monitoring capacity to assess the health outcomes of our nation's most vulnerable populations.

An effort to help track and monitor the changing status of the safety net was launched by the Agency for Healthcare Research and Quality (AHRQ) and the Health Resources and Services Administration (HRSA), but was brought to a close due to limited budget and shifting priorities. In light of the absence of a national effort to monitor the safety net's capacity to affect the health outcomes of our nation's most vulnerable population research is needed to generate adequate data upon which policies can be developed to best serve the needs of our nation's most vulnerable patients.

A hospital safety net is part of a local community and as such the strength and viability of a safety net hospital is dependent upon the state and local support, state Medicaid policy, the structure of the local healthcare marketplace and the local community's economic health. There is widespread geographic variation in the economic viability of safety net hospitals with most safety net hospitals struggling to survive while a smaller group of safety net hospitals enjoy financial success. The geographic variation in safety net affects a hospital's ability to recruit and retain professional nurses who may be lured to more financially viable hospitals with better compensation packages.

Safety net hospitals are charged with the objective of eliminating racial and ethnic disparities. Yet this objective has not been met. Safety net providers care for a high proportion of racial and ethnic minorities; and are theoretically positioned to be leaders in the area of providing ethnocentric care. The findings that Hispanics are more likely to die following surgical repair of hip fracture in any New Jersey hospital; that patients are more likely to die in safety net hospitals; and that black patients are more likely to stay longer in hospitals tell us that New Jersey continues to have disparities in the quality of patient care. New Jersey needs to stay motivated and continue to work towards health equity and support research that investigates what enables the perpetuation of health disparities.

Based on the lack of a comprehensive data monitoring system of safety net hospitals, variation in safety net hospital financial strength and the disparities in health outcomes following hip fracture surgery for older racial and ethnic minorities in New Jersey hospitals; research is needed in the following areas:

1. Multi state outcomes research involving all safety net hospitals is needed. Variation in outcomes between safety net hospitals may provide insight into hospital characteristics, organizational characteristics and patients characteristics and their relation to outcomes. Research specifically focused on the heterogeneity of safety net hospitals may illuminate the range of safety net hospital providers that exist. Currently, the safety net system is understood as a patchwork. More specific data on the piece of the patchwork would generate meaningful data. Stronger performing safety net hospitals may serve as models for hospitals with poor patient outcomes. A coherent program of multistate research on safety net hospital outcomes would also contribute meaningful data on which policymakers may base future decisions.

2. The role of the nurse in safety net hospital outcomes is an important area of research. Large multi-state studies would reveal variation in nurse resource allocation by geographic region. A larger multi-state study may reveal a stronger association between nurse resources and patient outcomes than this current study revealed. An additional area of research is educational preparation of the nurse, the safety net, and patient outcomes. Are more highly educated nurses lured away from safety net hospitals by better compensation packages? Nurse educational preparation has been linked to patient mortality. Does the safety net hospital have a disproportionate number of nurses with less than a Bachelor of Science degree and is this linked to the higher odds of patient mortality in safety net hospitals?

3. Large multi-state outcomes research studies of safety net hospitals are needed to investigate the role of regional variation in health care disparities between safety net hospitals. Such studies may reveal that the disparities are more localized or are generalized across all hospitals. Differentiating the pattern of the disparity by geography may illuminate the role of the health care provider, the skill of the safety net regionally to care for a particular ethnic group and the concentration of a particular racial or ethnic group in a region of the country. Given the tendency of ethnic groups to want to be with their own familiar people and to cluster in the same communities; it would seem possible that hospitals would know what minorities they serve. Research that examines safety net hospital leadership strategies for reducing racial and ethnic disparities is also needed. While provider bias may be a factor is this disparity, the safety net hospital as a system may have a latent failure in operation that perpetuates the disparity. Those failures may include governance policies that exclude minority involvement; financial decisions that reduce translator services and cultural sensitivity training for clinicians. Research that investigated safety net managerial policies regarding ethnic and minority issues would also be an illuminating endeavor.

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November 25, 2013

**P.I. Name:** Cimiotti
**Protocol #:** E14-291

Jeannie P. Cimiotti
College of Nursing - Newark
Ackerson Hall
180 University Avenue
Newark Campus

Dear Jeannie Cimiotti:

**Notice of Exemption from IRB Review**

**Protocol Title:** "Nurse Resources and Surgical Outcomes in Elderly Patients: The role of the Safety Net"

The project identified above has been approved for exemption under one of the six categories noted in 45 CFR 46, and as noted below:

**Exemption Date:** 11/19/2013 **Exempt Category:** 4

This exemption is based on the following assumptions:

- **This Approval** - The research will be conducted according to the most recent version of the protocol that was submitted.
- **Reporting** – ORSP must be immediately informed of any injuries to subjects that occur and/or problems that arise, in the course of your research;
- **Modifications** – Any proposed changes MUST be submitted to the IRB as an amendment for review and approval prior to implementation;
- **Consent Form (s)** – Each person who signs a consent document will be given a copy of that document, if you are using such documents in your research. The Principal Investigator must retain all signed documents for at least three years after the conclusion of the research;

**Additional Notes:** **None**

**Failure to comply with these conditions will result in withdrawal of this approval.**

The Federalwide Assurance (FWA) number for Rutgers University IRB is FWA00003913; this number may be requested on funding applications or by collaborators.

Sincerely yours,

Michelle Watkin

Acting For,
Dr. Beverly Tepper, Ph.D.
Professor
Chair, Rutgers University Institutional Review Board

cc: Karen Moosvi

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# CURRICULUM VITAE

1953 Born July 27, Weehawken, New Jersey

1971 Graduated Ridgefield Memorial High School, Ridgefield, New Jersey

1975 Graduated University of Miami, Florida, Bachelor of Science in Nursing

1995 Graduated Rutgers, The State University of New Jersey, Newark, New Jersey
Master of Science in Nursing

## Principal Positions

1975- 1980 Staff nursing at Jersey City and Englewood Medical Centers

1980-1982 Greater New York Hospital Association; Medicaid Project Coordinator

1995-Present Advanced Practice Adult Mental Health Nurse Prescriptive Authority

1995- 2005 Instructor, Christ Hospital School of Nursing, Jersey City, NJ

2005- 2006 Deputy Executive Director, New Jersey Board of Nursing, Newark, NJ

2007 -2012 Instructor Mental Health Nursing, UMDNJ, Newark NJ

2012-2013 Teaching Fellow, College of Nursing, Rutgers, The State University of
New Brunswick, NJ

## Principal Writings

Holly, C. & Moosvi, K.; Gardienier, D., (Ed). (2012) *Is Peer Review Outdated?* The Journal for Nurse Practitioners, 8 (5).

Cimiotti, J., Johansen, M.L., Heelan, L.M., & Moosvi, K. (2013). It's About Time: An Analysis of the Aging New Jersey Nurse Workforce. A Report to Governor Chris Christie and the New Jersey State Legislature. New Jersey Collaborating Center for Nursing, New Brunswick, New Jersey.

Moosvi, K. & Levin, R.F. (2013). *Evidence-Based Practice: Using Evidence to Influence Health Policy.* Research and Theory for Nursing Practice 27(3).