ADMINISTRATIVELY-MEDIATED VARIABLES AND OUTCOMES OF HOSPITALIZED INJURED OLDER ADULTS

By

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DEDICATION

This dissertation is dedicated with love to my family, friends, and colleagues who have encouraged and supported me on this journey. Special attention is given to the following individuals:

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CHAPTER I

INTRODUCTION

Over the next 20 years, the U.S. will experience a dramatic increase in its older population as a result of increased life expectancy and aging of the baby boom generation. The effects will be felt throughout society, and particularly so in health care. Caring for older adults poses many challenges. Older adults in healthcare settings present complex clinical scenarios of chronic conditions, physiologic changes associated with aging, and geriatric syndromes (e.g., cognitive impairment, falls, and malnutrition). The rising demand for health services by an older population calls for innovative research aimed at optimization of quality and cost effectiveness.

Statement of the Problem

Hospitalized injured older adults (HIOAs) are a vulnerable and understudied population. The composite of HIOAs brings the addition of 'injury' to an already complex picture, where care and management demand attention to both injury-related *and* geriatric-specific issues. More than 47% of patients discharged from hospitals with a primary injury diagnosis are age 65 or older (Agency for Healthcare Research and Quality (AHRQ), 2008, 2009). Falls are the leading cause of injury, comprising more than 60% of hospital admissions for injured patients over age 64 and over 80% of hospital admissions after age 84 (Agency for Healthcare Research and Quality (AHRQ),

2008). By 2030, the number of injured older adults will exceed 7 million annually (Centers for Disease Control and Prevention (CDC), 2009).

In spite of these striking statistics, much work is needed in the study of HIOAs. Although patient characteristics as predictors of outcomes have been studied extensively, organizational factors and processes of care associated with outcomes for HIOAs are much less studied and may play a role in outcomes. Best practices specific to age-related needs have barely begun to be addressed in trauma publications. Mortality is the most studied outcome for HIOAs, yet the usefulness of mortality as an outcome measure may not be optimal in light of expected decline in survival rates associated with aging. Other outcomes such as readmission rates and development of adverse events may be more pertinent to this population in understanding quality of care.

In 1999, the Institute of Medicine released the report, "To Err Is Human: Building a Safer Health System," resulting in a national outcry at the incidence of preventable adverse events caused by the health care system (Institute of Medicine (IOM), Kohn, Corrigan, & Donaldson, 2000). The report set forth a national agenda for improving patient safety through design of safer systems. Since 1999, awareness of the importance of patient safety has heightened; however, much scientific work is still needed to determine organizational strategies for improving patient safety (Agency for Healthcare Research and Quality (AHRQ), 2010; Clancy, 2009). This is particularly true in regards to HIOAs. A national study examining the occurrence of potential patient safety events among all injured adults revealed that adverse events related to hospitalization are significantly higher among older trauma patients (Chang et al., 2008). The odds of experiencing at least one adverse event during hospitalization increased from 1.48 to 1.83

(35%) between ages 65 and 90, compared with 1.06 to 1.38 (32%) in patients between ages18 to 64 (Chang, et al., 2008). These findings demonstrate increasing susceptibility to adverse events and likely reflect changes in baseline vulnerability associated with aging. This highlights the importance and relevance of patient safety indicators as outcome measures in research on HIOAs.

Purpose of the Study

The proposed study addresses the problem described above through a health services approach with a focus on organizational factors and patient safety indicators. Health services research (HSR) is aimed at optimizing health care outcomes within the real world. HSR examines the delivery of health care within organizations, with an ultimate goal of improving the health and well-being of individuals, families, organizations, communities, and populations (AcademyHealth, 2008). This approach to research reflects a belief that an array of factors contribute to patient outcomes, and that the delivery of healthcare should be based on best available evidence from multiple sites and large samples and populations.

A systematic review of predictors and outcomes for HIOAs revealed a dearth of research on the contribution of organizational factors on outcomes for HIOAs, and an absence of studies examining patient safety indicators (avoidable adverse events) as an outcome measure (Maxwell & Mion, 2010, Unpublished Study-b). The purpose of this study was to examine administratively-mediated variables (AMVs), or alterable organizational factors within U.S. hospitals that might be associated with the occurrence of adverse events for HIOAs in acute care settings.

Background and Significance

As previously stated, HIOAs represent a subpopulation that differs from the broader adult population in both scope and complexity. A research agenda for HIOAs should entail study of the effects of hospitalization *and* injury on aging persons since each area is pertinent to outcomes. Care of the injured at trauma centers and care of hospitalized older adults have been studied as separate entities, and over 70 studies have specifically examined outcomes for HIOAs. However, few studies have incorporated variables from all three areas (hospitalization, injury,aging) into study design. A synthesis of literature (by the PI) within these domains (hospitalization, injury, and aging) provided the foundation for development and design of the proposed study, reflecting an overarching desire to understand the relative importance of both injury-specific and geriatric-specific needs of HIOAs during hospitalization.

Hospitalization.

Hospitalization poses more risks for older patients as compared to younger patients in three areas: 1) potential for iatrogenic issues (e.g., nosocomial infections, medication errors); 2) baseline susceptibility to stressors (i.e., delirium, illness severity); and 3) risk of geriatric syndromes (e.g., falls, skin breakdown) (Podrazik & Whelan, 2008). Creditor (1993) addressed the 'hazards of hospitalization' in the elderly and outlined the interaction of aging and hospitalization in eight areas: muscle strength and aerobic capacity, vasomotor stability, respiratory function, demineralization, urinary incontinence, sensory deprivation, skin integrity, and nutritional status. These interactions

contribute to deconditioning, dizziness and falls, reduced oxygenation, pressure sores, functional incontinence, and increased fracture risk (Podrazik & Whelan, 2008). Many studies related to risks of hospitalization have been conducted on older hospitalized patients. Findings from these studies are applicable to HIOAs as interactions of aging and hospitalization are germane to all hospitalized older adults. Table 1.1 summarizes the findings from five systematic reviews related to patient predictors and outcomes (e.g., functional improvement) for hospitalized older adults (Bachmann et al., 2010; Campbell, Seymour, Primrose, & ACME plus project, 2004; Hickman, Newton, Halcomb, Chang, & Davidson, 2007; Hoogerduijn, Schuurmans, Duijnstee, De Rooij, & Grypdonck, 2007; McCusker, Kakuma, & Abrahamowicz, 2002). Of note, patient predictors of multiple outcomes include functional status, cognitive impairment, presenting illness, and increasing age. Practices associated with improvements in outcomes include discharge planning and multidisciplinary teams.

Injury.

Within the US, trauma centers are considered the preferred/optimal acute care facilities for management of injured patients. Interest in the efficacy of trauma centers (TCs) and trauma systems (TSs) on patient outcomes has grown with the rise in health services research and concern for quality and cost-effectiveness. Celso and colleagues (2006) conducted a systematic review and meta-analysis of literature between 1966 and August 2004 and assessed patient outcomes in states (or regions) with implemented trauma systems. Investigators found a 15% reduction in mortality in favor of the presence of an inclusive trauma system. In the past five years, R01 or R49 grants have resulted in

major studies examining the effect of TCs and TSs on costs, mortality, and quality of life (MacKenzie et al., 2006; MacKenzie et al., 2007; MacKenzie et al., 2010; McConnell, Newgard, Mullins, Arthur, & Hedges, 2005; Utter et al., 2006; Weir et al., 2010).

Table 1.1. Summary from Five Systematic Reviews on Predictors and Practices Associated with Outcomes in Hospitalized Older Adults.

	OUTCOMES					
	Increased LOS [a]	Increased Mortality [a,b]	Disposition other than home [a,b]	Increased Readmission rate [a]	Functional Decline [b,c,d]	
Patient Predictors	Functional status Cognitive score Illness severity Poor nutrition Co-morbidities Presenting illness Poly-pharmacy Increasing age Male gender	Functional status Cognitive score Presenting illness Co-morbidities Poly-pharmacy Increasing age Male gender	Functional status Cognitive score Presenting illness Increasing age	Functional status Illness severity Co-morbidities Poly-pharmacy Presenting illness Increasing age	Pre-admission functional status Cognitive impairment Increased LOS Increasing age Depression	
	OUTCOMES					
	Decreased LOS [e]	Patient Satisfaction [e]	Decreased admission to residential care [e]	Improved provider practice [e]	Functional improvement [b]	Incidence of delirium [e]
Practices and Interventions	Discharge planning	Multi-disciplinary team approach Discharge planning Improved communication	Multi-disciplinary team approach	Multi-disciplinary team approach	Multi-disciplinary team approach Orthopedic geriatric rehabilitation	Targeted assessment

[a] Campbell et al.(2004); [b] Bachmann et al. (2010); [c] McCusker et al. (2002); [d] Hoogerduijn et al. (2005); [e] Hickman et al. (2007)

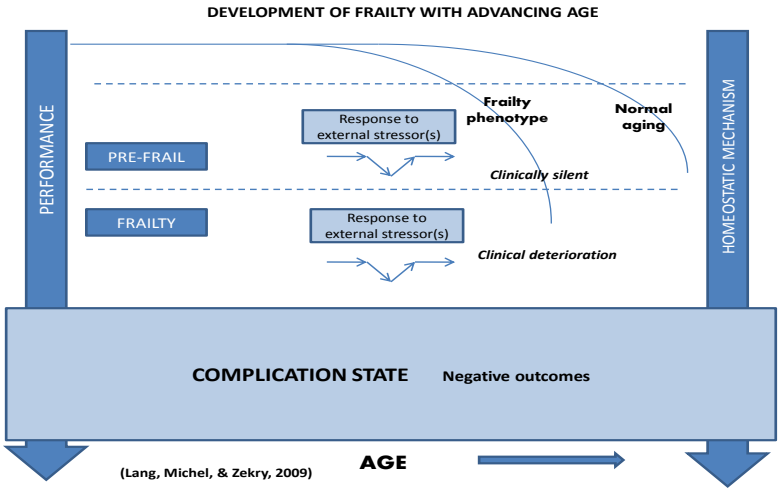
Since 2004, over 20 studies have examined a variety of predictor variables associated with outcomes among all adult injured populations, however, only three examined outcomes in older injured patients (MacKenzie, et al., 2010; Marcin & Romano, 2004; Rotondo et al., 2009). Each of these studies failed to demonstrate a statistically significant difference in outcomes for HIOAs as compared to younger patients. In a more recent study (Hsia et al., 2011) of California hospitals between 1999 and 2008, investigators examined the likelihood of an elderly patient receiving care in a trauma center versus a non-trauma center. Although the study did not examine patient outcomes, it revealed that increasing age was strongly associated with lower likelihood of trauma center care and that the pattern was unchanged even with risk adjustment for injury type and severity. Considering the complexities of injury severity, concomitant with geriatric-specific issues, the role of trauma centers for HIOAs needs further study.

Aging.

The development of frailty with advancing age is an important factor in the study of hospitalized older adults. Knowledge of the concept of *vulnerability*, and its relationship to the aging process, is necessary for an understanding of the importance of the concept to research on HIOAs. Omission of this concept in health services research on older adults may be responsible for many unanswered questions and conflicting findings. *Frailty* is a widely used term describing vulnerable elders and is becoming a recognized distinct clinical syndrome with a biological basis (Lang, Michel, & Zekry, 2009). Lang et al. discussed the indistinct borders between aging and frailty that can be a confounding factor in studies if not understood. While normal aging results in

physiologic changes, frailty represents an extended process of increasing vulnerability during which physiological reserve diminishes, resulting in impairments in mobility, balance, muscle strength, motor processing, cognition, nutrition, endurance and physical activity (Lang, et al., 2009). Figure 1.1 provides a visual aid for understanding the concept of frailty. Of note, the pre-frail period presents as clinical 'silence', yet decline is occurring and physiologic reserves are sufficient for persons to respond adequately to insults of disease, injury, or stress. The frailty cycle develops from an accumulation of the effects of lack of physical exercise, poor nutrition, unhealthy environments, injuries, disease, and drug use (all types) (Lang, et al., 2009). As such, it is noted that frailty can affect more than the aging population, and that older persons can avoid frailty well into advanced age. An awareness of this concept within the proposed study is necessary since a greater percentage of older adults are affected by frailty in contrast to younger adults.

Figure 1.1. Development of Frailty with Advancing Age



The Assessing Care of Vulnerable Elders (ACOVE) project is among the most prominent works on frailty, defining 'vulnerability' as "persons 65 years of age and older who are at increased risk for death or functional decline" (Wenger, Shekelle, & ACOVE Investigators, 2001). The Vulnerable Elder Survey (VES-13) was developed to identify frail older adults. Subsequent research deemed functional status to be the most important predictor of death and functional decline (Wenger, et al., 2001). From a nationally representative sample of community-dwelling adults age 65 and older, 32% were vulnerable (had crossed a pre-frail to frail threshold), indicating a four-fold increase in the risk of death or functional decline over a 2-year period (Min et al., 2009). The percentage of older adults in a pre-frail stage has not been measured; however, an awareness that a significant percentage of older adults may reside in both frail and pre-frail stages underscores the importance of this concept for research in older populations.

Hospitalized injured older adults.

A systematic review of research published between 1980 and September 2010 was conducted to examine outcomes related to HIOAs (Maxwell & Mion, 2010, Unpublished Study-b). Among 71 studies, over 60 examined patient characteristics, and only 10 examined organizational factors associated with outcomes, including trauma center care and trauma center volume. Findings indicated decreased mortality among all injured patients at level I trauma centers. Only one study examined a geriatric-specific intervention (geriatric trauma team) (Fallon et al., 2006).The association of patient characteristics with outcomes demonstrated consistent findings with increasing age, male

gender, injury severity, pre-existing conditions, and physiologic demise as predictors of worse outcomes.

Research Aims

Further study on the relationship of organizational structures and processes with outcomes is needed to begin to understand the role that hospital structures, resources, and processes play in maintaining patient safety for HIOAs. The aims for the proposed study were:

1. To determine the extent of adoption of targeted ACOVE (Assessing Care of Vulnerable Elders) indicators for hospitalized injured older adults in acute care settings;
2. To determine associations among administratively-mediated variables (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOAs;
3. To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indictors for HIOAs.

The study was accomplished through a descriptive design using: 1) a survey of hospitals in 24 states, 2) 2009 American Hospital Association (AHA) Survey data, 3) 2009 Healthcare Cost and Utilization Project Nationwide In-patient Sample (HCUP NIS), and variables from a previous study (Maxwell & Mion, 2010, Unpublished Study-a). Datasets were constructed from these sources to describe the study sample and to conduct analyses that addressed each of the study aims.

Aim One was addressed by a mailed survey to chief nursing officers (CNOs) in U.S. hospitals in 24 states with a mail or web-based respondent-selected return mechanism. Aim Two and Aim Three were addressed through utilization of the four data sources listed above. Independent variables (AMVs) were obtained from the survey of hospitals, AHA data, and the previous study. Aim Two was addressed by using 'adoption of targeted ACOVE indicators' as an intermediate outcome variable to determine associations between AMVs, patient characteristics, and adoption of ACOVE indicators. Aim Three was addressed by utilizing selected patient safety indicators (PSIs) derived from the 2009 HCUP NIS, as outcome variables. Variations in hospital rates of four PSIs were examined, and the extent to which AMVs explained variations was studied.

Aim One was proposed because ACOVE quality indicators that address cognitive and functional impairment (leading predictors of mortality and increased length of stay) have been shown to improve outcomes for hospitalized older adults. Aim Two was proposed because characteristics of hospitals and characteristics of HIOAs associated with adoption of ACOVE indicators were unknown. Aim Three was proposed because relationships between AMVs and the rate of adverse events in HIOAs were unknown, leaving little direction as to how to decrease HIOA adverse events.

Summary

This chapter provides the background and rationale for this dissertation study. The study incorporated categories of AMVs from three domains (hospitalization, injury, and aging) to study the relative importance of individual variables and clusters of variables. The study also highlighted geriatric-specific ACOVE indicators related to

cognitive and functional impairment, prominent predictors of negative outcomes in older adults. The following chapters discuss the study in detail. The theoretical framework and review of relevant literature are covered in Chapter II. Chapter III presents the methodology used to accomplish the study. Chapter IV presents the results, and Chapter V discusses implications and recommendations for future research.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Theoretical Framework

A health services framework, the Minnick and Roberts Outcomes Production Framework (Minnick, 2001) was used to guide the study (Figure 2.1). Work by Minnick and colleagues focused on resource clusters within organizations that must be present to achieve better outcomes (Minnick, Young, & Roberts, 1995; Minnick, Fogg, Mion, Catrambone, & Johnson, 2007; Minnick, Mion, Johnson, Catrambone, & Leipzig, 2007; Minnick, Roberts, Young, Kleinpell, & Marcantonio, 1997). The approach taken in studies guided by this model was to identify the extent of variation of inter- and intra-institutional labor, capital, and process inputs, and to determine whether variations contributed to outcomes. The model reflects the belief that examination of clusters of variables provides a real world approach that may be preferable to individual variable approaches (Minnick, Fogg, et al., 2007).

A strength and focus of this framework is that it distinguishes mutable factors from factors that are beyond control of administrators. The term administratively-mediated variables (AMVs) is the over-arching concept within the framework, with capital inputs (CI), organizational facets (OF), and labor inputs (LI) serving as secondary dimensions or concepts. Another feature of this model pertains to the role of patient characteristics. Hospitals often design service strategies based on homogenous patient populations, while in reality, variations in patient characteristics (age, admitting

diagnoses, marital status, payer status, education level) may call for service designs that are customized to variations in consumer types (Minnick, et al., 1997). This study examined variations in patient characteristics among HIOAs in U.S. hospitals. Figure 2.2 depicts the adapted model with study aims for this study. The model proposed that patient outcomes within health care settings result from interactive processes between working conditions (mutable and immutable), employee behaviors and attitudes, and patient characteristics.

Figure 2.1. Conceptual Framework: Minnick & Roberts Outcomes Production Model

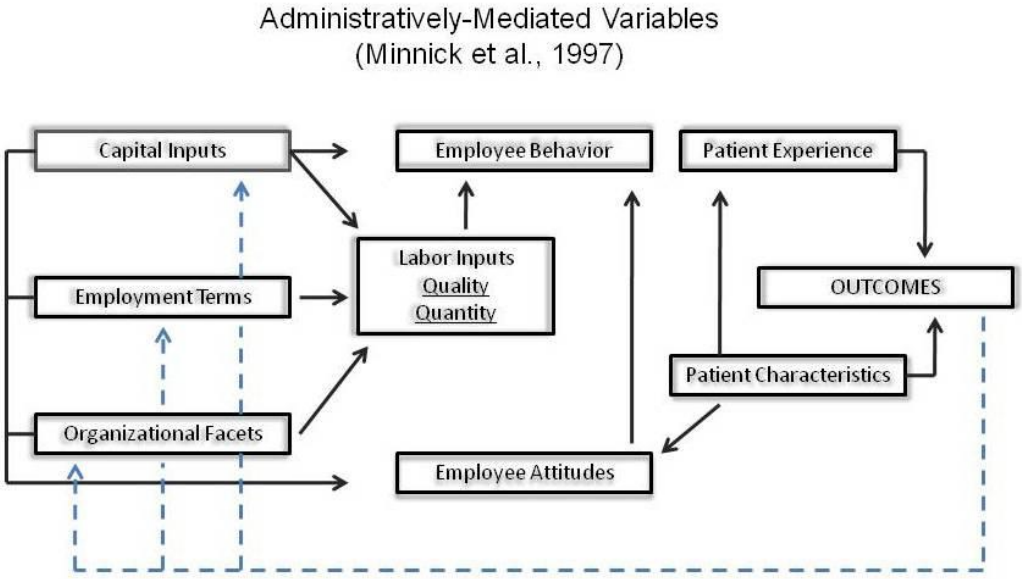
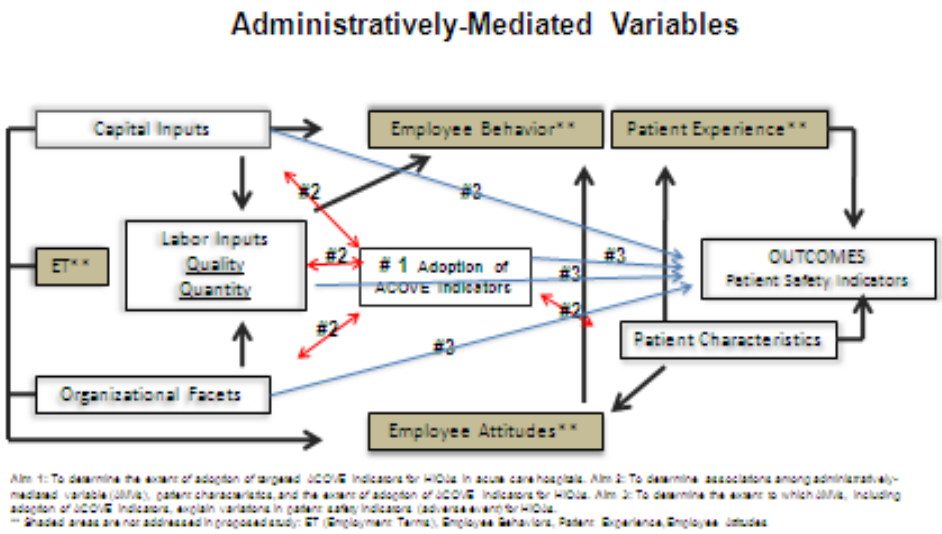


Figure 2.2. Adapted Conceptual Framework and Study Aims



Aim 1: To determine the extent of adoption of targeted ACOVE indicators for HIOus in acute care hospitals. Aim 2: To determine associations among administratively-mediated variable (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOus. Aim 3: To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indicators (adverse event) for HIOus.
** Shaded areas are not addressed in proposed study: ET (Employment Terms), Employee Behaviors, Patient Experience, Employee Attitudes

Administratively-mediated variables.

Implicit within the model is the recognition that a multiplicity of factors and interrelationships within health care settings contribute to patient outcomes. Administratively-mediated variables (AMVs) are mutable factors shaped by decisions of leaders within organizations. The concept implies that these variables can be altered (mediated) through administrative decisions. An assumption is that alterations in work conditions (capital inputs, organizational facets, labor inputs) contribute to variances in outcomes.

Capital inputs are defined as tangible items that entail significant financial investments by organizations (e.g., monitoring systems, room design). Examples include: 1) devices that influence patient behavior by potentially preventing disorientation and anxiety (e.g., noise reduction measures); 2) designs that increase staff direct contact time

with patients (e.g., unit configurations, room-based supplies); and 3) measures that provide for indirect patient assessment (e.g., monitoring, surveillance capabilities).

Employment terms are temporal (time-related) and workload requirements of caregivers. This AMV category was not examined in this study.

Organizational facets are defined as work environment, work traits, and work guides or organizational structures and procedures. Structures include traits within an organizations that affect worker autonomy (e.g., Magnet facility, ACE unit); and procedures include guidelines that influence the work environment (e.g., policies, standards of care). Care delivery processes also include those that influence providers' ability to exercise their expertise and direct standardization of work (Minnick, Fogg, et al., 2007).

Labor inputs are defined as measures that reflect the *quantity* of providers or the *quality* (characteristics) of providers within settings. Quantity includes factors such as number of RN FTEs or number of hospitalists; and quality includes factors such as nurse certification and level of experience. Within the framework, a second assumption is that labor inputs mediate the effects of capital inputs, employment terms, and organizational factors, and influence employee behavior (actions taken by employees for patients).

Patient characteristics represent baseline status at the outset of treatment and/or the status before onset of the problem that requires treatment. Within any study, investigators must consider patient-related elements considered to be most relevant to the outcome(s). Consideration of the expected influence of each characteristic is an essential step in study design. Within this study, patient characteristics were examined at the organizational level (Aim Two) to determine if variations were associated with adoption

of ACOVE indicators, based on the premise that variations in patient characteristics and expectations may call for system designs that are customized to different types of consumers (Minnick, et al., 1997; Young, Minnick, & Marcantonio, 1996). A third assumption within the framework is that patient characteristics influence employee attitudes, patient experience, and patient outcomes.

Employee attitudes reflect the internal disposition of employees. The *patient experience* describes the objective and subjective experience of patients. (These concepts were not examined in this study.)

ACOVE Quality Indicators (QIs) (organizational facets), a primary focus in this study, were designated as an intermediate outcome for Aim Two (Figure 2.2). The ACOVE Indicators, developed by RAND Health, include 392 quality indicators covering 26 conditions specific to vulnerable elders. ACOVE QIs follow an IF--THEN—BECAUSE format, with IF describing clinical characteristics of the patient; THEN describing the care process that should or should not be performed; and BECAUSE describing the expected health effect if the process is followed (Wenger, Roth, Shekelle, & the A.I., 2007). Quality indicators for measuring quality of hospital care for older adults were derived from 485 studies, resulting in 30 QIs in five areas: 1) general hospital care, 2) pneumonia, 3) preoperative care, 4) peri-operative care, and 5) postoperative care (Wenger, et al., 2007). Each indicator is derived from rigorous research (RCTs, systematic reviews).

Nine of the ACOVE indicators for hospitalized older adults address measures aimed at recognition of cognitive and functional impairment, and prevention of cognitive and functional decline during hospitalization. These nine indicators are of particular

importance in light of research on the predictors of outcomes among hospitalized older adults. Three systematic reviews of studies over several decades show that impaired cognition and function are strong predictors of worse outcomes, including increased length of stay, mortality, readmission rates, disposition other than home, and functional decline (Campbell, et al., 2004; Hoogerduijn, et al., 2007; McCusker, et al., 2002).

Patient safety indicators (PSIs) were the outcome measures for this study. Patient safety indicators are a set of measures developed by Agency for Healthcare Research and Quality (AHRQ) that can be used with hospital inpatient discharge data to provide perspective on patient safety by screening for problems that patients experience as a result of exposure to the healthcare system (Agency for Healthcare Research and Quality (AHRQ), 2007a). Indicators are likely amenable to prevention by changes at the system or provider level. Twenty PSIs are provider-level indicators; however, only 10 of these are applicable to trauma patients. Among the applicable PSIs, four were most applicable to older trauma patients, including: 1) decubitus ulcers, 2) infections due to medical care, 3) postoperative hemorrhage or hematoma, and 4) postoperative pulmonary embolus or deep vein thrombosis.

Analysis of Relevant Literature

Administratively-mediated variables.

An inventory approach was used to select AMVs for this study. This approach has been used in prior studies (Longo, Hewett, Ge, & Schubert, 2005; Minnick, et al., 1997) and is based on the premise that many system factors, human factors, and interactions

(clusters) contribute to optimal hospital care. Using this health services approach, potential contributors (AMVs) to outcomes for HIOAs were sought within the literature and an attempt was made to identify an inclusive list of the most salient variables. Appendix A provides an inventory list that summarizes identified variables with descriptions, rationale, and references for each variable. Criteria for variable selection included: 1) recommendations by geriatric organization(s), 2) evidence from systematic reviews of literature, 3) evidence from other research studies, and/or 4) published expert opinion. Variables were subsequently examined for relevance to the basic concepts and aims, as well as feasibility to measure with grading of these factors noted in Appendix A. From the list, variables that could be obtained from the AHA Survey and the PI's prior study were identified. Variables to be measured by a survey of hospitals were selected from the inventory and a survey instrument (discussed in detail in chapter 3) was developed by the PI.

The AMV inventory list contained over 75 variables (Appendix A). Sixty-six AMVs were selected for the study and conceptually categorized according to each AMV category (CI, OF, LI), relevance to the research aims, and the source from which each variable would be obtained (AHA, prior study, survey). Appendix B provides a detailed summary of selected study variables, including conceptual and operational definitions, variable types, instrument of measure, scale of measure, and aim(s) addressed. Table 2.1 provides an overview of selected AMVs categorized according to source.

Table 2.1. Overview of Selected Administratively-Mediated Variables (n = 66 variables)

CAPITAL INPUTS		
AHA Survey (n=4)	Survey (n=9)	
Electronic health record Access to measures that promote independence - Assistive technology - Physical outpatient rehab - Simulated rehab environment	Computer Support - Medication compatibility alerts - Retrieval of previous hospital data - Retrieval of nursing home data - Standardized checklist for (Ventilator-associated pneumonia (VAP) bundle - Standardized checklist for Catheter-acquired urinary tract infection (CAUTI) bundle ED Room Design In-room Supplies - Medications - Linens - Basic Supplies	
ORGANIZATIONAL FACETS		
AHA Survey (n=18)	Survey (n=14)	Prior Study (n=4)
ED Triage System Geriatric Services Geriatric-focused services - Skilled nursing beds - Intermediate nursing beds - Acute long-term care beds - Adult Day Care - Alzheimer's Center - Assisted living services - Home health services - Meals on wheels - Retirement housing - Transportation to health services Health status indicators Orthopedic services Ownership/physician Pain management Teaching Status Type of organization	Adoption of ACOVE indicators (9) Comprehensive geriatric assessment Family sleep arrangements in ICU Visitation hours in ICU Magnet Status Specialty Unit	Geriatric Resource Programs Trauma Center Status Trauma Center Verification Status Trauma System status
LABOR INPUTS		
AHA Survey (n=3)	Survey (n=14)	
Hospitalists Intensivists Patient representative services	Access to psychiatric nurse liaison Bachelor of Science in Nursing (BSN) percent Geriatric Advanced Practice Nurses (APNs) Geriatric Case Management Geriatricians Multi-disciplinary consultation teams Nurse certification Nurse/patient ratio Nurse staffing mix Nurse turnover Psych consultation services Gero-psychiatric services Registered nurse experience Trauma case managers	

ACOVE indicators.

As noted earlier, the aims of this study emphasize ACOVE indicators targeted to cognitive and functional status. The rationale for this emphasis was based on empirical evidence that cognition and functional ability were significant predictors of worse outcomes among hospitalized older adults and that indicators targeted to cognition and function improved multiple outcomes. Hence, it followed that measures aimed at recognition of these conditions and prevention of further impairment might also be associated with variations in PSI rates. This section provides a review of each ACOVE indicator within the study, followed by a brief summary of supportive evidence.

Multidimensional assessment of cognition upon admission.

An indirect line of evidence supports this indicator. Cognitive assessment can: 1) identify the presence of dementia, depression, or delirium; 2) determine patient readiness to learn; and 3) predict subsequent outcomes related to hospitalization. Identification of cognitive impairment on admission can alter the workup and management of patients, leading to vigilance aimed at preventing further decline (McCusker, Cole, Dendukuri, Belzile, & Primeau, 2001). Concerning patient safety, one study revealed associations between reported adverse events (i.e., falls and nursing errors) and patients with mild to moderate cognitive impairment (Watkin, Blanchard, Tookman, & Sampson, 2012). A meta-analysis of predictors for nursing home admission revealed that cognitive impairment is one of three primary predictors for nursing home admission (Gaugler, Duval, Anderson, & Kane, 2007). Dementia guidelines promote documentation of cognitive ability on admission to the hospital (Costa Jr et al., 1996; Eccles, Clarke,

Livingston, Freemantle, & Mason, 1998; Small et al., 1997). Detection of unrecognized cognitive impairment can also lead to enhanced family involvement and participation in targeted interventions.

Assessment of functional status on admission.

Functional impairment on admission to hospitals is a leading predictor of further functional decline, increased length of stay, geriatric syndromes, and readmissions (de Saint-Hubert et al., 2010; de Saint-Hubert, Schoevaerdts, Poulain, Cornette, & Swine, 2009; Hoogerduijn, et al., 2007). Screening patients upon admission enables better care planning and incorporation of targeted interventions to prevent further decline. Establishing baseline function through simple screening on admission can identify patients at increased risk for in-hospital ADL decline and failure to recover (Lindenberger et al., 2003).

Documented assessment for etiology of delirium.

Studies show that cognition is often impaired during hospitalization in older adults and that there is potential for improvement, both during and after hospitalization (Fields, MacKenzie, Charlson, & Perry, 1986; Hickey, Clinch, & Groarke, 1997; Lindquist, Go, Fleisher, Jain, & Baker, 2011). Potential etiologies for delirium include acute illness, infection, impaired hemodynamics, medications, and environmental change. Other studies suggest that linking the occurrence of delirium to a potential etiology may improve cognitive and functional recovery (Lundström et al., 2005; McCusker, Cole, Dendukuri, Han, & Belzile, 2003). Educational interventions for health care providers

focused on assessment, prevention, and treatment of delirium resulted in lower rates of delirium, quicker recovery, and better post-discharge outcomes (Lundström, et al., 2005; McCusker, et al., 2003; Mudge, Giebel, & Cutler, 2008).

Documented plan to increase mobility within 48 hours of admission.

Immobility is a risk factor for deconditioning, aspiration, pressure ulcers, deep vein thrombosis, and falls. Focused measures that address early ambulation can minimize or negate these adverse events. Studies show that early ambulation can reduce length of stay by one to two days (Fisher, Kuo, Graham, Ottenbacher, & Ostir, 2010; Mundy, Leet, Darst, Schnitzler, & Dunagan, 2003). Others advocate for proactive measures and ambulation protocols aimed at improving quality and safety in older adults (Murphy, 2011).

Pre-op screening of risk factors for delirium.

Several studies have identified risk factors for delirium that can be detected preoperatively. In a systematic review, dementia and severe medical illness were strongly associated with postoperative delirium (Elie, Cole, Primeau, & Bellavance, 1998). Other predisposing factors include vision impairment, cognitive impairment, alcohol abuse, poor functional status, abnormal electrolytes, and blood urea nitrogen to creatinine ratio of 18 or greater (Inouye, Viscoli, Horwitz, Hurst, & Tinetti, 1993; Marcantonio et al., 1994). Early identification of these risk factors may promote prevention or earlier detection and treatment of postoperative delirium, as well as adverse events associated with delirium.

Early ambulation after surgery.

Several RCTs revealed that early ambulation resulted in shorter length of stay and more rapid attainment of functional goals between Days 6 and 10 (Delaney et al., 2003; Larsen, Hansen, Thomsen, Christiansen, & Søballe, 2009; Munin, Rudy, Glynn, Crossett, & Rubash, 1998). One of these studies (Larsen, et al., 2009) also showed that accelerated perioperative rehabilitation protocols following hip and knee surgeries were more cost effective than traditional care. Smith, Parvizi, and Purtill (2011) found that immobility and delays in surgical intervention in patients with hip and femur fractures resulted in increased incidence of deep vein thrombosis and pulmonary embolus. These findings, along with previously discussed studies on early ambulation, suggest that recovery time can be reduced, thus averting potential complications related to prolonged hospitalization.

Delirium screening for three days postop.

Delirium is commonly associated with poor outcomes in older adults. The literature suggests that daily screening of elderly patients undergoing major surgery leads to early detection of postoperative delirium (Ely et al., 2001; Hattori et al., 2009; Inouye et al., 1999; Inouye, Foreman, Mion, Katz, & Cooney, 2001; Marcantonio, Ta, Duthie, & Resnick, 2002). Another prospective study (de Jonghe et al., 2007) revealed that early symptoms of delirium occurred during a 'prodromal phase'. Delirium was predicted by acute admission to the hospital, difficulty repeating and remembering words, disorientation, pressured speech, and flight of ideas (de Jonghe, et al., 2007). Injured

older adults are often admitted acutely to hospitals and many undergo surgery, highlighting the importance of delirium screening.

Cognitive and functional assessment at discharge and assessment for level of independence and need for home health.

Pre-discharge screening for cognition and functional status may identify patients with unmet needs. Studies have identified factors associated with the need for post acute referral, including lack of informal caregiver support, major walking restrictions, low self-rated health, higher depression scores, and number of comorbidities (Bowles et al., 2009; Mamon et al., 1992). Addressing unmet needs may allay the need for readmission and/or development of complications.

Of note, a recent study (Neuman, Speck, Karlawish, Schwartz, & Shea, 2010) assessed the prevalence of protocols for 11 ACOVE indicators in Pennsylvania hospitals (n=103). Five of the indicators examined in the study coincide with indicators examined in this study. The percentage of hospitals that indicated the presence of written protocols were as follows: 1) assessment of risk factors for delirium (21%); 2) screening for delirium after surgery (17%); 3) timing of mobilization after surgery (34%); 4) assessment of physical function at discharge (81%); and 5) assessment of cognition at discharge (40%). The study also found that inpatient geriatric consultation was available in 39% of hospitals and that teaching hospitals, as compared to non-teaching hospitals, reported significantly higher rates of protocols for postoperative delirium screening (Neuman, et al., 2010). These findings served as benchmarks for Aim One of this study. Comparisons are discussed in Chapter V.

Patient safety indicators.

The outcome measures chosen for this study included four patient safety indicators (PSIs) that were relevant to HIOAs. Mortality has been the most studied outcome in this population. PSIs may be a preferable outcome to examine variations in quality care among acute care settings, as PSI data elements provide an indirect measure for assessing quality of inpatient care. Development of the AHRQ PSIs arose from the Institute of Medicine's report on medical errors and the expressed need for restructuring of the health care system to improve quality (Institute of Medicine (IOM), et al., 2000). The PSIs are measures designed for use with inpatient discharge data to provide perspective on patient safety by screening for problems that patients experience as a result of being within the healthcare system (Agency for Healthcare Research and Quality (AHRQ), 2007a). The PSIs are also known as adverse events or complications arising from medical care, thus, were pertinent as outcome measures since they are directly related to provision of care within hospitals. While PSIs cannot define quality of care, they can be used to identify specific issues/problems for further investigation.

Development of the AHRQ PSIs involved a detailed approach for identification, development, and evaluation of PSIs that included review of literature, clinician panels, expert coders, and empirical analysis (Agency for Healthcare Research and Quality (AHRQ), 2007a). Detailed evidence for each PSI is available through AHRQ, including definitions of the indicators, numerators and denominators for each and strength of published evidence (Agency for Healthcare Research and Quality (AHRQ), 2007a). Appendix C provides a summary of the four PSIs examined in this study. The following

sections provide an overview of each PSI and supportive evidence (if any) related to HIOAs or hospitalized adults in general.

Decubitus ulcer.

This PSI is intended to detect cases of in-hospital decubitus ulcers in patients with a length of stay greater than 4 days. Needleman and Buerhaus (2001) identified this outcome as potentially sensitive to nursing. The ANA, state associations, and the California Nursing Outcomes Coalition identified pressure ulcers as "nursing-sensitive quality indicator for acute care settings" (Savitz, Jones, & Bernard, 1999). Studies have reported pressure ulcer incidence rates in acute-care settings between 7% and 9%, and prevalence rates between 14% and 17% (Comfort, 2008; Whittington & Briones, 2004). No studies were found that examined incidence of decubitus ulcers in HIOAs. Of note, one study in a single hospital compared AHRQ methodology for identification of pressure ulcer PSIs with a medical record review and found that failure to accurately code denominators for the PSI resulted in higher rates of pressure ulcers (Polancich, Restrepo, & Prosser, 2006).

Infections due to medical care.

This PSI detects cases of infection related to intravenous (IV) lines and catheters. The AHRQ project team found no published evidence to support the PSI constructs, however, the ANA and state associations identified the number of bacteremic episodes associated with central lines per critical care patient day as a "nursing-sensitive quality indicator for acute care settings" (Savitz, et al., 1999). Three studies validated increased

incidence in nosocomial infections in older versus younger injured patients, however associations with processes of care were not examined in these studies (Bochicchio, Joshi, Knorr, & Scalea, 2001; Grossman et al., 2003; Tornetta et al., 1999).

Postoperative hemorrhage or hematoma.

This PSI detects cases of bleeding (hemorrhage or hematoma) following a surgical procedure. The AHRQ project team stratified this indicator for patients with clotting differences (coagulopathies, on anticoagulants). The team also noted that patients admitted for trauma may have a higher risk for developing this indicator. No studies were found that examined this indicator in HIOAs, however, one study that compared hip fracture patients in two management groups (usual care (n=121) vs. co-management with orthopedist and geriatrician (n=193)) revealed a lower incidence of bleeding in the co-managed group (unadjusted mean 3.3 versus 0, p = .02) (Friedman, Mendelson, Bingham, & Kates, 2009). The adjusted p-value in this study was reported to be 'unstable' due to one site not experiencing the outcome. A systematic review of prehospital factors associated with severe injury in older adults (Scheetz, 2005), revealed that anticoagulant and antiplatelet agents were associated with increased mortality and increased length of stay. These studies highlight the importance of optimal management of coagulopathies in HIOAs.

Postoperative PE or DVT.

This PSI detects cases of postoperative venous thrombosis and embolism. The AHRQ project team considered the usefulness of this indicator as high in relationship to other PSIs since preventive techniques should decrease the rate of DVTs and PEs (Agency for Healthcare Research and Quality (AHRQ), 2007a). Needleman and Buerhaus (2001) did not find a relationship between nurse staffing and the occurrence of DVT/PE; however, Kovner and Gergen (1998) found an association between more registered nurse hours (and non-RN hours) and lower rates of DVT/PE after major surgery. Friedman, Meldelson, Bingham et al. (2009) found lower rates of thromboembolism in a group of hip fracture patients co-managed by a orthopedist-geriatrician team vs. usual care (mean 0.5 vs. 5.0), ($p < .05$) (adjusted $R^2 = .07$).

A final study that supported the use of PSIs as outcome measures for HIOAs examined the occurrence of PSI events among trauma patients age 18 and older (Chang, et al., 2008). The study used the HCUP NIS from 2000-2004 and enriched the data with AHRQ PSIs, injury severity measures, and comorbidity measures. Ten applicable PSIs were examined to determine the rate of occurrence of 1 or more PSIs in groups stratified by age, gender, race, length of stay, hospital type, U.S. region, and calendar year. In the overall trauma population, 1.43% of all patients experienced one or more PSIs. The adjusted odds of experiencing a PSI began to rise after age 35 and increased markedly after age 65 ($p < .05$) (ORs by age: 60-64, 1.38; 65-69, 1.48; 70-74, 1.62; 75-79, 1.61; 80-84, 1.61; 85-89, 1.64; 90+, 1.83). The adjusted odds of at least one adverse event increased eight-fold for patients hospitalized for four or more days as compared to those hospitalized for less than four days ($p < .05$, OR: 8.08) (Chang et al.). Statistically

significant associations were also found between higher injury severity and increased occurrence of PSIs, as well as urban teaching hospitals and increased occurrence of PSIs (Chang, et al., 2008). AHRQ reported PSI rates from the 2008 HCUP NIS for various groups. Table 2.2 outlines rates for the PSIs by gender, age ≥ 65, and Medicare patients, revealing higher PSI rates in older patients compared to all patients. These rates provided benchmarks for this study. Comparisons are discussed in Chapter V.

Table 2.2. Patient Safety Indicator Rates* by Groups

Patient Safety Indicator (PSI)	ALL	Male	Female	65-75	75+	Medicare
Pressure Ulcer	1.67	1.45	1.47	1.55	2.27	1.87
Central line BSI	0.11	0.12	0.07	0.12	0.08	0.12
Postop hemorrhage	0.34	0.28	0.24	0.25	0.27	0.38
Postop PE or DVT	0.94	1.05	0.89	1.10	1.31	0.96

*Rate per 1000 discharges
(AHRQ Quality Indicator: Comparative Data for the PSI based on the 2008 NIS)

Summary

This study utilized a health services research approach that focused on mutable organizational factors and patient safety indicator rates. The Minnick Model provided a conceptual framework on administratively-mediated variables within hospitals. The Model guided delineation of categories and proposed relationships between and among concepts. The study explored potential resource clusters and associations with PSI rates. The review of literature supported the use of ACOVE indicators and patient safety

indicators as pertinent variables for the study. The following chapter describes the methodologies employed to meet the aims of the study.

CHAPTER III

METHODOLOGY

Overview

The proposed study was accomplished through a descriptive design using retrospective data and survey data elements. Data collection was aimed at compiling organizational level administratively-mediated variables (n=66), patient characteristics (n=5), outcomes/PSIs (n=4), and hospital demographic/descriptive data. Data were obtained from four sources, including: 1) a survey developed by the PI, 2) 2009 AHA Survey, 3) 2009 HCUP NIS, and 4) a prior study conducted by the PI during 2009. Table 3.1 provides an overview of data sources and how each was utilized within the study. A secondary analysis of HCUP NIS data was conducted to derive organizational-level variables for patient characteristics and patient outcomes (PSIs). A survey of hospitals (identified from the 2009 HCUP NIS) was conducted to obtain AMVs, with additional AMVs obtained from the 2009 AHA Survey and prior study. An organizational level dataset was constructed for data analysis.

Table 3.1. Overview of Data Categories and Data Sources

Outcomes (Patient Safety Indicators)	Patient Characteristics (Age, Gender, Injury Severity, Comorbidities, % Hip Fractures)	Hospital Descriptives/ Demographics	Administratively-mediated Variables (Capital inputs, Organizational facets, Labor inputs)
-2009 HCUP NIS	-2009 HCUP NIS	-2009 AHA Survey	-2009 AHA Survey -Survey of CNOs -Prior Study

The purpose of this study was to examine administratively-mediated variables (AMVs), or alterable organizational factors within U.S. hospitals that might be associated with the occurrence of adverse events for HIOAs in acute care settings.

Study Aims

1) To determine the extent of adoption of targeted ACOVE indicators for hospitalized injured older adults (HIOAs) in acute care settings;
2) To determine associations among administratively-mediated variables (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOAs;
3) To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indicators (adverse events) for HIOAs.

Data Sources

Discharge (patient) level data. The *HCUP NIS* for 2009 was purchased from the Agency for Healthcare Research and Quality (AHRQ). The HCUP NIS is a database of inpatient stays built from hospitals that participate in the HCUP. The NIS is designed to approximate a 20 percent sample of U.S. hospitals within 44 states that comprise 96 percent of the U.S. population (Healthcare Cost and Utilization Project [HCUP], 2009). The NIS contains all-payer data on hospital inpatient stays from a sample of community hospitals, defined as "all non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions." The universe of community hospitals is divided

by five strata: 1) ownership/control, 2) bedsize, 3) teaching status, 4) urban/rural location, and 5) U.S. geographic region. Sampling probabilities are proportional to the number of community hospitals in each stratum (Healthcare Cost and Utilization Project (HCUP), 2009). The NIS can be linked to hospital-level data from the AHA Annual Survey database. Of note, some states impose restrictions on the release of certain data elements. Eighteen states in the 2009 NIS restrict identification of hospitals (AR, GA, HI, IN, KS, LA, ME, MI, MO, NE, NM, OH, OK, SC, SD, TN, TX, WY). This restriction limited this study to data from hospitals in 26 states rather than 44. Implications are discussed in Chapter IV.

The NIS is distributed on a single DVD as fixed-width ASCII formatted data files compressed with WinZip®. It includes the following files: 1) inpatient core files (unit of observation is an inpatient stay record); 2) hospital weight files (weights and variance estimation data elements for calculating national estimates); 3) disease severity measures files (four sets of disease severity measures and 29 comorbidities); and 4) diagnosis and procedure groups files (facilitates use of ICD-9-CM diagnostic and procedure information). In order to load and analyze NIS data, a hard drive with 15 gigabytes of space was needed, as well as analysis software (i.e., SPSS). The PI installed all software components on a home computer.

Complementary data. Additional data and software were obtained to facilitate risk adjustment and to create patient safety indicator measures from a patient/discharge dataset.

Trauma Mortality Prediction Model. The TMPM-ICD9 is a statistical model that uses injury ICD-9 codes to create regression-based estimates of injury severity (Glance et

al., 2009). A probability of mortality measure is based on a patient's five worst injuries with risk adjustment for age, gender, mechanism of injury, and hospital fixed effects (Glance, et al., 2009). Within this model, ICD-9-CM codes are mapped to a severity measure to create MARC (Model Averaged Regression coefficient) values. A predicted probability of death is created from the five worst injuries, as well as a variable that indicates whether the first and second worst injuries were in the same body region. Among other available injury severity measures (Abbreviated Injury Scale [AIS]; International Classification of diseases ninth Edition Injury Severity Score [ICISS]), the TMPM-ICD9 demonstrated superior model performance (Glance, Osler, Mukamel, Meredith, & Dick, 2011; Glance, et al., 2009). The PI obtained the TMPM-ICD9 calculator and permission for use from the developers of the TMPM-ICD9 (Appendix J). The TMPM-ICD9 calculator (software) was used to create a probability of mortality for each patient in the patient/discharge-level dataset from model-averaged regression coefficients (MARC values) for the five worst injuries using the following statistical model (Glance, et al., 2009):

- $P(death) = Probit[C_0 + C_1*I_1 + C_2*I_2 + C_3*I_3 + C_4*I_4 + C_5*I_5 + C_6*S + C_7*I_1*I_2]$

  I_1 through I_5: MARC (Model Averaged Regression Coefficient) values ordered from greatest to fifth worst injury.

  S: indicator variable set equal to 0 if the worst two injuries occurred in different body regions and set to 1 if they occurred in the same body region.

  C_0 through C_7: TMPM coefficients (C_0 = -(2.217565); C_1 = 1.406958; C_2 = 1.409992; C_3 = 0.5205343; C_4 = 0.4150946; C_5 = 0.8883929; C_6 = -

0.0890527; C_7 = -0.7782696) (TMPM based on National Trauma Data Bank, 2002-2004, 2006).

The TMPM calculator is a set of electronic instructions that runs inside Microsoft Excel. Data (patient identifier numbers [1-25,544] and injury ICD9 codes (800-859.9) were exported to Excel and formatted according to TMPM program specifications with each ICD9 code on a separate row. Once formatted, the TMPM program loaded ICD-9 data and displayed each patient number on a separate line followed by five fields with the patient's worst five injuries expressed as ICD9 codes. From the injuries, the TMPM program then computed a "predicted mortality" as a percentage (probability of death based on the injuries) (0 to 1). TMPM scores for each patient (n=25,544) were exported back to SPSS for subsequent conversion to hospital-level TMPM measures.

Elixhauser Comorbidity Classification System. Elixhauser Comorbidity software (Elixhauser, Steiner, Harris, & Coffey, 1998) assigns a dichotomous score (0/1) to 29 comorbidities from ICD-9-CM codes. Using DRG screening, this method excludes: 1) the primary reason for hospitalization as reflected by the principal diagnosis; 2) the severity of the principal diagnosis; 3) complications that result from the process of care; and 4) unimportant comorbidities or conditions present on admission that have a trivial impact on outcome (Elixhauser, et al., 1998). The 29 comorbidities included in the HCUP software are listed in Table 3.2. Developers chose to retain separate (29) comorbidities, rather than a summary measure, because individual comorbidities are irrelevant for some diseases and are likely to influence outcomes of different diseases and treatments differently (Elixhauser, et al., 1998). This method also allows investigators to examine the impact of specific comorbidities on different outcome measures. The

calculated Elixhauser Comorbidities are included in the HCUP NIS Disease Severity file. Table 3.3 provides an example of the Elixhauser method for one comorbidity (congestive heart failure), identifier ICD-9-CM codes, and screeningV28 DRGs.

Table 3.2. Elixhauser Comorbidities (within HCUP NIS)

Congestive Heart Failure	Valvular Disease	Pulmonary Circulation disorders
Peripheral vascular disease	Hypertension	Paralysis
Other neurological disorders	Chronic pulmonary disease	Diabetes without chronic complications
Diabetes with chronic complications	Metastatic cancer	Renal failure
Liver disease	Rheumatoid arthritis/collagen vascular disease	HIV and AIDS
Lymphoma	Coagulation deficiency	Solid tumor without metastasis
Weight loss	Obesity	Blood loss anemia
Fluid and electrolyte disorders	Alcohol abuse	Deficiency anemias
Psychoses	Drug abuse	Depression

Table 3.3. Example of Elixhauser method

Comorbidity	ICD9 CM Diagnosis Code	V28 DRG
Congestive Heart Failure	398.91, 402.02, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0-428.9	Cardiac: 001-002, 242-251, 253-254, 258-262, 280-293, 296-298, 302-303, 306-313

For this study, twenty-nine comorbidities from the HCUP NIS disease severity measure file were merged with inpatient core file data using a 'KEY' synthetic record identifier, enabling assessment of comorbidities at both the patient- and hospital-level. Since the comorbidities comprised 29 study variables, a review of literature was conducted to identify a methodology for condensing the 29 measures into a smaller summary of disease burden for each hospital in the study sample.

van Walraven, Austin, Jennings et al. (2009) used regression analyses with patient data (spanning 12 years) to determine independent associations of Elixhauser comorbidity groups with in-patient mortality. From these associations, points were assigned to each comorbidity group that equaled its regression coefficient divided by the coefficient in the model with the smallest absolute value. The method translated estimates into point values that were relative to the 'weakest' variable. For example, a variable assigned a value of 2 was deemed twice as strong as a variable with a point value of 1, but only half as strong as a variable assigned a point value of 4. Values ranged from -7 (drug abuse) to 12 (metastatic cancer). Point-coded comorbidities were then summed to create a single Elixhauser comorbidity score (index). Within the derivation study (van Walraven, et al., 2009), scores ranged from -14 to +56 with a median score of 0 (IQR 0-8). Comorbidities and their associated point values are presented in Table 3.4.

Table 3.4. Elixhauser Comorbidity Groups and Their Associated Point (Van Walraven, et al., 2009).

Comorbidity Group	Points	Comorbidity Group	Points
Congestive heart failure	7	Lymphoma	9
Valvular disease	-1	Metastatic cancer	12
Pulmonary circulation disorders	4	Solid tumor without metastasis	4
Peripheral vascular disorders	2	Rheumatoid arthritis/collagen vascular disease	0
Hypertension	0	Coagulopathy	3
Paralysis	7	Obesity	-4
Neurodegenerative disorders	6	Weight loss	6
Chronic pulmonary disease	3	Fluid and electrolyte disorders	5
Diabetes, uncomplicated	0	Blood loss anemia	-2
Diabetes, complicated	0	Deficiency anemia	-2
Hypothyroidism	0	Alcohol Abuse	0
Renal failure	5	Drug abuse	-7
Liver disease	11	Psychosis	0
Peptic ulcer disease, no bleeding	0	Depression	-3
AIDS/HIVS	0		

Of note, van Walraven et al. compared the Elixhauser comorbidity index to the Charlson comorbidity score for discriminating between patients who died and did not die in the hospital. The Elixhauser comorbidity index (methodology) exceeded the Charlson score in discrimination and was thus chosen for use with this study.

Table 3.5 provides a summary of comorbidities among the patient sample (n = 25,544) in this study with over 69,000 comorbidities representing 104,651 comorbidity points. To create an Elixhauser comorbidity score within the sample at the hospital level, the point values for each individual cormorbidity were summed and divided by the total number of patients present in the patient sample for each hospital. For example, patients at hospital # 32 represented 50 comorbidity points among 31 patients, producing a comorbidity index of 1.61; while patients at hospital # 87 represented 2364 comorbidity points among 513 patients, for a comorbidity index of 4.61. The hospital-level comorbidity index provided a continuous variable for risk adjustment that reflected the non-injury-related disease burden for each hospital. Permission was obtained from the developer of the Elixhauser comorbidity index for use in this study (Appendix J).

Table 3.5. Summary of Comorbidities and Total Comorbidity Points within Total Patient Sample (N=25,544)

COMORBIDITY	Point value	Patients N (%)	Total Comorbidity Points
AIDS	0	8 (<1%)	0
Alcohol Abuse	0	773 (3%)	0
Deficiency Anemias	-2	5420 (21%)	-10,840
Rheumatoid Arthritis	0	947 (4%)	0
Chronic Blood Loss Anemia	-2	514 (2%)	-1028
Congestive Heart Failure	7	3606 (14%)	25,242
Chronic Pulmonary Disease	3	4735 (19%)	14,205
Coagulopathies	3	1086 (43%)	3258
Depression	-3	3009 (12%)	-9027
Diabetes (uncomplicated)	0	4980 (19%)	0
Diabetes (w/ chronic complications)	0	828 (3%)	0
Drug Abuse	0	86 (<1%)	0
Hypertension	0	17679 (69%)	0
Hypothyroidism	0	4585 (18%)	0
Liver Disease	11	276 (1%)	3036
Lymphoma	9	180 (<1 %)	1620
Fluid & Electrolyte Disorders	5	5684 (22%)	28,420
Metastatic Cancer	12	274 (1%)	3288
Neurological Disorders	6	3377 (13%)	20,262
Obesity	-4	963 (4%)	-3852
Paralysis	7	688 (3%)	4816
Peripheral Vascular Disease	2	1560 (6%)	3120
Psychoses	0	796 (3%)	0
Pulmonary Circulation Disorders	4	865 (3%)	3460
Renal Failure	5	2892 (11%)	14,460
Solid Tumors (without metastasis)	4	451 (2%)	1804
Peptic Ulcer Disease	0	10 (<1%)	0
Valvular Disease	-1	2237 (9%)	-2237
Weight Loss	6	774 (3%)	4644
TOTAL		69,283	104,651

AHRQ Patient Safety Indicators.

The AHRQ Patient Safety Indicator (PSI) software was obtained by the PI to create hospital-level outcome measures for this study: 1) decubitus ulcer; 2) selected infections due to medical care; 3) postoperative hemorrhage or hematoma; and

4) postoperative deep vein thrombosis or pulmonary embolus. The PSI software screens inpatient discharge data for problems that patients experience from exposure to the healthcare system (Agency for Healthcare Research and Quality (AHRQ), 2007a). Appendix C provides a summary of four indicators, including the definition, numerator, denominator, strength of evidence as an outcome measure, and risk adjustment variables from which the PSIs are derived (Agency for Healthcare Research and Quality (AHRQ), 2007a).

The AHRQ PSI development team evaluated the soundness of the PSIs through a systematic process that assessed six areas of evidence, including face validity, precision, minimum bias, construct validity, application, and opportunity for quality improvement (Agency for Healthcare Research and Quality (AHRQ), 2007a). Empirical examination included statistical testing from which three different estimates of hospital performance were calculated for each indicator:

1) Raw indicator rate- the number of adverse events in the numerator divided by the number of discharges in the population at risk by hospital;
2) Adjusted raw indicator rate- risk adjustment with age, gender, modified DRG, and comorbidities;
    - Adjacent DRG categories that were separated by the presence or absence of comorbidities or complications were collapsed to avoid adjusting for the complication being measured.
    - APR-DRG risk adjustment was not implemented.
    - The ICD-9-CM codes used to define comorbidity categories were modified to exclude conditions likely to represent potentially preventable complications.

- "Acute or chronic" comorbidities were captured so that patient with severe comorbidities would not be mislabeled as not having conditions of interest.

3) Multivariate signal extraction- Adjusted "smoothed" methods were applied to adjust for reliability by estimating the amount of "noise" (variation due to random error) relative to the amount of "signal" (systematic variation in hospital performance or reliability) for each indicator.

The PSI Software was downloaded free of charge from AHRQ as a WinQI version for a Microsoft Operating system. The software was designed to run as a single-use application. Instructions were provided on the AHRQ website for loading data and verifying formatting. AHRQ technical support was also utilized to obtain results from the patient level dataset for this study. Utilization of the PSI software produced results of individual cases of adverse events within hospitals, as well as provider-level PSI rates for the sample hospitals as a whole. A report on the four PSIs within 128 hospitals was produced from the PSI software in Microsoft Excel. For each hospital, the report included: 1) the number of PSI cases within the numerator, 2) the number of applicable cases in the denominator, 3) the observed PSI rate, 4) the expected rate (based on population estimates from the 2008 HCUP NIS), and 5) an observed/expected (O/E) ratio. Following use of the PSI software to identify cases of PSI #12 and to calculate PSI rates for the hospitals in this study, the PSI data were exported to SPSS. The number of cases for PSI #12 (postoperative deep vein thrombosis or pulmonary embolus) divided by the total number of discharges for each hospital in the study was used to create a PSI rate for each hospital. This measure was used as the dependent variable for Aim Three.

American Hospital Association (AHA) Survey (2009).

The 2009 AHA Survey Database was purchased by Vanderbilt University School of Nursing for use by students and faculty. The AHA Survey is completed online by most US hospitals and profiles a universe of over 5000 hospitals. The database contains over 1000 fields covering hospital structure, service line, staffing, expenses, physician organization structures, beds and utilization (American Hosptial Association (AHA), 2010). A smaller AHA dataset comprised of only the 128 study hospitals and 27 AHA study variables was created in SPSS and subsequently merged by a hospital identifier with HCUP NIS data.

Prior Study.

States and hospitals (including trauma centers) in which five prominent geriatric resource programs (GRPs) were located in December 2009 were identified by the PI from data obtained directly from each program or from GRP websites. The five GRPs included two acute care models: Nurses Improving Care to Health System Elders (NICHE), Hospitalized Elder Life Program (HELP); and three other prominent programs: Geriatric Education Centers (GEC), Association of Directors of Geriatric Academic Programs (ADGAP) and Donald W. Reynolds Foundation Centers. Trauma centers and trauma center levels were obtained from the American Trauma Society Trauma Information Exchange Program (ATS-TIEP). The prior study identified the presence and availability of GRPs within specific U.S. hospitals, as well as trauma center status, trauma center level, and verification mechanism (state or American College of Surgeons Committee on Trauma verification). The presence of an inclusive trauma system within states was also

identified. These data were manually incorporated into the proposed study database with subsequent checks for accuracy.

Population/Sample/Setting

Population.

The population for this study consisted of hospitals defined by the AHA as "non-federal, short term, acute care hospitals with facilities and services available to the public" (American Hosptial Association (AHA), 2010) that admitted patients age 65 and older with primary injury diagnoses. This included community hospitals, as well as academic medical centers. Federal and military hospitals were excluded.

Sample: Hospital level. The 2009 HCUP NIS is a nationally representative sample containing data from 1050 hospitals in 44 states. Variables from which stratification was conducted include geographic region (N, MW, W, S), control (public, voluntary, proprietary), location (urban, rural), teaching status (teaching, non-teaching), and bed size (small, medium, and large). Eighteen states were excluded from the study since identification of individual hospitals was not possible. One hundred and six hospitals that did not have patients meeting inclusion criteria were excluded. These factors limited the population of hospitals for this study. Among identifiable hospitals with at least 10 applicable patients, 128 hospitals from 24 states returned study surveys and comprised the hospital sample.

Sample: Patient (discharge) level. Eligible criteria for patients were: patients age 65 and older with a primary injury diagnosis (excluding 905-909 [late effects of injury],

930-939 [foreign body], and 958 [early complications of trauma]) were extracted from the 2009 HCUP NIS.

Data Collection Procedures

The overall purpose of this study was to examine administratively-mediated variables (AMVs), or alterable organizational factors within U.S. hospitals that might be associated with the occurrence of adverse events for HIOAs in acute care settings. Data collection procedures are presented by study aims.

Aim One. To determine the extent of adoption of targeted ACOVE indicators for hospitalized injured older adults (HIOAs) in acute care settings.

Survey of hospitals- survey development.

Data collection was achieved using a 17-item survey instrument (Appendix D) developed by the PI to collect pertinent variables (AMVs) that were not available in the 2009 AHA survey, including: 1) capital inputs (i.e., computer support features, and in-room supply features); 2) organizational facets (i.e., adoption of ACOVE indicators, geriatric assessment, family visitation features, Magnet recognition, and specialty units); and 3) labor inputs (i.e., access to select providers and services, RN quality measures [BSN, certification, experience], and staffing measures) (American Hosptial Association (AHA), 2010). The process for selection of variables was discussed in a previous section (pp. 18-19). Survey item development was based on consultation with other investigators (A. Minnick, L. Mion) who measured similar concepts/variables in prior studies, as well

as recommended methodologies (Dillman, Smyth, & Christian, 2008; Fink, 2009; Fowler, 2009; Lynn, 1986).

Following initial survey development, content validation was conducted, based on the content validity index (CVI) (Lynn, 1986; Polit & Beck, 2008). Eight chief nursing officers (CNOs) from community hospitals were selected to review the survey instrument as expert reviewers. A content validation tool was provided for CNOs to rate survey items for relevance and appropriateness. A 4-point relevance rating scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant) was used to evaluate each item. Since ACOVE indicators were an emphasized variable in the study, each indicator was evaluated separately for relevance. The PI met with each of the CNOs to explain the survey instrument and relevance rating tool. Six completed expert reviews were collected. Based on recommendations (Lynn, 1986), a CVI was computed for each survey item by summing the number of 3 or 4 ratings and dividing by the number of experts (6). Results ranges from .5 to 1.0 (.5 [2 items]; .83 [4 items]; 1.0 (21 items]). Items scored with a CVI of .5 were based on feelings that the item was misplaced under the wrong AMV sub-category (CI, OF, LI). The six reviewers rated *all* AMVs as relevant to the over-arching concept (administratively-mediated variables). Based on results from the expert review, no revisions to the survey instrument were made (see Appendix E).

Survey of hospitals-data collection.

The survey of hospitals was distributed to CNOs at 465 identifiable hospitals from 26 states in the 2009 HCUP NIS. Distribution was conducted by postal mailing. A postcard announcing the survey (Appendix F) was mailed first, followed by an initial

mailing of the survey and two subsequent mailings of the survey to non-respondents, each spaced 10 days apart. A cover letter (Appendix G) explained the purpose of the survey and provided directions for completion and return. Cover letters for follow-up survey mailings (Appendix H) to non-respondents reiterated the purpose of the survey and emphasized the potential advancement in knowledge for understanding outcomes in HIOAs. Protection of institutions and human subjects, as well as Institutional Review Board (IRB) approval was addressed in the letter. Postcards were mailed on August 29, 2011 and the final survey mailing occurred on September 29, 2011. One month (October 2011) was allowed for return of completed surveys. Data analysis began on November 1, 2011. Among the 128 returned surveys, 110 (86%) were received via postal mailing and 18 were completed via web-based REDCap (2011). Returned surveys reflected a response rate of 27.8% and was consistent with previously conducted similar studies (Edwards et al., 2009). As a follow-up note, four additional surveys were submitted after data analysis was begun, increasing the response rate to 28.8%. To convert survey results into study data, as completed surveys (via mail) were returned, the PI entered survey results into REDCap, noting the survey number assigned by REDCap. REDCap survey numbers were subsequently used to link survey data with other data sources in development of the completed study dataset.

Aim Two: To determine associations among administratively-mediated variables (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOAs.

Selection of AMVs for analysis.

Seventy-five AMVs from returned surveys (n=42), AHA data (n=27), and the prior study (n=4) were categorized according to AMV sub-categories. For each sub-category, items were examined for percent of missing variables. A strategy was defined for exclusion of variables: 1) variables with low variability (> 90% or < 10%, no variation in mean/median/IQR); 2) collinearity ≥ .80 among variables; 3) variables with less than 10 cases of 'presence'; and 4) variables with > 15% of missing cases (> 19 hospitals). Using these criteria, 23 variables were excluded. Among the remaining 52 variables, missing data values were examined and reported in Tables 4.14 – 4.16. Among dichotomous variables (present or not present), missing data were assumed 'not present' in the hospital and coded as "0". This conservative approach was based on an assumption that if a hospital failed to answer the AHA survey question, it did so because it did not provide the service. Missing data among continuous variables were treated as missing data because no assumptions could be made and the data values were not available. Multiple imputation was not conducted. A detailed descriptive summary of each AMV is presented in Chapter IV, including excluded variables and missing data.

Development of organizational-level patient characteristics.

Distributions of patient characteristics (age, TMPM scores, gender, and comorbidities, hip fractures, HIOAs among total discharges) within the patient-level data were examined. Based on the distributions, the following measures were chosen for use as hospital-level patient characteristic variables: 1) mean age, 2) percent female patients, 3) median TMPM-ICD9 scores, 4) mean comorbidity index, 5) percent hip fractures

(ICD9: 820) among all HIOAs, and 6) percent HIOAs (among all discharges). A profile of hospital-level patient characteristics is provided in Table 3.6. From patient-level data, a mean age was calculated for each hospital, resulting in an overall mean of 82 (SD 2.2) years. The mean percentage of female patients within hospitals was 72 (SD 7.4) percent. An injury severity (TMPM ICD-9) index for each hospital reflected the sum of all TMPM scores divided by the number of HIOAs at each hospital. The median TMPM index was .013 (IQR .012-.015) reflecting overall low probabilities of mortality based on injury severity alone. As previously discussed, a comorbidity index was calculated for each hospital. The mean comorbidity index was 3.9 (SD 1.18). Finally, the percentage of patients with hip fractures (ICD9: 820) as a primary diagnosis was assessed for each hospital. The mean percentage was .36 (SD .16).

Table 3.6. Profile of Hospital-Level Patient Characteristics (N=128).

Characteristic	M (SD)	Median	IQR	Min/Max
AGE (Mean) [a]	81.9 (2.16)	81.8	80.8-83.0	74.8-88.4
PERCENT FEMALE [b]	71.8 (7.4)	72.5	68.2-76.6	40-90
INJURY SEVERITY (Median TMPM-ICD9) [c]	.013 (.003)	.013	.012-.015	.005-.02
COMORBIDITIES (Index) [d]	3.90 (1.18)	3.89	3.19-4.72	.13-7.19
PERCENT HIOAs [e]	.024 (.013)	.022	.017-.027	.001-.104
PERCENT HIP FRACTURE DIAGNOSIS [f]	.36 (.16)	.39	.28-.47	.00-.77

[a] Summary of hospital means; [b] Summary of hospital percent female; [c] Summary of hospital median injuryseverity(Trauma Mortality Prediction Model [TMPM- probability of mortality based on injury ICD9 codes]) scores; [d] Summary of hospital comorbidity indices (based on Elixhauser comorbidity point system [Walraven et al., 2009]); [e] Total number of HIOAs/Total hospital discharges; [f] Summary of hospital percentage of patients with primary diagnosis ICD9: 820.0-820.9.

Development of an ACOVE Indicator Index.

To summarize and condense the nine individual ACOVE indicator adoption variables into one variable, ACOVE indicator variables were extracted from the returned CNO surveys (N=128) and a new variable (ACOVE Index) was created. Levels of adoption for each ACOVE indicator ranged from 0 (no activity) to 5 (full implementation throughout hospital). A sum of the extent of implementation (0-5) for each indicator (n = 9) was totaled to create a new continuous-level variable for use as an outcome variable for Aim Two and as an independent variable for Aim Three. Each indicator ranged from 0 to 5, thus the ACOVE index reflected nine indicators and a theoretical range of 0 to 45.

Aim Three: To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indicators (adverse events) for HIOAs.

Patient Safety Indicators

Utilizing AHRQ PSI software applied to HCUP data for the patient-level sample, PSI rates from the patient-level data were calculated. Among patient discharges that met inclusion criteria for PSI calculations (n=25,513), three PSI reports (PSI #3-pressure ulcers, PSI #7-central line infections, PSI #9- post-operative hemorrhage/hematoma) identified less than 10 cases from the patient level data. One PSI report (PSI #12-postoperative deep vein thrombosis or pulmonary embolus) revealed 134 cases among the patient-level sample for an overall provider rate of .01which was greater than the reference population-estimated rate (0.005). The difference in the sample rate (.01) and

the reference population rate (.005) indicated that the sample case mix was more severe than the reference population.

Table 3.7 displays each of the PSIs, the number of cases within the numerators and denominators, the PSI rate, and the population-estimated rate associated with each PSI.

Table 3.7. Patient Safety Indicators: Cases and Rates within Patient-level Study Sample.

PSI	Numerator (identified cases)	Denominator	Rate	Population Rate
#3 Pressure Ulcer	9	8878	0.001	0.005
#7 Central Line Associated Infections	5	18,109	0.0003	0.0007
#9 Post-operative hemorrhage or hematoma	3	13,641	0.0002	0.0005
#12 Post-operative DVT or pulmonary embolus	134	13,487	0.01	0.005

Based on the PSI reports obtained from the patient-level sample, three PSIs (pressure ulcers, central line infections, and postoperative hemorrhage) were excluded from the study dataset for use as an outcome (dependent) variable. The retained PSI (#12 postoperative deep vein thrombosis or pulmonary embolus) report revealed 134 cases among 112 hospitals. A PSI rate (outcome variable) was created for each hospital by dividing the number of cases for each hospital by the total number of discharges for each hospital.

Dataset Construction

A hospital-level study dataset comprised of demographic and descriptive variables, AMVs, patient characteristic summary variables, and outcome variables (ACOVE Index, hospital rates for PSI #12) was constructed for the data analysis phase of the study. Appendix I provides an overview of the dataset construction as it was built in SPSS. Variable categories, variables, and level of measurement are included.

Data Management and Quality Control

Missing values within the study dataset were examined. For patient-level data, missing values resulted in exclusion of 31 cases from the PSI software analysis. For hospital-level data, 23 variables were excluded from analysis secondary to low variability and missing data. All 128 hospitals were included in the data analysis.

Surveys of CNOs were returned by mail to the PI's home or completed through REDCap. As the PI received completed surveys, each was entered into REDCap and stored in a lock file cabinet in the PIs home office. REDCap is an encrypted web-based application designed exclusively to support research studies with data management reports, data integrity reports for data cleaning and evaluation, and tracking reports for longitudinal studies (Harris, et al., 2009). The study dataset for data analysis was built in SPSS 19.0. De-identified aggregate hospital data were (and continue to be) maintained offsite on the PI's personal computer.

Data Analysis Strategy

Data Cleaning Procedures.

After the study dataset was constructed, and prior to data analysis, each variable in the dataset was examined separately. Frequencies were checked to identify invalid numerical values and missing data. Few invalid numerical values were found. If the intended response could be determined from the invalid value, the value was changed to an appropriate value. For example, from the CNO survey data (item #12) that asked the number of hours per week that visitors were allowed in the ICU, one response was "24/7." This response was converted to "168" reflecting 168 hours per week. If the intended response for invalid values could not be determined, the value was deleted and treated as a missing value. Dichotomous variables with missing data were assumed to not be present and thus coded as "0". Missing data among continuous variables were treated as missing data.

Descriptive Statistics.

Descriptive statistics (frequencies, measures of central sample was compared with the larger nationally-representative sample (2009 HCUP tendency and variability) were generated for all hospital and patient-level variables. The study sample was compared with the larger nationally-representative sample (2009 HCUP NIS) for representativeness.

Aim One: Descriptive statistics (frequencies, percentages) were generated for nine ACOVE indicators. Descriptive statistics were then generated for each individual

indicator by hospital characteristics (U. S. region, bed size, location, ownership, teaching status, trauma center status, and presence of a geriatric acute care model).

To examine possible differences in individual indicators among key hospital characteristics a new variable was constructed for each indicator: (0) 'not implemented' ('no activity' or 'under development'), and (1) 'partial to complete implementation' (from 'implemented partially on some units' to 'implemented fully throughout hospital'). Subsequently, chi-square tests of independence were conducted to test differences in ACOVE indicator adoption between and among hospital characteristics.

Aim Two: Descriptive statistics (frequencies, percentages, measures of central tendency and variability) were generated for AMVs, patient characteristics, and an ACOVE Indicator Index. Spearman correlations between patient characteristics and AMVs were conducted to assess patient level associations with AMVs.

Prior to conducting correlational statistics, distributions of variables were examined. Thirteen variables from the survey of CNOs were ordinal level (not available [0], available to select adult nursing units [1], available to all adult nursing units [2]). Among the thirteen variables, nine variables (medication compatibility alerts, retrieval of nursing home data, checklist for VAP, decision support for pressure ulcer risk assessment, psychiatric nurse liaison, psychiatric consultation, gero-psychiatric consultation, geriatricians, geriatric advanced practice nurses) had less than 10 cases in the 'available to select nursing units' category and a preponderance of cases in the 'available to all nursing units' category, thus, these nine variables were converted to dichotomous variables (not available [0], available to adult nursing units [1]). Upon examination of continuous level variables, six of eight (percent nurse certification,

percent other ICU, percent LPNs med/surg, percent other med/surg, percent RN turnover, percent RN workforce ≥ 5 years experience) were skewed. The values for these six variables were rank transformed, thus achieving normal distribution for use in Pearson (Aims 2 and) and linear regression analyses (Aim Three).

Three sets of correlational statistics were generated between: 1) patient characteristics and AMVs, 2) patient characteristics with an ACOVE Index, and 3) AMVs with an ACOVE Index. The three correlational sets address relationships in the Minnick & Roberts Outcomes Model. Examination of associations of patient characteristics (consumer types) with AMVs can identify hospitals having or lacking specific resources deemed important (in the literature) for hospitalized older adults. Those associations, as well as associations of patient characteristics with an ACOVE Index, address the premise that variations in patient characteristics may call for system designs that are customized to different types of consumers (Minnick, et al., 1997; Young, et al., 1996). Associations between AMVs and an ACOVE Index place particular emphasis on the key concept of the model, ***administratively-mediated variables***, which recognizes that AMVs can be altered or shaped by the decisions of leaders within organizations, and that resource clusters (e.g., groups of AMVs, groups of quality indicators) must be present to achieve better outcomes.

Due to the limited sample size, bivariate correlational statistics were used for addressing the questions of Aim Two. Considering the high number of AMVs (n=52) in the study, to reduce the likelihood of Type I errors, a critical alpha level of .01 was used for determination of statistically significant associations.

Aim Three: Descriptive analyses were generated for the dependent variable (PSI #12: Rate of postoperative deep vein thrombosis or pulmonary embolus). The dependent variable was extremely (positive) skewed, thus those data values were rank transformed resulting in a normal distribution. Pearson correlations between independent variables (patient characteristics, AMVs) and the dependent variable (rate of PSI #12) were conducted to determine associations. A critical alpha level of .01 was established for determination of statistically significant associations. In the final analysis for Aim Three, a multivariate hierarchical regression model was used to test the contributions of variables within four hypothesized levels of influence (patient characteristics, general hospital factors, trauma centers, and geriatric-specific factors).

Summary

The preceding sections have provided a detailed description of the data sources, study sample, data collections procedures, data management, dataset construction, and analytic strategies used for this study. Chapter IV presents results from the data analysis and Chapter V concludes with a discussion about the study finding, implications, strengths and limitations, and recommendations for future research.

CHAPTER IV

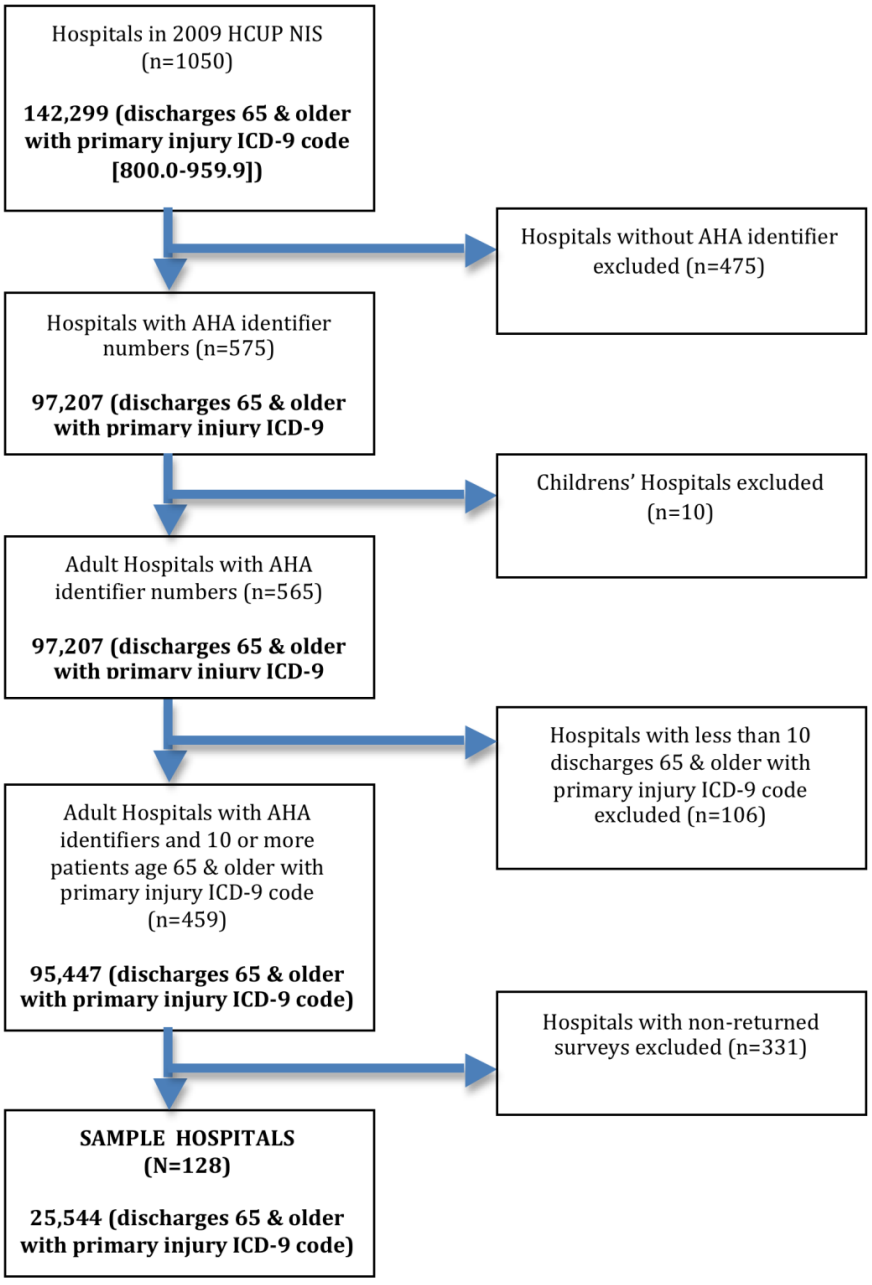
RESULTS

This chapter provides the results of a study examining administratively-mediated variables, including targeted ACOVE indicators, at 128 hospitals. The chapter begins with a profile of sample participants at the hospital and discharge level. Each study aim is addressed separately with a discussion of the statistical analysis and results obtained. The chapter concludes with an overall summary of the research findings.

Participant Profile

Hospital and patient selection followed a defined process (Figure 4.1). First, from the 2009 HCUP NIS Inpatient Core Files and Hospital Weight Files, hospitals with an AHA identifier were isolated (n=575) and those without an identifier were excluded from the study (n=475). Next, from hospitals with an AHA identifier, children's hospitals were excluded (n=10). From the remaining 565 hospitals, the patient/discharge-level data were examined for the presence and number of patients 65 and older with a primary injury diagnosis (ICD9 800.0 – 959.9 [excluding 905-909 [late effect of injuries]; 930-939 [foreign bodies]; 958-959 [complications]). Hospitals with 10 or more applicable patients were included in the study (n=459) and those with less than 10 applicable patients were excluded (n=106). Finally, among hospitals with 10 or more patients, those that returned a study survey were included in the final study sample (n=128). Discharge-level data from the 128 sample hospitals included 25,544 patient discharges that met inclusion criteria.

Figure 4.1. Process of Hospital and Patient (Discharges) Selection for Dissertation Study



HIOA: Age 65 or older with a primary injury diagnosis- ICD-9 code: 800.0-959.9 (excluding 905-909 [late effect of injuries]; 930-939 [foreign bodies]; 958-959 [complications])

Descriptive statistics were generated for hospital- and patient/discharge- level variables to summarize hospital and patient characteristics of the samples (Tables 4.1 & 4.2) and to compare the study sample with a nationally-representative sample (2009 HCUP NIS).

Sample Hospitals and Patients by Hospital Characteristics

Table 4.1 provides a description of hospitals and discharges by hospital characteristics. Among the four geographic regions, hospitals were over-represented in the Northeast (30%) and under-represented in the South (18%). Within patient level data, the Northeast was over-represented (37%), with under-representation in the Midwest (18%). The sample of hospitals was examined by hospital bed size with modifications based on the AHA bed size classification system. The AHA bed sizes 1 through 3 (1= 6 to 24 beds; 2=25 to 49 beds; 3=50 to 99 beds) were collapsed with a single digit 1 (1 to 99 beds) for this study to represent small hospitals. The remaining codes (2 through 6) matched AHA codes (2= 100-199; 3=200-299; 4= 300-399; 5= 400-499; 6= 500+). Among sample hospitals (n=128), 50 (39%) had a bed capacity of less than 100. Forty-nine hospitals (38%) had bed capacities of 100 to 299, and twenty-nine hospitals (23%) had bed capacities greater than 300, including 10 hospitals (8%) with 500 or more beds. Patient characteristics for bed sizes and ownership status by AHA categories could not be determined within the HCUP categorizations. Eighty-seven hospitals (68%) were located in urban settings with 92% of the patients in an urban setting. The majority of hospitals had a private, not-for-profit ownership status.

Table 4.1. Descriptive Statistics of Sample Hospitals and their Patients of Injured Older Adults Age 65and Older (N = 128)

Hospital Characteristic	SAMPLE	
	HOSPITALS (N=128) N (%)	PATIENTS (N=25,544) N (%)
Hospital Region		
Northeast	38 (30%)	9534 (37%)
Midwest	36 (28%)	4631 (18%)
South	23 (18%)	5720 (22%)
West	31 (24%)	5659 (22%)
Hospital Bedsize (AHA Categories)		
1-99	50 (39%)	-
100-199	23 (18%)	-
200-299	26 (20%)	-
300-399	13 (10%)	-
400-499	6 (5%)	-
500+	10 (8%)	-
Hospital Location		
Rural	41 (32%)	2132 (8%)
Urban	87 (68%)	23,412 (92%)
Hospital Ownership		
Government- Non-federal	23 (18%)	-
Private- Not-for-profit	95 (74%)	-
Private- Investor-owned	10 (8%)	-
Teaching Status (COTH)		
Non-teaching	95 (74%)	13,755 (54%)
Teaching	33 (26%)	11,789 (46%)
Trauma Center Status		
Non-Trauma Center	73 (57%)	10,997 (43%)
Level I	9 (7%)	4126 (16%)
Level II	16 (13%)	6572 (26%)
Level III or IV	30 (23%)	3849 (15%)
Geriatric Acute Care Model (NICHE or HELP)		
Absent	116 (91%)	19,875 (78%)
Present	12 (9%)	5669 (22%)

HIOA: Hospitalized Injured Older Adult; AHA: American Hospital Association; HCUP: Healthcare Cost &Utilization Project; COTH: Council of Teaching Hospitals; NICHE: Nurses Improving Care for Hospitalized Elders; HELP: Hospitalized Elder Life Program

Based on teaching status, 95 (74%) hospitals were non-teaching hospitals. Fifty-four percent of patients were in non-teaching hospitals. Among trauma centers and non-trauma centers, 73 (57%) of hospitals were non-trauma centers and 55 were trauma centers (Level 1= 9 [7%]; Level II= 16 [13%]; Level III or IV = 30 [23%]). Among patients, 43% were from non-trauma centers and 57% were in trauma centers (Level I =

16%; Level II = 26%; Level III or IV = 15%). Finally, the sample was examined for the presence of a geriatric-specific acute care model (NICHE and/or HELP). Twelve hospitals (9%) had a geriatric acute care model in place and 5669 patients (22%) were from the 12 hospitals.

Qualitative Comparison of HIOA Patients with the 2009 HCUP

To determine the extent to which the patient sample matched a nationally-representative sample of HIOAs in acute care hospitals, the sample was compared to patients (HIOAs) in the 2009 HCUP NIS (Table 4.2). The patient sample (n = 25,544) was compared to patients meeting the same inclusion criteria in the larger 2009 HCUP NIS (n = 142,299) by hospital characteristics (region, HCUP bed size categories, and teaching status), and by patient characteristics (gender, mechanism of injury, and types of primary injuries).

Hospital characteristics.

By geographic region, the patient sample was over-represented in the Northeast (37%) and under-represented in the South (22%). By HCUP bed size categories (small, medium, large), distribution of the patient sample matched the larger HCUP NIS sample with 5% or less difference in each category. Patients from teaching hospitals were also similar to the HCUP NIS with 45% in the discharge sample and 41% in the HCUP NIS.

Table 4.2. Profile of HIOA patients in the HCUP NIS with HIOA patients in sample hospitals

Hospital Characteristics	HIOA Discharges [a] 2009 HCUP NIS (N=142,299)	HIOA Discharges [a] Sample (N=25,544)
Hospital Region		
Northeast	28,765 (20%)	9534 (37%)
Midwest	32,194 (23%)	4631 (18%)
South	54,141 (38%)	5720 (22%)
West	27,199 (19%)	5659 (22%)
Bedsize		
Small	16,834 (12%)	2803 (11%)
Medium	34,790 (24%)	7067 (28%)
Large	90,675 (64%)	15,674 (61%)
Teaching Status		
Hospitals (COTH)	57,652 (41%)	11,789 (45%)
Discharge Characteristics		
Gender (female)	98,755 (69%)	17,847 (70%)
Mechanism of Injury		
Falls	107,293 (75%)	19,876 (78%)
Motor vehicle (traffic)	6,119 (4%)	2607 (5%)
Other	17587 (12%)	3007 (12%)
Missing	11,147 (8%)	1357 (5%)
Type of Primary Injury		
Fracture of neck of femur (hip)	53,063 (37%)	9,240 (36%)
Lower extremity fracture	16,029 (11%)	2,930 (11%)
Upper extremity fracture	12,734 (9%)	2,328 (9%)
Other fractures	25,609 (18%)	4,622 (18%)
Intracranial injuries	16,120 (11%)	2,969 (12%)
Superficial injuries	5203 (4%)	1019 (4%)
Crushing/Internal injuries	3681 (3%)	644 (3%)
Open wounds	2782 (2%)	547 (2%)
Sprains and strains	2771 (2%)	489 (2%)
Skull fractures	1855 (1%)	341 (1%)
Burns	777 (0.5%)	118 (0.5%)
Spinal cord injuries	742 (0.5%)	1660 (0.5%)

HIOA: Hospitalized Injured Older Adults; [a] Patients 65 and older with primary ICD-9 diagnosis 800.0-959 (excluding 905-909 [late effect of injuries]; 930-939 [foreign bodies]; 958-959 [complications])

Discharge characteristics.

An examination of the patient/discharge sample by patient characteristics revealed similar distributions to the larger HCUP NIS in all categories. Sixty-nine percent of the discharges in both samples were female. Falls comprised the largest mechanism of injury in both samples with 78% in the discharge study sample and 75% in the HCUP NIS.

Types of injuries were also similar with femur neck fractures (ICD-9: 820.0) comprising 36% of the study sample and 37% of the HCUP NIS, and other lower extremity fractures (ICD-9: 821-829) comprising 11% in both samples. Upper extremity fractures (ICD-9: 810-819) comprised 9% of both samples and 'other' fractures (ICD-9: 805-809) accounted for 18% of both samples. Intracranial injuries (ICD-9: 850-854) comprised 11% of both samples. Less frequent injuries listed as a primary diagnosis also matched in both sets, including superficial injuries (4%), crushing/internal injuries (3%), open wounds (2%), sprains and strains (2%), skull fractures (1%), burns (0.5%), and spinal cord injuries (0.5%).

Aim One

Aim One: To determine the extent of adoption of targeted ACOVE indicators for hospitalized injured older adults in acute care settings. The variables collected to meet this aim were obtained from a survey of hospitals sent to chief nursing officers. Respondents could choose one of six levels of adoption that ranged from 'no activity' to 'implemented fully throughout the hospital.' This section presents the extent of adoption of all indicators followed by extent of adoption by hospital characteristics for each individual indicator.

Descriptive Summary of Overall Indicator Adoption.

Table 4.3 provides a summary of adoption of the nine indicators among the sample hospitals (n=128). Indicators that had no activity in hospitals ranged from a low of 7% (assessment for level of independence and need for home health on discharge) to 63% (surgical patients screened for delirium for 3 days postop). The degree of full implementation of an indicator throughout the hospital ranged from 11% (multidimensional assessment of cognition) to 72% of the hospitals (assessment for level of independence and need for home health on discharge).

Table 4.3. Summary of Adoption of Nine Targeted ACOVE Quality Indicators (N=128)

ACOVE INDICATOR	No activity	Under development	Implemented partially on some units	Implemented fully on some units	Implemented partially throughout hospital	Implemented fully throughout hospital
1) Multidimensional assessment of cognition (n=126)	52 (41%)	15 (12%)	17 (14%)	14 (11%)	14 (11%)	14 (11%)
2) Assessment for functional status (n=127)	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)
3) Documented assessment for etiology of delirium (n=123)	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)
4) Documented plan to mobilize within 48 hours of admission (n=126)	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)
5) Documented screening for risk factors of delirium on surgical patients (n=125)	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)
6) Ambulatory surgical patients are ambulated by postop day 2 (n=126)	17 (14%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)
7)Surgical patients screened for delirium for 3 days postop (n=123)	78 (63%)	16 (13%)	7 (6%)	1 (1%)	4 (3%)	17 (14%)
8)Surgical patients assessed at discharge for cognitive and functional status with comparison to preop levels (n=124)	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	26 (21%)
9) Assessment for level of independence and need for home health on discharge (n=127)	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)

ACOVE: Assessing Care of Vulnerable Elders

Indicators focused on processes aimed at functional ability tended to have higher percentages of full implementation than indicators related to cognition. For example, indicators 2, 4, 6, & 9 (related to functional ability) ranged from 24% to 72% while indicators 1, 3, 5, 7, & 8 (related to cognition) ranged from 11% to 21%. Three of the indicators had 'no activity' in over 50% of hospitals: documentation of screening for risk factors of delirium on surgical patients (63%); surgical patients screened for delirium for three days postop (63%); and surgical patients assessed at discharge for cognitive and

functional status with comparisons to preoperative levels (57%). The indicator most likely to have no adoption was 'surgical patients are screened for delirium three days postoperatively' (74% with no activity or under development). The indicator with the highest level of adoption was 'assessment for level of independence and need for home health on discharge' (91% with partial to full implementation).

Post-Hoc Analyses of Hospital Characteristics with Degree of Implementation by ACOVE Indicators

ACOVE Indicator 1: Multidimensional assessment of cognition.

Table 4.4 presents a summary of this indicator by hospital characteristics, including geographic region, bed size, teaching status, trauma center status, and presence of a geriatric acute care model. The table divides (bolded lines) the level of adoption by varying levels of 'not implemented' and varying levels of 'partial to complete implementation.' The last (shaded) column represents the number and percent of hospitals in any degree of implementation.

One hundred and twenty-six of 128 hospital respondents answered this survey question. Partial to complete implementation of this indicator by hospital characteristics ranged from 33% (hospitals in the Midwest, level III or IV trauma centers; and hospitals with geriatric acute care models) to 71% (i.e., level I trauma centers). Statistically significant differences were observed for trauma center status with level I trauma centers having the highest percentage of implementation (71%, Pearson Chi-Square: 11.51 (df 3,

$_{125)}$, p=.009) compared to the lowest (19% for level II trauma centers). No statistically significant differences in rates were found among the other characteristics.

Table 4.4. ACOVE Indicator 1: Adoption of Multi-Dimensional Assessment of Cognition by Hospital Characteristics (n=126)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=37)	9 (24%)	4 (11%)	8 (22%)	4 (11%)	5 (13%)	7 (19%)	24 (65%)
Midwest (n=36)	19 (53%)	5 (14%)	3 (8%)	1 (3%)	5 (14%)	3 (8%)	12 (33%)
South (n=23)	7 (30%)	6 (26%)	3 (13%)	5 (22%)	2 (9%)	0 (0%)	10 (44%)
West (n=30)	17 (57%)	0 (0%)	3 (10%)	4 (13%)	2 (7%)	4 (13%)	13 (43%)
TOTAL	52 (41%)	15 (12%)	17 (13%)	14 (11%)	14 (11%)	14 (11%)	59 (47%)
Hospital Bedsize [b]							
1-99 (n=50)	19 (38%)	4 (8%)	6 (12%)	4 (8%)	11 (22%)	6 (12%)	27 (54%)
100-199 (n=23)	13 (51%)	2 (9%)	4 (18%)	3 (13%)	1 (4%)	0 (0%)	8 (35%)
200-299 (n=25)	13 (52%)	3 (12%)	3 (12%)	4 (15%)	0 (0%)	4 (15%)	11 (42%)
300-399 (n=12)	5 (50%)	1 (8%)	2 (17%)	0 (0%)	1 (8%)	2 (17%)	5 (50%)
400-499 (n=6)	2 (33%)	1 (17%)	0 (0%)	2 (33%)	0 (0%)	1 (17%)	3 (42%)
500+ (n=10)	0 (0%)	4 (44%)	2 (22%)	1 (11%)	1 (11%)	1 (11%)	5 (56%)
TOTAL	52 (41%)	15 (12%)	17 (13%)	14 (11%)	14 (11%)	14 (11%)	59 (47%)
Teaching Status (COTH) [c]							
Non-teaching (n=95)	41 (43%)	10 (11%)	11 (12%)	10 (10%)	14 (15%)	9 (9%)	44 (46%)
Teaching (n=31)	11 (35%)	5 (16%)	6 (19%)	4 (13%)	0 (0%)	5 (16%)	15 (48%)
TOTAL	52 (41%)	15 (12%)	17 (13%)	14 (11%)	14 (11%)	14 (11%)	59 (47%)
Trauma Center Status [d]							
Non-trauma center (n=73)	26 (36%)	6 (8%)	12 (16%)	8 (11%)	10 (14%)	11 (15%)	41 (56%)
Level I TC (n=8)	1 (14%)	1 (14%)	2 (29%)	1 (14%)	0 (0%)	2 (29%)	5 (71%)
Level II TC (n=15)	7 (44%)	6 (38%)	2 (13%)	1 (6%)	0 (0%)	0 (0%)	3 (19%)
Level III or IV TC (n=30)	18 60%)	2 (7%)	1 (3%)	4 (13%)	4 (13%)	1 (3%)	10 (33%)
TOTAL	52 (41%)	15 (12%)	17 (13%)	14 (11%)	14 (11%)	14 (11%)	59 (47%)
Geriatric Acute Care Model [e]							
Absent (n=113)	50 (44%)	9 (8%)	17 (15%)	14 (12%)	14 (12%)	10 (9%)	55 (48%)
Present (n=13)	2 (17%)	6 (50%)	0 (0%)	0 (0%)	0 (0%)	4 (33%)	4 (33%)
TOTAL	52 (41%)	15 (12%)	17 (13%)	14 (11%)	14 (11%)	14 (11%)	59 (47%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: 7.72 $_{(df 3, 125)}$, p= .052; [b] Pearson Chi-Square: 3.01 $_{(df 5, 125)}$, p=.698; [c] Pearson Chi-Square = 0.04 $_{(df 1, 125)}$, p= .841; [d] Pearson Chi-Square: 11.52 $_{(df 3, 125)}$, p=.009; [e] Pearson Chi-Square = 0.97 $_{(df 1, 125)}$, p=.250

ACOVE Indicator 2: Assessment for functional status.

Table 4.5 presents the summary of this indicator by hospital characteristics. One hundred and twenty-seven of 128 hospital respondents answered this survey question. Partial to complete implementation of this indicator ranged from 67% (Midwest region; 400-499 bed size) to 97% (Northeast region). A statistically significant difference among geographic regions was observed with the northeast region having the highest percentage of partial to complete implementation (97%; Pearson Chi-Square: 13.213 $_{(df\ 3,\ 126)}$, p=.004) compared to the lowest (67%) in the Midwest. No statistically significant differences were found for other hospital characteristics. Of note, hospitals most likely to have *full* implementation throughout the hospital (column 6) of the indicator throughout the hospital were those in the Northeast (71%), hospitals with a geriatric acute care model (75%), and level I trauma centers (75%).

Table 4.5. ACOVE Indicator 2: Adoption of Assessment for Functional Status by Hospital Characteristic (n= 127)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	1 (3%)	0 (0%)	6 (16%)	4 (10%)	0 (0%)	27 (71%)	37 (97%)
Midwest (n=36)	9 (25%)	3 (8%)	0 (0%)	4 (11%)	4 (11%)	16 (45%)	24 (67%)
South (n=23)	5 (22%)	1 (4%)	1 (4%)	3 (13%)	2 (9%)	11 (48%)	17 (74%)
West (n=30)	4 (13%)	0 (0%)	2 (7%)	3 (10%)	5 (17%)	16 (53%)	26 (87%)
TOTAL	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)	104 (82%)
Hospital Bedsize [b]							
1-99 (n=50)	4 (8%)	1 (2%)	2 (4%)	3 (6%)	8 (16%)	32 (64%)	45 (90%)
100-199 (n=23)	5 (22%)	2 (8%)	3 (13%)	3 (13%)	1 (4%)	9 (39%)	16 (70%)
200-299 (n=25)	5 (19%)	0 (0%)	2 (8%)	5 (19%)	0 (0%)	14 (54%)	21 (81%)
300-399 (n=12)	3 (25%)	0 (0%)	1 (8%)	1 (8%)	0 (0%)	7 (58%)	9 (75%)
400-499 (n=6)	1 (17%)	1 (17%)	0 (0%)	1 (17%)	1 (17%)	2 (33%)	4 (67%)
500+ (n=11)	1 (10%)	0 (0%)	1 (10%)	1 (10%)	1 (10%)	6 (60%)	9 (90%)
TOTAL	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)	104 (82%)
Teaching Status (COTH) [c]							
Non-teaching (n=95)	13 (14%)	3 (3%)	7 (7%)	11 (12%)	11 (12%)	50 (53%)	79 (83%)
Teaching (n=32)	6 (19%)	1 (3%)	2 (6%)	3 (9%)	0 (0%)	20 (63%)	25 (78%)
TOTAL	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)	104 (82%)
Trauma Center Status [d]							
Non-trauma center (n=73)	9 (12%)	2 (3%)	6 (8%)	7 (10%)	6 (8%)	43 (59%)	62 (85%)
Level I TC (n=9)	1 (13%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)	6 (75%)	7 (88%)
Level II TC (n=15)	4 (25%)	1 (6%)	0 (0%)	2 (13%)	0 (0%)	9 (56%)	11 (69%)
Level III or IV TC (n=30)	5 (17%)	1 (3%)	2 (7%)	5 (17%)	5 (17%)	12 (40%)	24 (80%)
TOTAL	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)	104 (82%)
Geriatric Acute Care Model [e]							
Absent (n=114)	18 (16%)	3 (3%)	9 (8%)	13 (11%)	11 (10%)	61 (53%)	94 (82%)
Present (n=13)	1 (8%)	1 (8%)	0 (0%)	1 (8%)	0 (0%)	9 (75%)	10 (83%)
TOTAL	19 (15%)	4 (3%)	9 (7%)	14 (11%)	11 (9%)	70 (55%)	104 (82%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: 13.21 $_{(df3, 126)}$, p= .004; [b] Pearson Chi-Square: 6.36 $_{(df5, 126)}$, p=.273; [c] Pearson Chi-Square = 0.41 $_{(df1, 126)}$, p= .345; [d] Pearson Chi-Square: 2.56 $_{(df3, 126)}$, p=.471; [e] Pearson Chi-Square = 0.02 $_{(df1, 126)}$, p= .626

ACOVE Indicator 3: Documented assessment for etiology of delirium.

Table 4.6 summarizes this indicator by hospital characteristics. One hundred and twenty-three of 128 hospital respondents answered this survey question. No statistically significant differences between implementation groups were found for any hospital characteristic. Partial to complete implementation was present in over 50% of the hospital characteristics with one exception (level II trauma centers [36%]).

Table 4.6. ACOVE Indicator 3: Adoption of Documented Assessment for Etiology of Delirium by Hospital Characteristics (n= 123)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=37)	7 (19%)	2 (5%)	9 (24%)	1 (3%)	3 (8%)	15 (41%)	28 (76%)
Midwest (n=35)	8 (23%)	9 (26%)	4 (11%)	4 (11%)	3 (9%)	7 (20%)	18 (51%)
South (n=22)	7 (32%)	4 (18%)	3 (14%)	2 (9%)	4 (18%)	2 (9%)	11 (50%)
West (n=29)	7 (24%)	3 (10%)	3 (10%)	6 (21%)	4 (14%)	6 (21%)	19 (66%)
TOTAL	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)	76 (62%)
Hospital Bedsize [b]							
1-99 (n=50)	12 (24%)	7 (14%)	5 (10%)	6 (12%)	9 (18%)	11 (22%)	31 (62%)
100-199 (n=23)	4 (17%)	5 (22%)	5 (22%)	3 (13%)	1 (4%)	5 (22%)	14 (61%)
200-299 (n=23)	9 (38%)	1 (4%)	3 (13%)	3 (13%)	1 (4%)	7 (29%)	14 (58%)
300-399 (n=12)	3 (25%)	1 (8%)	3 (25%)	0 (0%)	1 (8%)	4 (33%)	8 (67%)
400-499 (n=5)	0 (0%)	2 (40%)	1 (20%)	1 (20%)	1 (20%)	0 (0%)	3 (60%)
500+ (n=10)	1 (11%)	2 (22%)	2 (22%)	0 (0%)	1 (11%)	3 (30%)	6 (67%)
TOTAL	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)	76 (62%)
Teaching Status (COTH) [c]							
Non-teaching (n=95)	25 (25%)	12 (13%)	11 (12%)	12 (13%)	13 (14%)	22 (23%)	58 (62%)
Teaching (n=28)	4 (14%)	6 (22%)	8 (28%)	1 (4%)	1 (4%)	8 (28%)	18 (66%)
TOTAL	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)	76 (62%)
Trauma Center Status [d]							
Non-trauma center (n=73)	18 (25%)	7 (10%)	11 (15%)	6 (8%)	10 (14%)	21 (29%)	48 (66%)
Level I TC (n=8)	0 (0%)	2 (29%)	3 (43%)	0 (0%)	0 (0%)	2 (29%)	5 (71%)
Level II TC (n=13)	5 (36%)	4 (29%)	3 (21%)	0 (0%)	0 (0%)	2 (14%)	5 (36%)
Level III or IV TC (n=29)	6 (21%)	5 (17%)	2 (7%)	7 (24%)	4 (14%)	5 (17%)	18 (62%)
TOTAL	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)	76 (62%)
Geriatric Acute Care Model [e]							
Absent (n=112)	29 (26%)	16 (14%)	17 (15%)	13 (12%)	14 (12%)	24 (21%)	68 (61%)
Present (n=11)	0 (0%)	2 (20%)	2 (20%)	0 (0%)	0 (0%)	6 (60%)	8 (80%)
TOTAL	29 (24%)	18 (15%)	19 (15%)	13 (11%)	14 (11%)	30 (24%)	76 (62%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: $6.08_{(df 3, 122)}$, p= .112; [b] Pearson Chi-Square: $.349_{(df 5, 122)}$, p=.999; [c] Pearson Chi-Square = $0.10_{(df 1, 122)}$, p= .472; [d] Pearson Chi-Square: $4.79_{(df 3, 122)}$, p=.190; [e] Pearson Chi-Square =$1.53_{(df 1, 122)}$, p=.187

ACOVE Indicator 4: Documented plan to increase mobility within 48 hours of admission.

Table 4.7 provides a summary of this indicator by hospital characteristics. One hundred and twenty-six of 128 hospital respondents answered this survey question. Partial to complete implementation of this indicator by hospital characteristic ranged from 38% (level II trauma centers) to 87% (level I trauma centers). There were no statistically significant differences between groups for any of the hospital characteristics. Partial to complete implementation occurred in 50% or more for each characteristic with the exception of level II trauma centers.

Table 4.7. ACOVE Indicator 4: Adoption of Documented Plan to Increase Mobility within 48 Hours of Admission by Hospital Characteristics (n= 126)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	5 (13%)	5 (13%)	3 (8%)	6 (16%)	5 (13%)	14 (37%)	28 (74%)
Midwest (n=35)	12 (34%)	2 (8%)	5 (14%)	2 (6%)	7 (20%)	7 (20%)	21 (60%)
South (n=23)	7 (30%)	3 (13%)	3 (13%)	2 (9%)	4 (17%)	4 (18%)	13 (57%)
West (n=30)	11 (37%)	1 (3%)	5 (17%)	5 (17%)	3 (10%)	5 (17%)	18 (60%)
TOTAL	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)	80 (63%)
Hospital Bedsize [b]							
1-99 (n=50)	13 (26%)	2 (4%)	4 (8%)	4 (8%)	15 (30%)	12 (24%)	35 (70%)
100-199 (n=22)	6 (27%)	3 (14%)	2 (9%)	5 (23%)	2 (9%)	4 (18%)	13 (59%)
200-299 (n=25)	8 (31%)	3 (12%)	3 (12%)	3 (12%)	2 (8%)	7 (27%)	15 (58%)
300-399 (n=12)	5 (42%)	0 (0%)	2 (17%)	2 (17%)	0 (0%)	3 (25%)	7 (58%)
400-499 (n=6)	1 (17%)	1 (17%)	3 (50%)	1 (17%)	0 (0%)	0 (0%)	4 (67%)
500+ (n=11)	2 (27%)	2 (20%)	2 (20%)	0 (0%)	0 (0%)	4 (40%)	6 (60%)
TOTAL	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)	80 (63%)
Teaching Status (COTH) [c]							
Non-teaching (n=94)	28 (30%)	6 (6%)	11 (12%)	12 (13%)	17 (18%)	20 (21%)	60 (64%)
Teaching (n=32)	7 (22%)	5 (16%)	5 (16%)	3 (9%)	2 (6%)	10 (31%)	20 (62%)
TOTAL	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)	80 (63%)
Trauma Center Status [d]							
Non-trauma center (n=73)	19 (26%)	7 (10%)	8 (11%)	12 (15%)	9 (12%)	19 (26%)	47 (64%)
Level I TC (n=9)	1 (13%)	0 (0%)	3 (38%)	0 (0%)	0 (0%)	4 (50%)	7 (87%)
Level II TC (n=15)	6 (38%)	4 (25%)	2 (13%)	1 (6%)	0 (0%)	3 (19%)	6 (38%)
Level III or IV TC (n=29)	9 (31%)	0 (0%)	3 (10%)	3 (10%)	10 (35%)	4 (14%)	20 (69%)
TOTAL	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)	80 (63%)
Geriatric Acute Care Model [e]							
Absent (n=113)	34 (30%)	9 (8%)	15 (13%)	15 (13%)	18 (16%)	23 (20%)	71 (63%)
Present (n=13)	1 (8%)	2 (17%)	1 (8%)	0 (0%)	1 (8%)	7 (58%)	9 (75%)
TOTAL	35 (28%)	11 (9%)	16 (13%)	15 (12%)	19 (15%)	30 (24%)	80 (63%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: $2.53_{(df\,3,\,125)}$, p= .470; [b] Pearson Chi-Square: $1.69_{(df\,5,\,125)}$, p=.890; [c] Pearson Chi-Square $=0.02_{(df\,1,\,125)}$, p= .527; [d] Pearson Chi-Square: $7.05_{(df\,3,\,125)}$, p=.070, [e] Pearson Chi-Square = $0.79_{(df\,1,\,125)}$, p=.296

ACOVE Indicator 5: Documented screening of surgical patients for risk factors for delirium.

Table 4.8 provides a summary of the implementation of this indicator by hospital characteristic. One hundred and twenty-five of 128 hospital respondents answered this survey question. Partial to complete implementation of this indicator ranged from 11% (Midwest region) to 50% (bed size 400 to 499). There were no statistically significant differences between groups for any hospital characteristic.

Table 4.8. ACOVE Indicator 5: Adoption of Documented Screening of Surgical Patients for Risk Factors for Delirium Prior to Surgery BY Hospital Characteristics (n= 125)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=37)	19 (16%)	6 16%	3 (8%)	1 (3%)	2 (5%)	6 (16%)	12 (32%)
Midwest (n=35)	28 (80%)	3 (9%)	1 (3%)	1 (3%)	0 (0%)	2 (6%)	4 (11%)
South (n=22)	16 (73%)	1 (5%)	1 (5%)	1 (5%)	1 (5%)	2 (9%)	5 (22%)
West (n=31)	16 (51%)	4 (13%)	3 (10%)	2 (7%)	1 (3%)	5 (16%)	11 (36%)
TOTAL	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)	32 (26%)
Hospital Bedsize [b]							
1-99 (n=50)	36 (72%)	4 (8%)	1 (2%)	0 (0%)	2 (4%)	7 (14%)	10 (20%)
100-199 (n=22)	14 (64%)	4 (18%)	2 (9%)	1 (5%)	0 (0%)	1 (5%)	4 (18%)
200-299 (n=24)	13 (56%)	4 (16%)	1 (4%)	4 (16%)	0 (0%)	3 (12%)	8 (32%)
300-399 (n=13)	6 (46%)	1 (8%)	2 (15%)	0 (0%)	2 (15%)	2 (15%)	6 (46%)
400-499 (n=6)	3 (50%)	0 (0%)	2 (33%)	0 (0%)	0 (0%)	1 (17%)	3 (50%)
500+ (n=10)	7 (78%)	1 (11%)	0 (0%)	0 (0%)	0 (0%)	1 (11%)	1 (11%)
TOTAL	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)	32 (26%)
Teaching Status (COTH) [c]							
Non-teaching (n=94)	60 (64%)	9 (10%)	5 (5%)	4 (4%)	3 (3%)	13 (14%)	25 (26%)
Teaching (n=31)	10 (62%)	5 (16%)	3 10%)	1 (3%)	1 (3%)	2 (6%)	7 (22%)
TOTAL	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)	32 (26%)
Trauma Center Status [d]							
Non-trauma center (n=74)	42 (59%)	9 (12%)	4 (6%)	3 (4%)	3 (4%)	11 (15%)	21 (29%)
Level I TC (n=8)	6 (75%)	0 (0%)	2 (25%)	0 (0%)	0 (0%)	0 (0%)	2 (25%)
Level II TC (n=14)	11 (73%)	2 (13%)	1 (7%)	0 (0%)	0 (0%)	1 (7%)	2 13%)
Level III or IV TC (n=29)	19 (66%)	3 (10%)	1 (3%)	2 (7%)	1 (3%)	3 (10%)	7 (24%)
TOTAL	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)	32 (26%)
Geriatric Acute Care Model [e]							
Absent (n=113)	75 (66%)	10 (9%)	8 (7%)	5 (4%)	3 (3%)	13 (11%)	29 (25%)
Present (n=12)	4 (30%)	4 (42%)	0 (0%)	0 (0%)	1 (9%)	2 (18%)	3 (27%)
TOTAL	79 (63%)	14 (11%)	8 (6%)	5 (4%)	4 (3%)	15 (12%)	32 (26%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: 6.29 $_{(df3, 124)}$, p= .099; [b] Pearson Chi-Square:7.47 $_{(df5, 124)}$, p=.171; [c] Pearson Chi-Square = 0.20 $_{(df1, 124)}$, p= .426; [d] Pearson Chi-Square: 1.60 $_{(df3, 124)}$, p=..661; [e] Pearson Chi-Square = 0.02 $_{(df1, 124)}$, p=.570

ACOVE Indicator 6: Patients ambulatory prior to surgery are ambulated by postop day 2.

Table 4.9 summarizes the implementation of this indicator by hospital characteristic. One hundred and twenty-six of 128 hospital respondents answered this survey question. Partial to complete implementation ranged from 60% (500+ bed size) to 93% (level III or IV trauma centers). No statistically significant differences between groups were found for any hospital characteristic.

Table 4.9. ACOVE Indicator 6: Adoption of Patients Ambulatory Prior to Surgery are Ambulated by Postoperative Day #2 by Hospital Characteristics (n= 126)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	4 (11%)	2 (5%)	4 (11%)	4 (11%)	3 (8%)	21 (55%)	32 (84%)
Midwest (n=34)	5 (15%)	1 (3%)	5 (15%)	3 (9%)	3 (9%)	17 (50%	28 (82%)
South (n=23)	4 (17%)	2 (8%)	2 (8%)	5 (22%)	1 (4%)	9 (39%)	17 (74%)
West (n=31)	4 (13%)	0 (0%)	5 (16%)	4 (13%)	4 (13%)	14 (45%)	27 (87%)
TOTAL	17 (13%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)	104 (83%)
Hospital Bedsize [b]							
1-99 (n=49)	6 (12%)	0 (0%)	4 (8%)	6 (12%)	5 (10%)	28 (55%)	43 (88%)
100-199 (n=22)	2 (9%)	2 (9%)	4 (18%)	2 (9%)	0 (0%)	12 (46%)	18 (82%)
200-299 (n=25)	6 (23%)	0 (0%)	3 (12%)	4 (15%)	1 (4%)	12 (48%)	20 (77%)
300-399 (n=13)	1 (8%)	0 (0%)	3 (23%)	3 (23%)	3 (23%)	3 (23%)	12 (92%)
400-499 (n=6)	0 (0%)	1 (17%)	2 (33%)	0 (0%)	0 (0%)	3 (50%)	5 (83%)
500+ (n=11)	2 (20%)	2 (20%)	0 (0%)	1 (10%)	2 (20%)	3 (30%)	6 (60%)
TOTAL	17 (13%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)	104 (83%)
Teaching Status (COTH) [c]							
Non-teaching (n=93)	12 (13%)	2 (2%)	9 (10%)	11 (12%)	7 (8%)	52 (56%)	79 (85%)
Teaching (n=33)	5 (15%)	3 (9%)	7 (21%)	5 (15%)	4 (12%)	9 (27%)	25 (76%)
TOTAL	17 (13%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)	104 (83%)
Trauma Center Status [d]							
Non-trauma center (n=74)	10 (14%)	2 (3%)	8 (11%)	10 (14%)	7 (10%)	36 (49%)	61 (84%)
Level I TC (n=9)	1 (11%)	1 (11%)	2 (22%)	1 (11%)	2 (22%)	2 (22%)	7 (78%)
Level II TC (n=15)	4 (25%)	2 (13%)	3 (19%)	2 (13%)	0 (0%)	5 (31%)	10 (63%)
Level III or IV TC (n=28)	2 (7%)	0 (0%)	3 (11%)	3 (11%)	2 (7%)	18 (64%)	26 (93%)
TOTAL	17 (13%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)	104 (83%)
Geriatric Acute Care Model [e]							
Absent (n=113)	16 (14%)	2 (2%)	16 (14%)	15 (13%)	10 (9%)	55 (48%)	96 (84%)
Present (n=12)	1 (8%)	3 (25%)	0 (0%)	1 (8%)	1 (8%)	6 (50%)	8 (67%)
TOTAL	17 (13%)	5 (4%)	16 (13%)	16 (13%)	11 (9%)	61 (48%)	104 (83%)

ACOVE: Assessing Care of Vulnerable Elders; [a]Pearson Chi-Square: 1.71 $_{(df 3, 125)}$, p= .635; [b] Pearson Chi-Square: 5.89 $_{(df 5, 125)}$, p=.317; [c] Pearson Chi-Square =1.43 $_{(df 1, 125)}$, p= .176; [d] Pearson Chi-Square: 6.72 $_{(df 3, 125)}$, p=.081; [e] Pearson Chi-Square =2.32 $_{(df 1, 125)}$, p=.132

ACOVE Indicator 7: Surgical patients screened for delirium for 3 days postop.

Table 4.10 provides a summary of the implementation of this indicator by hospital characteristic. One hundred and twenty-three of 128 hospital respondents answered this survey question. Partial to complete implementation ranged from 6% (level II trauma centers) to 83% (400 to 499 bed size). Statistically significant differences between groups were found for hospital bed size with hospitals of bed size 400 to 499 having 83% partial to complete implementation (Pearson Chi-square: 17.83 $_{(df\ 5,\ 122)}$, p=.003), compared to only 5% for hospitals of bed size 100 to 199.

Table 4.10. ACOVE Indicator 7: Adoption of Surgical Patients Screened for Delirium for 3 Days Postop by Hospital Characteristics (n= 123)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	21 (55%)	7 (18%)	1 (3%)	0 (0%)	1 (3%)	8 (21%)	10 (26%)
Midwest (n=34)	25 (73%)	3 (9%)	1 (3%)	1 (3%)	1 (3%)	3 (9%)	6 (18%)
South (n=22)	15 (68%)	4 (18%)	1 (5%)	0 (0%)	1 (5%)	1 (5%)	3 (14%)
West (n=29)	17 (59%)	2 (7%)	4 (14%)	0 (0%)	1 (3%)	5 (17%)	10 (35%)
TOTAL	78 (63%)	16 (13%)	7 (6%)	1 (<1%)	4 (3%)	17 (14%)	29 (24%)
Hospital Bedsize [b]							
1-99 (n=47)	33 (79%)	4 (9%)	2 (4%)	0 (0%)	2 (4%)	6 (13%)	10 (21%)
100-199 (n=21)	15 (71%)	5 (24%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)	1 (5%)
200-299 (n=25)	16 (62%)	4 (15%)	0 (0%)	1 (4%)	1 (4%)	4 (15%)	6 (23%)
300-399 (n=13)	7 (54%)	1 (8%)	1 (8%)	0 (0%)	1 (8%)	3 (23%)	5 (39%)
400-499 (n=6)	1 (17%)	0 (0%)	3 (50%)	0 (0%)	0 (0%)	2 (33%)	5 (83%)
500+ (n=11)	6 (60%)	2 (20%)	1 (10%)	0 (0%)	0 (9%)	1 (10%)	2 (20%)
TOTAL	78 (63%)	16 (13%)	7 (6%)	1 (<1%)	4 (3%)	17 (14%)	29 (24%)
Teaching Status (COTH) [c]							
Non-teaching (n=90)	62 (69%)	9 (10%)	3 (3%)	0 (0%)	3 (3%)	13 (14%)	19 (21%)
Teaching (n=33)	16 (49%)	7 (21%)	4 (12%)	1 (3%)	1 (3%)	4 (12%)	10 (30%)
TOTAL	78 (63%)	16 (13%)	7 (6%)	1 (<1%)	4 (3%)	17 (14%)	29 (24%)
Trauma Center Status [d]							
Non-trauma center (n=72)	44 (62%)	9 (13%)	2 (3%)	0 (0%)	4 (6%)	12 (17%)	18 (25%)
Level I TC (n=9)	4 (44%)	0 (0%)	4 (44%)	0 (0%)	0 (0%)	1 (11%)	5 (56%)
Level II TC (n=15)	11 (68%)	4 (25%)	0 (0%)	0 (0%)	0 (0%)	1 (6%)	1 (6%)
Level III or IV TC (n=27)	19 (70%)	3 (11%)	1 (4%)	1 (4%)	0 (0%)	3 (11%)	5 (19%)
TOTAL	78 (63%)	16 (13%)	7 (6%)	1 (<1%)	4 (3%)	17 (14%)	29 (24%)
Geriatric Acute Care Model [e]							
Absent (n=110)	72 (67%)	11 (10%)	6 (5%)	1 (1%)	4 (4%)	15 (14%)	26 (23%)
Present (n=13)	4 (33%)	5 (42%)	1 (8%)	0 (0%)	0 (0%)	2 (17%)	3 (25%)
TOTAL	78 (63%)	16 (13%)	7 (6%)	1 (<1%)	4 (3%)	17 (14%)	29 (24%)

ACOVE: Assessing Care of Vulnerable Elders; [a] Pearson Chi-Square: 3.94 $_{(df3, 122)}$, p= .268; [b] Pearson Chi-Square: 17.83 $_{(df5,122)}$, p=.003; [c] Pearson Chi-Square =1.13 $_{(df1, 122)}$, p= .203; [d] Pearson Chi-Square: 8.28 $_{(df3, 122)}$, p=.041; [e] Pearson Chi-Square =0.02 $_{(df1, 122)}$, p= .572

ACOVE Indicator 8: Surgical patients assessed at discharge for cognitive and functional status with comparison to preoperative levels.

Table 4.11 summarizes the implementation of this indicator by hospital characteristic. One hundred and twenty-four of 128 hospital respondents answered this survey. Partial to complete implementation ranged from 14% (100 to 199 bed size) to 54% (200 to 299 bed size). There were no statistically significant differences between groups for any hospital characteristic. While not statistically significant, hospitals in the Northeast region had a higher percentage of implementation (47%) compared to 29% in the Midwest. Hospitals with geriatric acute care models had a higher percentage of implementation (50%) compared to 36% in hospitals without a geriatric acute care model.

Table 4.11. ACOVE Indicator 8: Adoption of Surgical Patients Assessed at Discharge for Cognitive and Functional Status with Comparison to Preop Levels by Hospital Characteristics (n= 124)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	16 (42%)	4 (11%)	1 (3%)	1 (3%)	2 (5%)	14 (37%)	18 (47%)
Midwest (n=34)	23 (68%)	1 (3%)	2 (6%)	2 (6%)	2 (6%)	4 (12%)	10 (29%)
South (n=23)	12 (52%)	3 (13%)	2 (8%)	1 (4%)	1 (4%)	4 (17%)	8 (35%)
West (n=29)	10 (66%)	0 (0%)	3 (10%)	2 (7%)	1 (3%)	4 (14%)	10 (34%)
TOTAL	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	6 (5%)	26 (21%)
Hospital Bedsize [b]							
1-99 (n=48)	27 (56%)	2 (4%)	4 (8%)	2 (4%)	4 (8%)	9 (19%)	19 (40%)
100-199 (n=22)	16 (73%)	3 (14%)	0 (0%)	1 (5%)	0 (0%)	2 (9%)	3 (14%)
200-299 (n=25)	12 (46%)	0 (0%)	1 (4%)	2 (8%)	1 (4%)	10 (39%)	14 (54%)
300-399 (n=12)	6 (50%)	0 (0%)	1 (8%)	1 (8%)	1 (8%)	3 (25%)	6 (50%)
400-499 (n=6)	5 (83%)	0 (0%)	1 (17%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)
500+ (n=11)	4 (40%)	3 (30%)	1 (10%)	0 (0%)	0 (0%)	2 (20%)	3 (30%)
TOTAL	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	6 (5%)	26 (21%)
Teaching Status (COTH) [c]							
Non-teaching (n=92)	53 (58%)	5 (5%)	4 (4%)	4 (4%)	5 (5%)	21 (23%)	34 (37%)
Teaching (n=32)	17 (53%)	3 (9%)	4 (13%)	2 (6%)	1 (3%)	5 (16%)	12 (38%)
TOTAL	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	6 (5%)	26 (21%)
Trauma Center Status [d]							
Non-trauma center (n=73)	37 (51%)	5 (7%)	3 (4%)	3 (4%)	4 (6%)	21 (29%)	31 (43%)
Level I TC (n=9)	5 (62%)	0 (0%)	2 (25%)	0 (0%)	0 (0%)	1 (13%)	3 (38%)
Level II TC (n=15)	10 (63%)	3 (19%)	0 (0%)	1 (6%)	0 (0%)	2 (13%)	3 (19%)
Level III or IV TC (n=27)	18 (67%)	0 (0%)	3 (11%)	2 (7%)	2 (7%)	2 (7%)	9 (33%)
TOTAL	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	6 (5%)	26 (21%)
Geriatric Acute Care Model [e]							
Absent (n=111)	65 (58%)	7 (6%)	7 (6%)	6 (5%)	5 (4%)	22 (20%)	40 (36%)
Present (n=13)	5 (42%)	1 (8%)	1 (8%)	0 (0%)	1 (8%)	4 (33%)	6 (50%)
TOTAL	70 (57%)	8 (7%)	8 (7%)	6 (5%)	6 (5%)	6 (5%)	26 (21%)

ACOVE: Assessing Care of Vulnerable Elders; [a] Pearson Chi-Square: $2.72_{(df3, 123)}$, p= .437; [b] Pearson Chi-Square: $10.59_{(df5,123)}$, p=.060; [c] Pearson Chi-Square $<0.01_{(df1, 123)}$, p= .564;
[d] Pearson Chi-Square: $3.37_{(df3, 123)}$, p=.341; [e] Pearson Chi-Square = $0.95_{(df1, 123)}$, p= .252

ACOVE Indicator 9: Discharge assessment for level of independence and need for home health.

Table 4.12 provides a summary of the implementation of this indicator by hospital characteristic. One hundred and twenty-seven of 128 hospital respondents answered this survey question. This indicator had the highest degree of implementation among all of the ACOVE indicators in this study. Partial to complete implementation ranged from 75% (level II trauma centers) to 100% (level 1 trauma centers). There were no statistically significant differences between groups for any hospital characteristic.

Table 4.12. ACOVE Indicator 9: Adoption of Discharge Assessment for Level of Independence and Need for Home Health by Hospital Characteristic (n= 127)

HOSPITAL CHARACTERISTIC	Not Implemented		Partial to Complete Implementation				Hospitals with partial to complete implementation N (%)
	No activity N (%)	Under development N (%)	Implemented partially on some units N (%)	Implemented fully on some units N (%)	Implemented partially throughout hospital N (%)	Implemented fully throughout hospital N (%)	
Hospital Region [a]							
Northeast (n=38)	1 (3%)	0 (0%)	1 (3%)	3 (8%)	2 (5%)	31 (82%)	37 (97%)
Midwest (n=35)	4 (11%)	1 (3%)	1 (3%)	3 (9%)	2 (6%)	24 (69%)	30 (86%)
South (n=23)	2 (8%)	1 (4%)	1 (4%)	1 (4%)	1 (4%)	17 (74%)	20 (86%)
West (n=31)	2 (7%)	0 (0%)	1 (3%)	4 (13%)	5 (16%)	19 (61%)	29 (94%)
TOTAL	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)	116 (91%)
Hospital Bedsize [b]							
1-99 (n=50)	2 (4%)	0 (0%)	1 (2%)	5 (10%)	2 (4%)	39 (80%)	48 (96%)
100-199 (n=22)	2 (9%)	1 (5%)	2 (9%)	1 (5%)	2 (9%)	14 (64%)	19 (86%)
200-299 (n=25)	4 (15%)	0 (0%)	0 (0%)	3 (12%)	1 (4%)	18 (69%)	22 (85%)
300-399 (n=13)	0 (0%)	0 (0%)	0 (0%)	1 (8%)	3 (23%)	9 (69%)	13 (100%)
400-499 (n=6)	1 (17%)	0 (0%)	1 (17%)	0 (0%)	1 (17%)	3 (50%)	5 (83%)
500+ (n=11)	0 (0%)	1 (10%)	0 (0%)	1 (10%)	1 (10%)	7 (70%)	9 (90%)
TOTAL	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)	116 (91%)
Teaching Status (COTH) [c]							
Non-teaching (n=94)	5 (5%)	2 (2%)	4 (4%)	7 (7%)	5 (5%)	71 (76%)	87 (93%)
Teaching (n=33)	4 (12%)	0 (0%)	0 (0%)	4 (12%)	5 (15%)	20 (61%)	29 (88%)
TOTAL	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)	116 (91%)
Trauma Center Status [d]							
Non-trauma center (n=74)	5 (7%)	1 (1%)	3 (4%)	4 (6%)	5 (7%)	55 (75%)	67 (92%)
Level I TC (n=9)	0 (0%)	0 (0%)	0 (0%)	1 (11%)	3 (33%)	5 (56%)	9 (100%)
Level II TC (n=15)	3 (19%)	1 (6%)	0 (0%)	2 (13%)	0 (0%)	10 (63%)	12 (75%)
Level III or IV TC (n=29)	1 (3%)	0 (0%)	1` (3%)	4 (14%)	2 (7%)	21 (72%)	28 (97%)
TOTAL	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)	116 (91%)
Geriatric Acute Care Model [e]							
Absent (n=114)	7 (6%)	2 (2%)	4 (4%)	11 (10%)	9 (8%)	82 (71%)	106 (93%)
Present (n=13)	2 (17%)	0 (0%)	0 (0%)	0 (0%)	1 (8%)	9 (75%)	10 (83%)
TOTAL	9 (7%)	2 (2%)	4 (3%)	11 (9%)	10 (8%)	91 (72%)	116 (91%)

ACOVE: Assessing Care of Vulnerable Elders; [a] Pearson Chi-Square: $3.90_{(df\,3,\,126),}$ p= .271; [b] Pearson Chi-Square: $5.29_{(df5,126),}$ p=.382; [c] Pearson Chi-Square = $0.68_{(df1,\,126),}$ p= .309; [d] Pearson Chi-Square: $7.27_{(df\,3,\,126),}$ p=.064; [e] Pearson Chi-Square =$1.07_{(df1,\,126),}$ p= .278

Summary of Results for Aim One

The preceding paragraphs and tables presented the extent of adoption of targeted ACOVE indicators for hospitalized injured older adults in acute care settings from an overall perspective and from a detailed presentation of individual indicators by hospital characteristics. Table 4.13 presents a summary of each indicator and its partial to complete adoption among all hospitals. Overall, partial to complete implementation of the ACOVE indicators ranged from 24% (surgical patients screened for delirium for 3 days postop) to 91% (discharge assessment for level of independence and need for home health). Although indicator adoption varied by individual indicators and among hospital characteristics, several trends emerged. First, indicators related to functional ability had higher degrees of implementation than those related to cognition. Partial to complete implementation of indicators related to functional ability ranged from 64% to 91% and those related to cognition ranged from 26% to 62%. Second, the Northeast region had overall higher degrees of indicator implementation compared to the South and Midwest regions, and the highest percentages for six of nine indicators; one indicator difference (assessment of functional status) was statistically significant. Third, level I trauma centers had higher percentages of indicator implementation than all other level trauma centers and non-trauma centers for seven of nine indicators; and one indicator differences were statistically significant. Level II trauma centers had the lowest percentages of indicator implementation for all nine indicators. Statistically significant difference trends were not noted for hospital bed size, teaching status or presence of geriatric acute care models.

Table 4.13. Summary of study hospitals with partial to complete implementation of nine targeted ACOVE indicators (n=128)

TARGETED ACOVE INDICATOR	Hospitals with Partial to Complete Implementation N (%)
1. Multidimensional assessment of cognition (n=126)	59 (47%)
2. Assessment for functional status (n=127)	104 (82%)
3. Documented assessment for etiology of delirium (n=123)	76 (62%)
4. Documented plan to mobilize within 48 hours of admission (n=126)	80 (64%)
5. Documented screening for risk factors of delirium on surgical patients (n=125)	32 (26%)
6. Ambulatory surgical patients are ambulated by postop day 2 (n=126)	104 (83%)
7. Surgical patients screened for delirium for 3 days postop (n=123)	29 (24%)
8. Surgical patients assessed at discharge for cognitive and functional status with comparison to preoperative levels (n=124)	46 (37%)
9. Discharge assessment of level of independence and need for home health (n=127)	116 (91%)

Aim Two

Aim Two: To determine associations among administratively-mediated variables (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOAs. The variables used to meet this aim were obtained from the four data sources described in Chapter 3 (see pg. 31). A sequential approach was employed to conduct data analyses. First, descriptive statistics (frequencies, percentages, and measures of central tendency and variability) were conducted for AMVs, patient characteristics, and the composite ACOVE Indicator Index. Second, univariate associations between hospital-level patient characteristics and AMVs were examined to assess patient level associations with AMVs. Third, univariate associations of independent variables (AMVs, patient characteristics) with the dependent variable (ACOVE Indicator Index) were examined to determine associations with ACOVE Indicator adoption.

Descriptive Statistics- Administratively-Mediated Variables

Tables 4.14 through 4.16 provide descriptive summaries of AMVs (capital inputs, organizational facets, and labor inputs). Each is described below by: 1) report of missing items, 2) items with low variability, 3) items with less than 10 cases, 4) and variables subsequently dropped based on the exclusion criteria described in Chapter 3 (see pg. 41).

Capital Inputs. Table 4.14 summarizes this sub-category. Missing data for individual variables ranged from missing in one hospital (< 1%) to missing in 23 hospitals (18%) (electronic health record). Six variables (43%) had no missing data. One variable (electronic health record) had > 15% missing cases (23 hospitals non-reporting), and one variable was present in over 90% of hospitals (computer support for retrieval of

previous hospital data). One variable had less than 10 cases (ED design for geriatric patients). These variables were dropped from further analysis as noted by 'gray shading." Presence of the remaining capital input variables in hospitals ranged from 28 (22% [computer support for retrieval of nursing home data]) to 111 (87% [computer support for medication compatibility alerts]).

Table 4.14. Descriptive Summary of Capital Input Administratively-Mediated Variables by Sub-Category, Number of Hospitals with Submitted Data, Missing Cases, and Frequencies (N=128)

ADMINISTRATIVELY-MEDIATED VARIABLES		% Missing	N=128 (%)*
Capital Inputs			
Computer Support	Medication compatibility alerts on all adult units (n=128)	0%	111 (87%)
	Retrieval of previous hospital data on all adult units (n=127)	<1%	118 (92%)
	Retrieval of nursing Home Data on All Adult Units (n=128)	0%	28 (22%)
	Standardized Checklist for VAP Bundle on All Adult Units (n=125)	2%	82 (64%)
	Standardized Checklist for CAUTI Bundle on All Adult Units (n=127)	<1%	82 (64%)
	Decision Support for Pressure Ulcer Risk Assessment (n=127)	<1%	96 (75%)
In-Room Supplies	Room-based Medications (n=128)	0%	21 (16%)
	Room-based Linens (n=128)	0%	47 (37%)
	Room-based Basic Supplies (n=128)	0%	89 (70%)
Access to Measures to Promote Independence	Assistive Technology (n=112)	12%	23 (18%)
	Physical Rehabilitation (n=112)	12%	104 (81%)
	Simulated Rehabilitation Environment (n=112)	12%	29 (23%)
Other	Electronic Health Record (n=105)	18%	94 (73%)
	ED Design for Geriatric Patients (n=128)	0%	2 (2%)

Organizational Facets. Table 4.15 summarizes this sub-category. Hospitals submitting data for these variables ranged from 98 to 128. Two variables (ED triage, health status indictors), had > 15% missing cases. Five variables (intermediate nursing beds, acute long term care beds, assisted living, retirement housing, physician ownership) had less than 10 cases. These eight variables (shaded gray) were excluded from

subsequent analyses. Presence of the remaining organizational facets ranged from 8% (adult day care) to 77% (orthopedic services). Two organizational facets not shown in Table 4.15 (ICU visitation hours per week, ACOVE Indicator Index) were continuous variables. ICU visitation hours (median: 154, IQR: 44-168) had > 15% missing cases, thus was excluded. The ACOVE indicator Index (median: 22, IQR: 13-29), a composite measure of nine ACOVE indicators, had a theoretical range of 0-45.

Table 4.15. Descriptive Summary of Organizational Facet Administratively-Mediated Variables by Sub-Category, Number of Hospitals with Submitted Data, Missing Cases, Frequencies, and Measures of Central Tendency (N=128)

ADMINISTRATIVELY-MEDIATED VARIABLES		% Missing	N=128 (%)*
Organizational Facets			
Geriatric-focused Services	Skilled Nursing Beds (n=112)	12%	27 (21%)
	Intermediate Nursing Beds (n=112)	12%	6 (5%)
	Acute Long Term Care Beds (n=112)	12%	2 (2%)
	Adult Day Care (n=112)	12%	10 (8%)
	Alzheimer's Center (n=112)	12%	12 (9%)
	Assisted Living Services (n=112)	12%	3 (2%)
	Home Health Services (n=112)	12%	37 (29%)
	Meals on Wheels (n=112)	12%	18 (14%)
	Retirement Housing (n=112)	12%	2 (2%)
	Transportation to Health Services (n=112)	12%	27 (21%)
	Comprehensive Geriatric Assessment Available on All Adult Units (n=126)	2%	29 (23%)
	Geriatric Services (n=112)	12%	57 (45%)
	Specialty Unit for Frail Elders (n=127)	<1%	11 (9%)
	Geriatric Resource Programs (n=128)	0%	13 (10%)
Trauma-focused Services	Trauma Centers (n=128)	0%	55 (43%)
	Trauma Center ACS-COT [a] Verification (n=128)	0%	12 (9%)
	Trauma System Status (n=128)	0%	35 (27%)
Other	5-Level Triage (ESI) [b] in Emergency Department (n=98)	23%	56 (44%)
	ICU-Visitor Sleeping Arrangements in Patient Room (n=128)	0%	60 (47%)
	ICU- Visitor Sleeping Arrangement Near ICU (n=128)	0%	42 (33%)
	Health Status Indicators (n=105)	18%	93 (73%)
	Magnet Hospital Status (n=127)	<1%	17 (13%)
	Orthopedic Services (n=112)	12%	99 (77%)
	Ownership/Physicians (n=112)	12%	2 (2%)
	Pain Management Program (n=112)	12%	74 (58%)
	Teaching Status (COTH) [c] (n=128)	0%	33 (26%)
	Control-Type Organization- Private, Non-profit (n=128)	0%	95 (74%)
	Control-Type Organization- Private, Non-profit (n=128)	0%	95 (74%)
	Type Organization- Private, Investor Owned (n=128)	0%	10 (8%)

Shaded cells = excluded from further data analysis; [a] ACS-COT: American College of Surgeons-Committee on Trauma; [b] ESI: Emergency Severity Index; [c] COTH: Council of Teaching Hospitals

Labor Inputs. Table 4.16 summarizes this sub-category. Hospitals submitting data for these variables ranged from 35 to 128. Missing data ranged from 0% to 73%. Nine variables (percent LPNs ICU, percent RN workforce ≤ 1 year experience, hospitalist availability, hospitalist FTEs, intensivist availability, intensivist FTEs, RN case

managers, social worker case managers, RN or social worker case managers) had > 15% missing cases; three variables (RN/patient ratio ICU, RN/patient ratio med/surg, percent RNs ICU) had low variability; and one variable (social worker case managers) had < 10 cases. Twelve variables were excluded from subsequent analyses. Presence of the remaining labor inputs ranged from 13% (geriatric advanced practice nurses) to 89% (multidisciplinary teams).

Table 4.16. Descriptive Summary of Labor Input Administratively-Mediated Variables by Sub-Category, Number of Hospitals with Submitted Data, Missing Cases, Frequencies, and Measures of Central Tendency (N=128)

ADMINISTRATIVELY-MEDIATED VARIABLES		% Missing	N=128 (%)*	Median	IQR
Nursing-Related Labor Inputs	Percent BSN [a] (n=122)	5%	-	.40	.20-.52
	Percent Nurse Certification (n=118)	8%	-	.20	.05-.40
	RN/Patient Ratio- ICU (n=120)	6%	-	2.0	2.0-2.0
	RN/Patient Ratio- Med/Surg (n=127)	<1%	-	5.0	4.0-5.0
	Percent RNs: ICU (n=116)	9%	-	.95	.90-1.0
	Percent LPNs ICU (n=108)	16%		.00	.00-.00
	Percent Other ICU (n=109)	15%		.05	.05-.10
	Percent RNs: Med/Surg (n=123)	4%	-	.75	.67-.90
	Percent LPNs Med/Surg (n=121)	5%		.01	.00-.10
	Percent Other Med/Surg (n=121)	5%		.19	.07-.30
	Percent RN Turnover (n=116)	9%	-	.07	.04-.11
	Percent RN Workforce with ≤ 1 year experience (n=105)	18%	-	.08	.05-.10
	Percent RN Workforce with ≥ 5 years experience (n=112)	12%	-	.76	.60-.90
Hospitalists and Intensivists	Hospitalist FTEs [b]/Total Beds (n=60)	53%	-	.03	.01-.05
	Hospitalists Available to All Adult Units (n=103)	20%	74 (58%)	-	-
	Intensivist FTEs/Adult ICU Beds (n=35)	73%	-	.19	.04-.38
	Intensivists Available to Adult ICUs (n=103)	20%	44 (34%)	-	-
Psychiatric-Related Labor Inputs	Psychiatric Nursing Liaison Available to All Adult Units (n=127)	<1%	46 (36%)	-	-
	Psychiatric Consultation Available to All Adult Units (n=125)	2%	93 (73%)	-	-
	Gero-Psychiatric Consultation Available to All Adult Units	<1%	44 (34%)	-	-

ADMINISTRATIVELY-MEDIATED VARIABLES		% Missing	N=128 (%)*	Median	IQR
	(n=127)				
Case Management Labor Inputs	Geriatric Case Manager for All Older Adults (n=126)	2%	82 (64%)	-	-
	Dedicated Trauma Case Managers (n=113)	12%	26 (20%)	-	-
	RN Case Managers (n=106)	17%	71 (56%)	-	-
	Social Worker Case Managers (n=91)	29%	3 (2%)	-	-
	RN or SW Case Managers (n=97)	24%	49 (38%)	-	-
Geriatric-trained Providers	Geriatricians Available to All Adult Units (n=124)	3%	36 (28%)	-	-
	Geriatric Advanced Practice Nurses Available to All Units (n=126)	2%	16 (13%)	-	-
Multi-disciplinary Teams	Multi-disciplinary Team Available to All Adult Units (n=127)	<1%	114 (89%)	-	-
	Multi-disciplinary Trauma Team Available to All Adult Units (n=121)	5%	32 (25%)	-	-
Other	Patient Representative Services (n=112)	12%	88 (69%)	-	-

Shaded cells = excluded from further data analysis; [a] BSN: RN Bachelor of Science in Nursing; [b] FTE: Full-time Equivalent; all cases (n=128) included as denominator; * missing values scored as "0" (not present).

Bivariate Analysis of Independent Variables

Correlations of hospital-level patient characteristics with capital inputs.

Table 4.17 summarizes all correlations between patient characteristics and capital inputs. One correlation was statistically significant ($p < .01$). Patients with higher comorbidities (reflecting higher disease burden in hospitals) was associated with hospitals more likely to have assistive technology available as opposed to hospitals without assistive technology. All other patient characteristics were not statistically significantly associated with any capital inputs.

Table 4.17. Correlations between Hospital-Level Patient Characteristics and Capital Inputs

	AMV	Age	% Female	TMPM [a]	Comorbidity Index	% Hip Fractures	% HIOAs
CAPITAL INPUTS	Medication compatibility alerts	-.07 (.468)	.05 (.564)	.06 (.487)	.03 (.709)	.14 (.152)	.10 (.283)
	Standardized checklist for VAP [b]	.00 (.989)	.21 (.017)	.11 (.203)	.07 (.456)	.21 (.016)	-.09 (.296)
	Standardized checklist for CAUTI [c]	.07 (.443)	.11 (.202)	.12 (.170)	-.02 (.818)	.22 (.014)	.08 (.347)
	Retrieval of NH [d] data	.18 (.042)	.15 (.082)	-.17 (.054)	-.02 (.786)	.01 (.877)	.12 (.182)
	Decision support for pressure ulcer risk assessment	-.08 (.378)	.03 (.722)	.13 (.151)	-.02 (.812)	.08 (.355)	.02 (.828)
	Room-based meds	-.13 (.143)	-.01 (.873)	.02 (.807)	.08 (.365)	-.07 (.467)	-.05 (.589)
	Room-based linens	-.12 (.173)	-.01 (.953)	.04 (.659)	.07 (.396)	.06 (.535)	-.05 (.611)
	Room-based basic supplies	-.09 (.327)	-.01 (.906)	.13 (.148)	.11 (.227)	.15 (.090)	.09 (.312)
	Physical rehabilitation	-.06 (.502)	-.08 (.375)	.02 (.864)	.02 (.803)	-.17 (.060)	-.07 (.462)
	Assistive technology	-.08 (.382)	-.10 (.281)	.17 (.059)	.24 (.007)	.04 (.621)	-.08 (.355)
	Simulated rehabilitation environments	-.18 (.046)	-.16 (.066)	.15 (.084)	.06 (.508)	-.01 (.903)	-.13 (.147)

Shaded cells: p = .01; [a] Trauma Mortality Prediction Model; [b] ventilator-acquired pneumonia; [c] catheter-acquired urinary tract infection; [d] nursing home

Correlations of hospital-level patient characteristics with organizational facets.

Table 4.18 summarizes all correlations of hospital-level patient characteristics with organizational facets. The statistically significant ($p < .01$) correlations are summarized below. *Higher HIOA mean age* (in hospitals) was associated with non-teaching hospitals as opposed to teaching hospitals, non-trauma centers as opposed to any trauma center types, non-trauma centers as opposed to those with higher level of trauma services, non-ACS verified trauma centers as opposed to ACS-verified trauma centers, and hospitals without pain management services as opposed to those with pain management services. *Higher percentage of female HIOAs* (in hospitals) was

associated with private, investor-owned hospitals as opposed to government, not-for-profit hospitals, non-teaching hospitals as opposed to teaching hospitals, non-trauma centers as opposed to any trauma center type, non-trauma centers as opposed to those with higher level of trauma services, non-ACS-verified trauma centers as opposed to ACS-verified TCs, and non-Magnet hospitals as opposed to Magnet hospitals. *Higher HIOA injury severity* (in hospitals) (median TMPM scores) was associated with teaching hospitals as opposed to non-teaching hospitals, higher level trauma centers as opposed to non-trauma centers, ACS-verified trauma centers as opposed to non-ACS-verified trauma centers, hospitals with geriatric resource programs and acute care models as opposed to those without, hospitals with a specialty unit for frail elders as opposed to those without, Magnet hospitals as opposed to non-Magnet hospitals, and hospitals with an Alzheimer Center as opposed to those without. *Higher HIOA percentage of hip fractures* (in hospitals) was associated with private, for-profit hospitals as opposed to government, not-for-profit hospitals, non-teaching hospitals as opposed to teaching hospitals, non-trauma centers as opposed to all trauma centers, and non-trauma centers as opposed to higher level trauma centers. *Higher percentage of HIOAs among total discharges* (in hospitals) was associated with non-teaching hospitals as opposed to teaching hospitals. *Higher HIOA comorbidities* (in hospitals) was not associated with any organizational facets.

Table 4.18. Correlations between Hospital-Level Patient Characteristics and Organizational Facets

	AMV	Age	% Female	TMPM [a]	Comorbidity Index	% Hip Fractures	% HIOAs
ORGANIZATIONAL FACETS	Ownership [b]	-.09 (.321)	.28 (.001)	.13 (.133)	.13 (.145)	.26 (.003)	.16 (.077)
	Teaching status [c]	-.46 (<.001)	-.37 (<.001)	.34 (<.001)	.02 (.812)	-.35 (<.001)	-.29 (.001)
	Trauma center status [d]	-.29 (.001)	-.36 (<.001)	.17 (.055)	.09 (.315)	-.29 (.001)	-.02 (.839)
	Trauma center levels [e]	.39 (<.001)	.44 (<.001)	-.28 (.002)	-.09 (.308)	.35 (.000)	.08 (.356)
	TC ACS verification [f]	-.39 (<.001)	-.49 (<.001)	.34 (<.001)	.08 (.397)	-.18 (.043)	-.16 (.075)
	Inclusive trauma system	.16 (.069)	-.05 (.584)	-.11 (.204)	.07 (.431)	-.09 (.339)	.15 (.092)
	Home Health services	.04 (.644)	-.04 (.676)	.02 (.847)	.02 (.847)	.01 (.871)	.02 (.849)
	Meals on Wheels	-.09 (.290)	-.10 (.254)	-.02 (.818)	.02 (.847)	-.18 (.039)	.04 (.628)
	Comprehensive geriatric assessment	.10 (.049)	.13 (.160)	-.09 (.311)	-.02 (.864)	.01 (.927)	.02 (.850)
	Geriatric Services	-.05 (.593)	.02 (.869)	.09 (.310)	.07 (.435)	-.14 (.106)	-.17 (.054)
	ICU Sleeping arrangements in patient room	.16 (.068)	.00 (.964)	.01 (.899)	.19 (.036)	.05 (.603)	.07 (.447)
	ICU Sleeping arrangement near ICU	-.03 (.728)	.07 (.412)	-.04 (.694)	-.05 (.556)	.01 (.874)	.09 (.312)
	Geriatric resource program(s)	-.21 (.020)	-.23 (.010)	.28 (.001)	.07 (.425)	-.11 (.205)	-.02 (.793)
	Geriatric acute care model(s)	-.17 (.050)	-.19 (.030)	.25 (.005)	.06 (.526)	-.08 (.373)	-.02 (.839)
	Specialty unit for frail elders	.16 (.075)	-.06 (.518)	.27 (.002)	-.16 (.078)	.02 (.833)	-.18 (.839)
	Magnet hospital	-.19 (.035)	-.24 (.007)	.23 (.009)	.06 (.541)	-.15 (.103)	-.14 (.117)
	Transportation services	-.19 (.035)	-.21 (.015)	.15 (.093)	-.03 (.760)	-.09 (.313)	-.13 (.156)
	Skilled nursing beds	.05 (.589)	.16 (.079)	-.07 (.424)	-.01 (.873)	.04 (.632)	.09 (.313)
	Orthopedic services	-.18 (.042)	-.02 (.786)	.18 (.046)	.08 (.400)	.13 (.136)	.07 (.453)
	Pain Mngmt services	-.28 (.001)	-.17 (.057)	.13 (.136)	.01 (.893)	-.10 (.253)	-.08 (.364)
	Alzheimer center	-.13 (.149)	-.15 (.089)	.29 (.001)	.13 (.131)	-.07 (.425)	-.16 (.073)

Shaded cells: p = .01; [a] Trauma Mortality Prediction Model; [b] Ownership coded: government, not-for-profit (1), private, not-for-profit (2), private, investor-owned (3); [c] Teaching status coded: non-teaching (0), teaching (1); [d] Trauma center status coded: non-TC (0), TC (1); [e] Trauma center levels coded: level I (1), level II (2), level III/IV (3), non-TC (4); [f] American College of Surgeons verification- coded: non-ACS (0), ACS (1)

Correlations of hospital-level patient characteristics with labor inputs.

Table 4.19 summarizes all correlations of patient characteristics with labor inputs. Statistically significant ($p < .01$) correlations are summarized below. *Higher HIOA mean age* (in hospitals) was associated with lower percentages of BSN nurses as opposed to higher percentages of BSN nurses and no dedicated trauma case managers as opposed to presence of dedicated trauma case managers. *Higher percentage of female HIOAs* (in hospitals) was associated with lower percentages of BSN nurses as opposed to higher percentages, higher percentages of LPNs on med/surg units as opposed to lower percentages of LPNs on med/surg units, no dedicated trauma case managers as opposed to presence of dedicated trauma case managers, and no multidisciplinary trauma team as opposed to presence of multidisciplinary trauma teams. *Higher HIOA injury severity* (in hospitals) (median TMPM scores) was associated with higher percentages of BSN nurses as opposed to lower percentages of BSN nurses, lower percentages of LPNs on med/surg units as opposed to higher percentages of LPNs on med/surg units, availability of geriatric advanced practice nurses as opposed to no geriatric APN nurses and presence of multidisciplinary trauma teams as opposed to no multidisciplinary trauma teams. *Higher percentage of HIOAs with a primary hip fracture diagnosis* (in hospitals) was associated with no dedicated trauma case managers as opposed to presence of dedicated trauma case managers. Finally, *higher percentage of HIOAs among total discharges* was associated with lower percentages of RN certification as opposed to higher percentages of RN certification, no geriatricians as opposed to presence of geriatricians, and no psychiatric consultation as opposed to availability of psychiatric consultation.

Higher HIOA comorbidities (in hospitals) was not statistically significantly associated with any labor inputs

Table 4.19. Correlations between Hospital-Level Patient Characteristics and Labor Inputs

	AMV	Age	% Female	TMPM [a]	Comorbidity Index	% Hip Fractures	% HIOAs
LABOR INPUTS	% BSNs [b]	-.27 (.003)	-.24 (.007)	.31 (<.001)	.05 (.613)	-.06 (.528)	-.20 (.029)
	RN certification	-.21 (.024)	-.11 (.228)	.17 (.061)	.10 (.289)	.07 (.452)	-.24 (.008)
	Percent RN Med/Surg	-.07 (.458)	-.09 (.303)	.06 (.487)	-.02 (.868)	.05 (.620)	.04 (.689)
	Percent LPN Med/Surg	.14 (.124)	.24 (.008)	-.28 (.002)	-.12 (.198)	.02 (.793)	.07 (.462)
	Percent Other Med/Surg	-.02 (.827)	.00 (.974)	.10 (.292)	.07 (.438)	.01 (.927)	-.06 (.548)
	Percent RN turnover	-.12 (.189)	-.01 (.897)	.04 (.709)	.01 (.887)	.12 (.190)	.13 (.179)
	% RNs ≥ 5 years exp	.16 (.089)	.12 (.215)	-.24 (.011)	-.13 (.181)	-.12 (.224)	.01 (.887)
	Geriatric APNs [c]	-.19 (.032)	-.19 (.035)	.30 (.001)	.09 (.338)	-.12 (.175)	-.16 (.069)
	Geriatricians	-.23 (.010)	-.20 (.022)	.19 (.028)	.04 (.641)	-.17 (.050)	-.23 (.009)
	Case manager for all geriatric patients	.03 (.757)	.19 (.039)	.05 (.590)	.06 (.540)	.07 (.443)	.19 (.036)
	Dedicated trauma case manager	-.26 (.006)	-.31 (.001)	.22 (.019)	.12 (.206)	-.33 (<.001)	.02 (.871)
	Multidisciplinary Team	-.07 (.447)	.07 (.418)	.02 (.798)	-.02 (.820)	.01 (.914)	.07 (.418)
	Multidisciplinary trauma team	-.19 (.034)	-.33 (<.001)	.23 (.008)	.01 (.883)	-.21 (.015)	.06 (.492)
	Psychiatric nurse liaison	-.09 (.331)	.00 (.983)	.18 (.049)	.18 (.035)	.09 (.307)	-.21 (.017)
	Psychiatric consultation	.00 (.998)	-.08 (.396)	.13 (.143)	.19 (.027)	.18 (.039)	-.27 (.002)
	Gero-psychiatric consultation	.02 (.853)	-.02 (.840)	.13 (.159)	.19 (.037)	.09 (.312)	-.21 (.018)
	Patient representative services	-.05 (.595)	-.19 (.036)	.21 (.015)	.10 (.279)	,03 (.771)	-.12 (.163)

Shaded cells: $p < .01$; [a] Trauma Mortality Prediction Model; [b] bachelor of science in nursing; [c] advanced practice nurse(s)

Bivariate Analyses of Independent Variables and the ACOVE Indicator Index

Correlations of hospital-level patient characteristics with ACOVE Indicator Index.

Correlations between hospital-level patient characteristics and the ACOVE Indicator Index are shown in Table 4.20. No statistically significant associations were present between any patient characteristics and the ACOVE Indicator Index.

Table 4.20. Correlations of Patient Characteristics with ACOVE Indicator Index

Patient Characteristic	ACOVE Index (r, p-value)
MeanAge	.06 (.524)
Percent female	.14 (.123)
Injury severity (TMPM)	-.06 (.510)
Comorbidity index	-.15 (.085)
Percent Hip fractures	-.07 (.446)
Percent HIOAs/Total discharges	.05 (.542)

Correlations of AMVs with ACOVE Indicator Index.

Correlations between AMVs and the ACOVE Indicator Index are shown in Table 4.21. Three variables (computer support for pressure ulcer risk assessment, Alzheimer centers, comprehensive geriatric assessment) were found to be statistically significant ($p < .01$). A higher ACOVE Index (ACOVE adoption) was associated with availability of computerized decision support for pressure ulcer risk assessment as opposed to non-availability, hospitals *without* Alzheimer Centers as opposed to hospitals with Alzheimer Centers, and availability of comprehensive geriatric assessment as opposed to non-availability.

Table 4.21. Correlations of Administratively-Mediated Variables with ACOVE Indicator Index

Administratively-Mediated Variables	ACOVE Index (r, p-value)
Capital Inputs	
Medication compatibility alerts	.14 (.117)
Retrieval of nursing home data	.20 (.024)
Standardized checklist for VAP Bundle	.22 (.013)
Standardized checklist for CAUTI Bundle	.20 (.021)
Decision support for pressure ulcer risk assessment	.23 (.009)
Room-based medications	-.00 (.969)
Room-based linens	.08 (.374)
Room-based basic supplies	.09 (.327)
Assistive technology	.00 (.978)
Physical rehabilitation	.09 (.315)
Simulated rehabilitation environment	-.18 (.039)
Electronic health record	-.06 (.516)
Organizational Facets	
Skilled nursing beds	-.03 (.747)
Alzheimer's center	-.26 (.003)
Home health services	-.21 (.019)
Meals on wheels	-.01 (.886)
Transportation to health services	-.03 (.747)
Comprehensive geriatric assessment	.29 (.001)
Geriatric services	.04 (.662)
Specialty unit for frail elders	.14 (119)
Geriatric resource programs	.05 (.607)
Trauma center status	-.21 (.017)
Trauma center ACS-COT verification	-.09 (.306)
Trauma system status	-.00 (.981)
Type ED Triage	.01 (.891)
ICU-visitor sleeping arrangements in patient room	.10 (.256)
ICU- visitor sleeping arrangement near ICU	-.09 (.339)
Magnet hospital status	-.09 (.315)
Orthopedic services	-.02 (.863)
Pain management Program	.01 (.935)
Teaching status (COTH)	-.08 (.388)
Control- type organization	.01 (.873)
Labor Inputs	
Percent BSN	-.06 (.480)
Percent nurse certification	.18 (.053)
Percent other ICU	-.02 (.801)
Percent RNs: Med/Surg	.11 (.210)
Percent LPNs Med/Surg	.03 (.756)
Percent Other Med/Surg	-.18 (.049)
Percent RN turnover	-.12 (.216)
Percent RN workforce with ≥ 5 years experience	.13 (.161)
Psychiatric nursing liaison	.12 (.168)
Psychiatric consultation	.06 (.527)
Gero-Psychiatric consultation	.01 (.880)
Case Manager- all geriatric patients	.06 (.525)
Dedicated trauma case managers	-.09 (.296)
Geriatricians	.08 (.366)

Administratively-Mediated Variables	ACOVE Index (r, p-value)
Geriatric advanced practice nurses	.10 (.286)
Multi-disciplinary team	.09 (.337)
Multi-disciplinary trauma team	-.07 (.423)
Patient representative services	-.04 (.640)

Shaded cells: $p < .01$.

Summary of Results for Aim Two

Data analysis for Aim Two examined administratively-mediated variables and associations with hospital-level patient characteristics and adoption of ACOVE indicators. Several highlights from the analyses and results are noted. First, the overall presence of geriatric-focused AMVs in hospitals was low. Less than 50% of hospitals had geriatric-focused AMVs, including support for retrieval of nursing home data, comprehensive geriatric assessment, geriatric services, and geriatric-trained providers (gero-psych consultation, geriatricians, geriatric advanced practice nurses). Second, examination of associations among HIOA patient characteristics and AMVs revealed that higher percentages of older patients, higher percentages of female patients, higher percentages of hip fractures, and higher percentages of HIOAs among total discharges are associated with hospitals lacking in resources. For example, hospitals with higher percentages of older patients and higher percentages of female patients were associated with non-teaching hospital, non-trauma centers, hospitals without geriatric resource programs, and hospitals without geriatric-trained providers. Third, hospitals that had a higher proportion of patients with higher injury severity were noted to be associated with increased resources, including teaching hospitals, geriatric-specific resources, orthopedic services, and Alzheimer centers. Comorbidities were statistically significantly associated with one AMV, assistive technology.

Examination of patient characteristics as consumer types revealed that patient characteristics were not associated with adoption of ACOVE indicators, however several associations were found between AMVs and adoption of ACOVE indicators. One AMV related to computerized support (decision support for pressure ulcer risk assessment) was statistically significantly associated with ACOVE indicator adoption, and it is also noted that three other AMVs related to computerized support (retrieval of nursing home data, standardized checklists for VAP and CAUTI bundles) were associated with a higher ACOVE Indicator Index. Comprehensive geriatric assessment was also associated with ACOVE indicator adoption while hospitals *without* Alzheimer Centers had higher ACOVE indicator adoption.

Aim Three

Aim Three: To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indicators for HIOAs.

The four data sources for this study were used to meet this aim and a sequential approach was employed. First, descriptive statistics were generated for hospital rates of postoperative deep vein thrombosis or pulmonary embolus (PSI #12). Second, correlations between independent variables (patient characteristics and AMVs [including the ACOVE Indicator Index]) and the dependent variable (PSI #12) were conducted to determine associations. Finally, a hierarchical regression model was used to determine whether variables (patient characteristics and AMVs) representing four levels of influence (patient-specific, hospital- specific, injury specific, and geriatric-specific) explained variations in PSI rates among hospitals.

Descriptive Statistics

Table 4.22 provides a summary of the prevalence of postoperative deep vein thrombosis or pulmonary embolus (PSI #12). The median PSI rate was .002 (two cases per one thousand patients) with a range from .00 to .04 (four cases per 100 patients).

Table 4.22. Descriptive Summary of PSI #12 (Postoperative deep vein thrombosis or pulmonary embolus) (N=112)

Dependent variable	Median	IQR	Min-Max
PSI #12 Deep vein thrombosis or pulmonary embolus	.002	.00-.006	.00-.04

Bivariate Analysis of Independent Variables

Correlations of patient characteristics with the deep vein thrombosis rates (PSI #12).

Associations of patient characteristics with PSI rates are shown in Table 4.23. The strongest positive and statistically significant associations ($p < .001$) were of injury severity and Comorbidity Index with rates of deep vein thrombosis. A statistically significant gender difference was also observed with hospitals having lower percentage of female HIOAs (in hospitals) having higher rates of PSI #12 (i.e., hospitals with more males had higher rates of DVTs or PEs).

Table 4.23. Unadjusted associations of patient characteristics and Rate of PSI #12 (Postoperative deep vein thrombosis and pulmonary embolus) (N=112)

Patient Characteristic	PSI #12
Mean Age	-.17 (.066)
Percent female	-.29 (.002)
Injury severity (TMPM)	.34 (< .001)
Comorbidity index	.33 (< .001)
Percent Hip fractures	-.00 (.978)
Percent HIOAs/Total discharges	-.10 (.317)

Shaded cells: $p < .01$.

Correlations of AMVs with the deep vein thrombosis rates (PSI #12).

Associations of AMVs with PSI #12 are shown in Table 4.24. Two capital input variables (assistive technology, simulated rehabilitation environment) were associated with higher rates of PSI #12 ($p < .01$). Three organizational facets (geriatric resource programs, level I/II trauma centers, pain management programs) were associated with higher rates of PSI #12 ($p < .01$). Last, two labor inputs (gero-psychiatric consultation, geriatric advanced practice nurses) were associated with higher rates of PSI #12 ($p < .01$).

Table 4.24. Associations of Administratively-Mediated Variables with PSI #12 (Postoperative deep vein thrombosis and pulmonary embolus) (N=112)

Administratively-Mediated Variables	PSI #12 (r, p-value)
Capital Inputs	
Decision support for pressure ulcer risk assessment	.15 (.107)
Room-based medications	-.05 (.626)
Room-based linens	.00 (.978)
Room-based basic supplies	-.00 (.969)
Assistive technology	.26 (.005)
Physical rehabilitation	.20 (.036)
Simulated rehabilitation environment	.36 (.000)
Organizational Facets	
Skilled nursing beds	-.00 (.982)
Alzheimer center	.17 (.072)
Home health services	.13 (.172)
Meals on wheels	.14 (.150)
Transportation to health services	.17 (.080)
Comprehensive geriatric assessment	-.05 (.572)
Geriatric services	.22 (.023)
Presence of geriatric resource program	.28 (.003)
Trauma center status	.19 (.042)
Trauma Center Level [a]	-.31 (.001)
Trauma center ACS-COT verification	.22 (.021)
Trauma system status	-.09 (.326)
ICU-visitor sleeping arrangements in patient room	-.14 (.130)
ICU- visitor sleeping arrangement near ICU	.03 (.729)
Magnet hospital status	.22 (.025)
Orthopedic services	.24 (.013)
Pain management program	.28 (.003)
Teaching status (COTH)	.22 (.020)
Control- type organization	.09 (.363)
ACOVE indicator index	-.06 (.532)
Labor Inputs	
Percent BSN	.24 (.013)
Percent nurse certification	.19 (.056)
Percent other ICU	-.09 (.397)
Percent RNs: Med/Surg	.21 (.034)
Percent LPNs Med/Surg	-.05 (.627)
Percent RN turnover	.06 (.534)
Percent RN workforce with ≥ 5 years experience	-.04 (.686)
Psychiatric nursing liaison	.21 (.030)
Psychiatric consultation	.21 (.025)
Gero-Psychiatric consultation	.27 (.004)
Case Manager- all geriatric patients	-.03 (.798)
Dedicated trauma case managers	.15 (.140)
Geriatricians	.16(.100)
Geriatric advanced practice nurses	.24 (.009)
Multidisciplinary team	.10 (.279)
Multi-disciplinary trauma team	.19(.051)
Patient representative services	.20 (.025)

Shaded cells: $p < .01$; [a] Trauma center level coding: level I (1), level II (2), level III/IV (3), non-TC (4)

Multivariate Hierarchical Model

Finally, a multivariate examination of the contributions of variables at four levels of influence (patient characteristics, general hospital factors, trauma centers, and geriatric-specific factors) with PSI #12 rates was conducted. It was hypothesized that after controlling for variables at the first three levels (patient characteristics, general hospital factors, trauma center) of influence, geriatric-specific AMVs would be statistically significant variables associated with rates of PSI #12. A hierarchical linear regression model was used for this analysis. Ten variables representing four levels of hypothesized influence were used in the regression model (1st level: patient characteristics [percent female, comorbidities, injury severity]; 2nd level: general hospital factors [simulated rehabilitation environments, pain management program]; 3rd level: trauma hospital characteristics [trauma center level]; and 4th level: geriatric-specific characteristics [ACOVE indicator adoption, presence of geriatric resource programs, geriatric advanced practice nurses]). Sequential introduction of variables according to level of influence enabled examination of associations with the dependent variable after adjusting for variables entered previously.

Results from the hierarchical multiple regression are summarized in Table 4.25. Statistically significant associations of patient characteristics with PSI rates were seen in the initial step (Multiple $R = .46$, $p < .001$), accounting for approximately 19% of the variability in PSI rates (Adjusted $R^2 = .19$). The addition of general hospital factors (simulated rehabilitation environments and pain management programs) resulted in a statistically significant increase shared variability in PSI rates (Multiple $R = .56$, Adjusted $R^2 = .28$; R^2 change $= .11$; $p < .001$). Further introduction of trauma center

levels and geriatric-specific variables, including ACOVE indicator adoption (ACOVE Index), did not demonstrate statistically significant increases in the amount of explained variability in PSI rates (R^2 change = .01 and .03) In the final model, controlling for the influence of all other variables, the strongest adjusted associations with rates of postoperative deep vein thrombosis or pulmonary embolus (PSI #12) were observed for comorbidities (comorbidity index) (~ 9% shared variance, $p < .001$) and simulated rehabilitation environments (~ 7% shard variance, $p = .004$).

Table 4.25. Summary of results from hierarchical multiple linear regression of PSI #12 (Postoperative DVT or PE) Rates on Four Levels of Influence (patient characteristics, general hospital factors, trauma centers, geriatric-specific characteristics) (N=112)

Characteristic	Beta	p-value	Unadjusted R	p-value	Adjusted R^2	R^2 change	p-value
Step 1			.46	<.001	.19	.21	<.001
Comorbidity Index	.27	.002					
Injury severity (TMPM)	.24	.015					
Percent female	-.13	.180					
Step 2			.56	<.001	.28	.11	<.001
Comorbidity Index	.29	.001					
Injury severity (TMPM)	.21	.027					
Percent female	-.06	.516					
Simulated rehabilitation environment	.26	.004					
Pain management program	.14	.111					
Step 3			.57	<.001	.28	.01	.362
Comorbidity Index	.29	.001					
Injury severity (TMPM)	.19	.042					
Percent female	-.01	.915					
Simulated rehabilitation environment	.25	.005					
Pain management program	.13	.156					
Trauma center level	-.10	.362					
Step 4			.59	<.001	.29	.03	.240
Comorbidity Index	.30	<.001					
Injury severity (TMPM)	.18	.050					
Percent female	-.02	.939					
Simulated rehabilitation environment	.26	.004					
Pain management program	.09	.310					
Trauma center level	-.08	.525					
ACOVE Indicator adoption	.11	.231					
Geriatric resource programs	.10	.291					
Geriatric advanced practice nurses	.04	.690					

$F = 6.06_{(df9, 111)}$, $p<.001$

Summary of Results for Aim Three

Data analysis for Aim Three examined administratively-mediated variables and associations with rates of one patient safety indicator (PSI), postoperative deep vein thrombosis or pulmonary embolus (PSI #12). Associations between patient characteristics and PSI rates were also examined. Prominent findings from the analyses are noted. First,

variables from all three AMV categories were associated with variance in PSI rates. Among capital inputs, hospitals with more rehabilitative resources had higher rates of PSI #12. Hospitals with select organizational facet resources (geriatric resource programs, level I trauma centers, Magnet hospitals, teaching hospitals, and orthopedic services) were also associated with higher rates of PSI #12. Among labor inputs, hospitals with more resources (BSN nurses, psychiatric services, geriatric advanced practice nurses) had higher rates of PSI #12.

A hierarchical regression model was used to understand associations of variables at four levels. Several highlights were noted. First, although trauma centers and geriatric-specific variables (including adoption of ACOVE indicators) were associated with higher rates of PSIs, they did not have statistically significant associations in a multivariate hierarchical model after adjusting for patient and general hospital characteristics. Among AMVs related to rehabilitation resources, hospitals with simulated rehabilitation environments explained a small percentage (7%) of variance in PSI rates. However, patient characteristics (particularly comorbidities) primarily contributed to variances in PSI rates. The null hypothesis that geriatric-specific AMVs would not explain variations of PSI rate after controlling for other patient and hospital characteristics was accepted.

CHAPTER V

DISCUSSION

This chapter provides a synopsis and discussion of study findings for this dissertation study. The following five sections are addressed: 1) sample characteristics, 2) aims, 3) strengths and limitations, 4) implications, and 5) recommendations for future research.

Sample Characteristics

Study samples were based on returned surveys (N=128) of chief nursing officers from identifiable hospitals in the 2009 HCUP NIS that provided care to at least 10 patients age 65 or older with a primary injury diagnosis. Among 128 identifiable hospitals, 25,544 patients/discharges formed a patient-level dataset. The ability to merge four data sources enabled creation of a hospital-level dataset enriched with hospital demographics, organizational factors (administratively-mediated variables), patient characteristics, and patient outcomes.

Comparisons of the current study sample characteristics at both hospital and patient levels with those from a national data source (Agency for Healthcare Research and Quality (AHRQ), 2009) and prior studies (Clark & Chu, 2002; Clark, DeLorenzo, Lucas, & Wennberg, 2005; Gorra, Clark, Mullins, & DeLorenzo, 2008; Maxwell & Mion, 2010, Unpublished Study-a) reveal similar findings. Given similar comparisons and the small sample size, external validity for this study is moderate. Thus, findings for

each of the study aims can be generalized with caution to the population of hospitalized injured older adults recognizing that teaching status and the Northeast regions were over-represented.

Aims

Aim One: To determine the extent of adoption of targeted ACOVE indicators for hospitalized injured older adults in acute care settings. Data to meet this aim were obtained from a survey of chief nursing officers (CNOs) because adoption of quality indicators is primarily a nursing function. The conduct of prior content validation by CNOs strengthened the survey validity.

Overall adoption of nine ACOVE indicators

Within the literature, two studies (Arora et al., 2009; Neuman, et al., 2010) have examined presence of and adherence to quality indicators in hospitals. Neuman et al. (2010) assessed the prevalence of written protocols for inpatient care of older adults through a survey of CNOs in Pennsylvania hospitals (n=103) for 2009. Comparisons of the current study with the previous study revealed some similarities: 1) assessment of risk factors for delirium (Neuman et al.: 21.1%; current study: 26%); 2) screening for delirium after surgery (Neuman et al.: 17.0%; current study: 24%); 3) timing of mobilization after surgery (Neuman et al.: 34.0%; current study: 83%); 4) assessment of physical function at discharge (Neuman et al.: 80.7%; current study: 91%); and 5) assessment of cognition at discharge (Neuman et al.: 40.2%; current study: 37%) (Neuman, et al., 2010). The difference in target populations of the two studies may

explain the findings. The current study focused on injured older adults and the other focused on all adults.

Arora et al. (2009) examined adherence to select ACOVE indicators at one University medical center. Two of the indicators (surgical patients assessed for cognitive status, documentation of multidimensional assessment of cognitive ability and assessment of functional status) examined in that work were also used in the current study. Adherence to assessment of cognition in surgical patients was 4.3% in the prior study, compared to 24% in the current study. Adherence to multidimensional assessment of cognition and functional status in the prior study was 41.9%, compared to 47% in the current study. Of note, the prior study examined *adherence* by conducting medical record reviews, while the measure (partial to complete adoption) for this study was obtained through a survey. This may account for the difference for assessment of cognition in surgical patients.

Compared with prior studies, the findings for the current study suggest that some improvements may have occurred in the adoption of ACOVE indicators. For example, compared with Neuman et al. (2010), protocol adherence/indicator adoption was higher for 4 of 5 indicators. The greatest difference was for timing of mobilization after surgery (34% vs. 83%). Differences in data collection methods (CNO self-report versus medical record review) could account for this difference. Many studies over the past 10 years, as well as the most recent studies and practice guidelines (Chong, Savige, & Lim, 2010; Gregory, Kostakopoulou, Cool, & Ford, 2010; Hildreth et al., 2010; Morris, Benetti, Marro, & Rosenthal, 2010) support early mobilization for elderly surgical patients. The findings of this study may reflect greater progress for this indicator. An alternate

explanation may be selection bias among CNOs. For example, the 128 CNOs who completed the survey may have had a greater interest in geriatric care and/or desire to provide positive answers. Given no reward or recognition was offered for survey completion, this does not seem like a likely explanation.

ACOVE indicator adoption by hospital characteristics.

Geographic region. Among the nine ACOVE indicators, the Northeast region had the highest percentage of adoption for six of nine indicators with one indicator (assessment of functional status) having a statistically significant difference compared to other geographic groups. For the remainder, the West region had the highest percentage for three of the indicators, and the Midwest and South were similar in adoption behind the Northeast and West. No studies have examined quality indicator adoption by geographic regions, however, one study (Marshall, Harbin, Hooker, Oswald, & Cummings, 2012) did examine whether safety-net hospitals published quality performance data and which were top performers in the Centers for Medicare and Medicaid Services (CMS) core quality and patient satisfaction (HCAHPS) measures. They reported hospitals in the Northeast were highest performers on core measures and were most likely to post core measures online. Another study (Jha, Li, Orav, & Epstein, 2005) examined hospital performance from CMS data on 10 quality indicators and found significant regional differences with the Midwest and Northeast outperforming the West and South.

One explanation may account for the findings in the current study. The Northeast region is home to both of the most prominent geriatric acute care models for hospitalized elders (NICHE and HELP). Based out of university medical centers (New York

University, Yale University) in the Northeast, other hospitals in the region may be more familiar with NICHE and HELP. In fact, a prior study (Maxwell & Mion, 2010, Unpublished Study-a)found that hospitals in two states (New York, New Jersey) had the highest number of NICHE programs within the U.S. This finding is consistent with findings in the studies described above (Jha, et al., 2005; Marshall, et al., 2012) that found better performance in the Northeast.

Bedsize and Teaching Status. Variability of ACOVE indicator adoption by bedsize and teaching status revealed no patterns of adoption or statistically significant differences. Indicator adoption varied widely among hospitals by bedsize. Among six indicators, percentages of adoption were equivalent for both teaching and non-teaching hospitals. These findings could be interpreted as encouraging because hospitals of variable bedsize and teaching status were able to achieve equivalent levels of ACOVE adoption. Other studies within the literature (Jha, et al., 2005) found no relationship between bedsize and quality of care. Adoption of quality indicators by teaching status has not been examined; however, patient outcomes have been examined between teaching and non-teaching hospitals. A systematic review (Papanikolaou, Christidi, & Ioannidis, 2006) of patient outcomes in teaching and non-teaching facilities revealed that teaching facilities did not experience better outcomes than non-teaching facilities. Another study (Vartak, Ward, & Vaughn, 2008) found that teaching hospitals treat sicker patients and perform more complicated procedures, but that after adjusting for patient characteristics, there were no differences in outcomes. The findings from the current study suggest that while many teaching hospitals may be located in academic settings and have more

resources than non-teaching hospitals this does not necessarily translate into written protocols and practice change.

Trauma center status. Adoption of ACOVE indicators by trauma center status revealed consistent findings across all nine indicators. Level I trauma centers had the highest percentage of adoption for six of nine indicators, and second highest for two others. Behind Level I trauma centers, non-trauma centers had the next highest percentages of ACOVE adoption. Level II trauma centers had the lowest percentage of ACOVE adoption for all nine indicators. One reason for these findings could be that the small sample of Level I trauma centers (n = 9) were not reflective of all Level I trauma centers. Considering that trauma centers are often teaching hospitals, the findings for the Level II trauma centers might be a more accurate portrayal of ACOVE adoption among trauma centers, and more consistent with adoption patterns of teaching hospitals.

Geriatric Acute Care Models. Adoption of ACOVE indicators among hospitals with/without geriatric acute care model (NICHE or HELP) was evenly distributed across all nine indicators. For three indicators (multidimensional assessment of cognition, discharge assessment for level of independence and home health, ambulation by postoperative day two), hospitals without an acute care model had higher percentages of adoption. For three indicators (assessment for etiology of delirium, plan to increase mobilization within 48 hours, discharge assessment for cognitive and functional status), hospitals with an acute care model had higher percentages, and for the remaining three indicators adoption percentages were equivalent within 5%.

These findings were unexpected because adoption of geriatric-specific indicators seems an expectation for hospitals with geriatric acute care models. Several explanations

for this are possible. First, closer inspection of the degrees of adoption among hospitals with an acute care model shows a *gap* between 'no implementation' and 'full implementation throughout the hospital.' The degrees of adoption that lie between the two extremes (partial implementation), contain only one or two hospitals for all nine indicators. This suggests that the NICHE or HELP hospitals in this study are either in beginning stages (no activity or under development) of adoption or have matured to the point of full adoption. Given the small sample size and survey method used for measurement, the statistical analysis might not detect this finding. Another explanation reflects the possibility that hospitals without a geriatric acute care model are using evidence-based guidelines (including ACOVE indicators) to develop protocols and that these hospitals may be similar in adoption to NICHE hospitals. Finally, an expectation of higher adoption rates among NICHE hospitals may not be appropriate. One study (Mezey et al., 2004) examined the use of geriatric nursing protocols and found that 51% of NICHE hospitals were using geriatric protocols. In the current study, the overall percentage of full adoption of all nine ACOVE indicators was 58%, or 7% above the prior study. Perhaps the current study reflects an *increase* in indicator adoption among NICHE hospitals.

Aim Two: To determine associations among administratively-mediated variables (AMVs), patient characteristics, and the extent of adoption of ACOVE indicators for HIOAs. Aim Two was based on the concept of 'administratively-mediated variables (AMVs),' a term defined by Minnick and colleagues to describe factors within hospitals that are shaped by decisions of key personnel (administrators) (Minnick, et al., 1997). The concept implies that variables can be altered (mediated) through administrative

actions. The Minnick and Roberts Outcome Model focuses on variables for which system modifications can be made, as opposed to patient or provider modifications. Sub-categories within the concept include capital inputs, organizational facets, and labor inputs. The current study examined an array of AMVs within the three categories that could potentially influence the adoption of quality indicators within hospitals. Variables were obtained from the survey of CNOs, the 2009 American Hospital Association (AHA) survey of hospitals, and a prior study. After descriptive statistics were conducted for over 70 AMVs, correlations between AMVs and patient characteristics, and correlations between AMVs and adoption of the nine ACOVE indicators were conducted and examined. The following paragraphs discuss the findings along with possible explanations for the results.

Association among AMVs and HIOA patient characteristics. A number of AMVs were associated with hospital-level patient characteristics at a .01 significance level. From a broad perspective, the study findings revealed that older female HIOAs with lower injury severity and less comorbidities are treated at hospitals with less resources. A correlation between increased patient age and hospitals with lower percentages of BSN nurses was a noted finding. Higher percentage of female HIOAs was associated with non-Magnet hospitals, higher percentage of LPNs on med/surg units and absence of trauma case managers and multidisciplinary trauma teams. Higher injury severity was associated with presence of geriatric resources, Magnet hospitals, Alzheimer centers, geriatric advanced practice nurses, higher percentages of BSN nurses, and lower percentages of LPNs on med/surg units. Given that teaching hospitals (i.e., trauma centers) are associated with higher percentages of BSN nurses (Goode et al., 2001), these

findings are not surprising. However, future research is needed to further understand reasons for these interrelationships.

Associations among AMVs, patient characteristics, and adoption of ACOVE indicators. Correlations among patient characteristics and an ACOVE indicator index showed no statistically significant clinical correlations. While it might be expected for hospitals with higher percentages of older patients or higher percentages of primary hip fractures to adopt geriatric-specific quality indicators, the findings suggest that is not the case. Perhaps, despite the fact that ACOVE indicators were developed over 10 years ago (Wenger, et al., 2001), many hospitals with older patients remain unaware of these indicators. Another possibility may be that while hospital patient safety standards have focused on risk assessment for falls and need for home health, few initiatives have addressed geriatric syndromes. Hospitals may be more responsive to indicators that are driven by third party payers.

Correlations among AMVs and the ACOVE indicator index did reveal statistically significant correlations ($p < .01$). Three AMVs were associated with ACOVE adoption, including, computerized decision support for pressure ulcer assessment, and comprehensive geriatric assessment. Of note, three other capital inputs related to computer support were associated at a .05 level of significance. These findings are supported by prior studies. Menachemi, Chukmaitov, Saunders et al. (2008) found that hospitals with greater adoption of information technologies were more likely to utilize quality indicator measures and to have desirable outcomes. Longo, Hewett, Ge et al. (2007) examined organizational factors associated with patient safety systems and found that computerization support such as safety alert systems and availability of data to

support patient care systems were associated with better performance in implementing patient safety.

Comprehensive geriatric assessment (CGA) was associated with adoption of ACOVE indicators. This finding was anticipated as implementation of geriatric-specific quality indicators is a part of CGA. Comprehensive geriatric assessment is defined as a "multidimensional interdisciplinary diagnostic process focused on determining a frail older person's medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and long term follow up (Rubenstein, Stuck, Siu, & Wieland, 1991)." A recent meta-analysis (Ellis, Whitehead, O'Neill, Langhorne, & Robinson, 2011) of randomized controlled trials found that older patients are more likely to survive admission to the hospital if they undergo CGA.

An unanticipated association was between hospitals without Alzheimer Centers and higher adoption of ACOVE indicators. Seemingly, hospitals *with* Alzheimer Centers would have higher ACOVE adoption. The limited sample size of hospitals with Alzheimer centers (n = 12) may account for this finding.

Aim Three: To determine the extent to which AMVs, including adoption of ACOVE indicators, explain variations in patient safety indicators for HIOAs. Results for this aim provided new knowledge regarding the occurrence of four adverse events among HIOAs. Three of the patient safety indicators to be used as dependent/outcome variables (pressure ulcers, central line infections, and postoperative hemorrhage or hematoma) had very low rates among the patient sample, rendering data analysis impossible. This suggests that among the population of HIOAs, these three adverse events are either (1) not large problems, or (2) go unreported. Given national programs, the second

explanation is unlikely. Perhaps lower injury severity, shorter lengths of stay, and more time for preoperative assessment contribute to this finding. National programs to prevent these problems may be having a salutary effect.

Although three PSIs occurred at very low rates among HIOAs, one PSI rate (postoperative deep vein thrombosis [DVT] or pulmonary embolus [PE]- PSI #12) was much higher and occurred ten times as often as in the reference population (2008 HCUP NIS). Deep vein thrombosis is a common complication after traumatic injury (Chiasson, Manns, & Stelfox, 2009; Geerts, Code, Jay, Chen, & Szalai, 1994). Risk factors include pelvic and lower extremity fractures and prolonged immobilization. Increasing age is considered the single most important predictor of venous thrombosis in trauma patients (Toker, Hak, & Morgan, 2011). In light of these facts, it is not surprising that the rate of PSI #12 was high within the patient sample, since all patients were 65 and older, and 48% of the sample of patients had lower extremity fractures. Compared with the other three indicators, even the best prevention efforts for PSI #12 have a low success rate.

Studies within the last three years have been critical of the use of this PSI as an outcome measure to assess quality in hospitals (and trauma centers). Two studies (Haut et al., 2009; Pierce et al., 2008) used the National Trauma Data Bank to identify DVT rates in trauma centers and found significant surveillance bias and inequities in coding practices. Another study (Kaafarani et al., 2011), applied AHRQ PSI software to identify patients having a DVT. Medical records were subsequently examined for 'flagged' patients and 21% were found to have inaccurate coding, while another 36% of cases were present on admission. In light of these other studies, the findings from the current study should be regarded with caution.

Association of patient characteristics with PSI #12. Three patient characteristics had associations with PSI #12 at a .01 level of significance, including higher injury severity (TMPM score) (r = .34), increased comorbidities (comorbidity index) (r = .33), and lower percents of female patients (r = -.29). These findings are consistent with the literature (Andreou et al., 2008; Haut, et al., 2009).

Associations of AMVs with PSI #12. Seven AMVs had associations with PSI #12 at a .01 level of significance or less. Two AMVs related to physical rehabilitation (assistive technology, simulated rehabilitation environments) were associated with higher rates of PSI #12. Three geriatric-specific AMVs (geriatric resource programs, geriatric advanced practice nurses, gero-psychiatric consultation), and two injury-related AMVs (trauma centers with higher levels of service, pain management programs) were associated with higher rates of PSI #12. These findings suggest that occurrences of PSI #12 occur more often in resource-intensive hospitals where HIOAs have higher injury severity and more comorbidities.

Multivariate analysis of AMVs with PSI #12. A hierarchical regression model was used to examine patient characteristics and AMVs that might explain variances in PSI rates. This approach enabled examination of the relative importance of four levels of variables (patient characteristics, general hospital characteristics, trauma centers, and geriatric-specific variables [including the ACOVE indicator index]). The analysis showed that after controlling for the influence of all variables in the model, comorbidities, injury severity, and simulated home and community rehabilitation environments in hospitals remained as the only explanatory variables. There are several explanations for these results. First, hospitals with simulated home and community rehabilitation environments

may serve as referral centers for patients with greater injury severity and greater need for more intensive rehabilitation, thus explaining higher rates of DVTs. Another explanation is that immobility related to injury contributed to the occurrence of DVT and its discovery during the rehabilitation phase. Finally, although several AMVs (including adoption of ACOVE indicators) did not emerge as explanatory variables, it is important to note that in the final analysis, comorbidities and injury severity provided the strongest explanation for occurrence of DVTs.

Prior studies have shown higher rates of DVTs and PEs in trauma centers (Ang et al., 2009). Other studies (MacKenzie, et al., 2006; Rotondo, et al., 2009) have highlighted poorer outcomes in trauma centers for older patients and have raised questions about quality of care. After risk adjustment, trauma centers *were not* a factor that explained occurrence of DVTs or PEs in this study. Perhaps efforts made in this study to accurately reflect injury severity and disease burden (comorbidity) through the use of additional software (TMPM scoring) and creation of a hospital-level comorbidity index from 29 identified comorbidities support continued use of these methods in studies that examine outcomes at the hospital level.

Strengths and Limitations

This study was first to utilize administrative data to examine organizational factors that are associated with outcomes specific to HIOAs. It was also an initial study to examine patient safety indicators as an outcome measure for HIOAs. In consideration of these firsts, this section discusses strengths and limitations of the study for the following areas: 1) use of administrative data, 2) multi-level analysis, and 3) study design.

Administrative data.

Studies using administrative data have inherent strengths and weaknesses. Advantages for this study included less ethical concerns, data availability and lower cost. Since administrative data had already been collected, ethical issues were minimized. The 2009 HCUP NIS was purchased for $50 from AHRQ. Additional software (TMPM, PSI software) was free of charge, yet provided significant assistance in risk adjustment. The 2009 AHA Survey data was available free of charge from Vanderbilt University School of Nursing.

Despite strengths, use of administrative data also had limitations. One threat to data validity is un-blinded data collection methods. Data within the HCUP NIS was collected for non-research purposes. Coding of diagnoses and procedures are primarily for billing purposes resulting in the potential for 'gaming' of data (Powell, Davies, & Thomson, 2003; Riley, 2009).

Validity of data/measures could have been undermined by changes in hospitals' discharge and transfer practices or by changes in reporting practices over time (Powell, et al., 2003).

Another limitation was that of time frame. The HCUP NIS and AHA Survey data contained information from two years prior to current events and may not have accurately represented current practice. It is also noted that data used for this study were limited to those variables available in the datasets and were thus lacking in clinical detail. A final limitation was that of coping with chance variability. Large quantities of data are prone to identifying false outliers that can lead to false conclusions for type I errors (Powell, et al.,

2003). Pre-specification of outcomes of interest (ACOVE Indicator Index, PSI #12) in this study and reporting statistical significance of .01 was employed to minimize false conclusions.

Multi-level analysis.

The use of more than one level of data (i.e., patient-level and hospital-level) provided opportunities that strengthened the study but also held the potential for bias. Studies involving multiple levels of influence must address hypothesized relationships that operate across different levels (Luke, 2004). Use of the 2009 HCUP NIS provided the opportunity to utilize patient-level data from a nationally-representative sample, thus enabling the current study to be an inclusive, multi-site study, representative of all hospitalized injured older adults. In order to represent patient-level variables in context at the hospital level, it was necessary to apply statistical methods to create hospital-level patient characteristics, and hospital-level outcome measures. Methods used to accomplish this were a strength of the study. As noted in a previous section (pp. 33-38), the use of the Trauma Mortality Prediction Model (TMPM) and the comorbidity index were superior to traditional methods for risk adjustment. Once injury severity, comorbidity measures, and outcome events (DVTs and PEs) were determined at the patient level, methods were employed for all patient-level characteristics to create variables that were accurate representations of hospital-level characteristics.

Study design.

The use of four data sources was a strength of this study and provided the opportunity to enrich a hospital-level dataset with variables heretofore unexamined in studies of HIOAs and trauma centers. The HCUP NIS provided patient characteristics and outcomes. AHA Survey data and the prior study provided hospital characteristics (administratively-mediated variables), and the survey of CNOs provided detailed hospital information on other variables not available in administrative data. The choice of specific administratively-mediated variables enabled a study design that incorporated variables at multiple levels of influence (patient, hospital, trauma center, and geriatric-specific).

Dissemination of the study survey to CNOs in only 26 of 50 states was a limitation. Since eighteen states did not provide identifiers for individual hospitals, it was not possible to include data from all states in the HCUP NIS. Despite this limitation, the distribution of returned surveys closely represented a nationally-representative sample (HCUP NIS) for multiple hospital and patient characteristics.

The small sample size (N=128) of hospitals was also a limitation of the study. For variables with small sub-categories (i.e. geriatric acute care models), it was difficult to establish clinically and statistically significant associations. The sample size also limited the number of variables that could be used in multivariate data analysis. Despite the small sample size, the survey mailing approach actually resulted in a favorable response rate compared to similarly conducted health services research studies (Edwards, et al., 2009; VanGeest, Johnson, & Welch, 2007). The methods designed to increase the number of returned surveys (pre-survey postcard, 3 survey mailings, paper & web-based completion options) were a strength of the study. While the response rate was relatively low,

considering the recipients were senior-level administrators, the response rate approaching 30% was expected and resulted in a representative distribution of hospitals.

A final limitation of the study was the absence of patient characteristics of cognitive and functional impairment. Cognitive impairment and functional impairment are strong predictors of worse outcomes in hospitalized older adults as a whole (Bachmann, et al., 2010; Campbell, et al., 2004), yet these data are not available in administrative data. The extent to which HIOAs are admitted to hospitals with cognitive and functional impairment is unknown, yet may be significant factors in understanding patient outcomes.

Implications

Three primary implications can be drawn from this study. First, overall adoption of ACOVE quality indicators targeted to cognition and functional status is low among acute care hospitals, despite over a decade of work to promote adoption. Reasons for this remain unclear, and ultimately, the relationship of indicator adoption and patient outcomes must be established. Second, the study identified select areas of potential salutary effects of national programs aimed at improving quality and safety. The occurrence of three of the patient safety indicators (pressure ulcers, central line infections postoperative hemorrhage) to be examined as outcome variables were found to be very low in the study sample, suggesting that these are not a problem. Quality indicators related to functional status had higher degrees of adoption, with one (discharge assessment of level of independence and need for home health) having > 90% partial to complete adoption among hospitals. Finally, this study provided more evidence

validating the occurrence of postoperative thromboembolism in older patients, yet failing to identify mutable factors associated with lower occurrence. Perhaps this highlights the need to reexamine the usefulness of this indicator as an outcome measure.

Secondary implications can also be drawn from this study. First, the study adds to the literature that demonstrates the importance of information technology (IT) in the adoption of quality indicators. Computer support for standardized checklists and decision support of risk assessment were associated with adoption of the ACOVE indicators. The availability of IT applications provides immediate access to information or decision support and enables nurses to spend more time with patients and to focus on quality (Menachemi, et al., 2008). This study strengthens understanding of how health IT can be linked to improved care processes aimed at improving outcomes.

Although the AMVs included in this study were not associated with improved outcomes, future studies using different AMVs might reveal associations. The current study did contribute to the body of knowledge regarding the role that patient characteristics play in patient outcomes. The study validates the contributions of injury severity and comorbidities to worse outcomes, and it points to the need to better understand the extent to which other patient characteristics (e.g., cognition and functional status) contribute to patient outcomes. The findings from this study challenge investigators to design studies that can detect the influence of organizational structures and processes on patient outcomes in light of strong patient-specific influences.

A final implication concerns the role that trauma centers play in the care of HIOAs. The extent to which trauma centers are utilizing indicators with their older injured adults is unknown and was a limitation in this study. The unanticipated finding

that Level II trauma centers were lowest among all hospitals in adoption of all nine ACOVE indicators raises unanswered questions. Further investigation is needed to understand this phenomenon.

Recommendations for Future Research

Hospitalized injured older adults are a vulnerable and understudied population. Research is needed that is directed at both understanding patient outcomes and improving patient outcomes. Much work is needed from which a program of research can be built. This dissertation research contributes to the body of knowledge and provides a foundation for future work. This section presents recommendations for future research in order of importance.

A first step for future research is to establish the extent to which variations in cognitive impairment and functional impairment exist among hospitals providing care to HIOAs. This is crucial for adequate risk adjustment in determining whether ACOVE adoption improves outcomes. A pilot study to determine the feasibility of administering functional and cognitive screening instruments to HIOAs after admission to the hospital is currently in progress at two types of hospitals (non-trauma center & Level II trauma center) in the PIs local community. The goal of the study is to identify and resolve potential problems related to instrument administration in preparation for a subsequent larger study.

The feasibility study described above will support the design of a prospective multi-site study aimed at determining the extent of baseline pre-existing cognitive impairment and functional impairment in HIOAs prior to the injury event at different

types of hospitals (level I TC, level II TC, non-TC). Although associations among medical patients are documented in the literature, associations among the sub-population of HIOAs have not been studied. As noted in Chapter I (Table 1.1, pg. 6), cognitive and functional impairment are associated with worse outcomes in the broader population of all hospitalized older adults. It is hypothesized that the extent of pre-existing impairment is even greater in the sub-population of HIOAs. These two studies are essential to subsequent work since outcomes research is dependent upon adequate risk adjustment for analyzing outcomes. Failure to consider all potential risk factors such as pre-existing cognitive and functional impairment can introduce bias and render erroneous results.

Concomitant with this work, the dissertation dataset provides additional opportunities for secondary data analyses. Using the sample hospitals (N=128), associations between AMVs and other patient outcomes (inpatient mortality, length of stay, discharge disposition) can be examined to begin to understand whether AMVs contribute to other outcomes. Using a larger sample of hospitals from the 2009 HCUP NIS with hospital identifiers (N=465), the presence of AMVs from AHA Survey data and the prior study can be examined. The larger sample can also be used to examine associations between specific AMVs (e.g. geriatric resources and services, hospitalists, intensivists) and outcomes (inpatient mortality, length of stay, discharge disposition).

Once a foundation is laid with the studies described above, the next step would be to design a prospective study that examines the effects of an intervention on patient outcomes. After a deeper understanding of patient characteristics is established, the intervention study could be designed to examine effects within stratified groups based on varying patient characteristics. For example, an intervention aimed at preventing delirium

could be used and patient outcomes (e.g., development of delirium, length of stay, cost) could be examined by injury severity, cognitive impairment, and functional impairment. An approach such as this would begin to establish the *relative* importance of specific interventions in light of varying injury severity and preadmission factors such as cognitive and functional status. It may also identify sub-populations of HIOAs that are more apt to respond to ACOVE indicators.

Conclusion

Aim One: Overall partial to complete adoption of nine ACOVE quality indicators was 57% with a range of 24% to 91% for individual indicators. Examination of ACOVE adoption by hospital characteristics revealed that the Northeast region and Level I trauma centers had higher degrees of ACOVE adoption, and that Level II trauma centers had the lowest degrees of ACOVE adoption. Adoption has remained poor despite efforts to raise awareness. *Aim Two:* Examination of patient characteristics and AMVs revealed that hospitals with a greater percentage of older HIOAs and females are associated with a lack of resources. Patient characteristics were not associated with adoption of ACOVE indicators. Associations between AMVs and adoption of ACOVE indicators revealed statistically significant positive associations with computerized support and comprehensive geriatric assessment. The presence of Alzheimer center services were associated negatively with ACOVE adoption. *Aim Three:* After risk adjustment, the strongest association with rates of deep vein thrombosis or pulmonary embolus in HIOAs was with comorbidities.

These findings suggest that despite 10 years of efforts to adopt ACOVE indicators in hospitals, much progress remains to be made. Before launching studies to further increase adoption, the lack of associations of ACOVE adoption and patient outcomes must be explained. Careful inclusion of risk adjustment for cognitive and functional status may help to elucidate if there is, in fact, a relationship between ACOVE adoption and outcomes. On a final note, this study validates other studies regarding the occurrence of DVTs in older hospitalized patients. Postoperative thromboembolism must be carefully reconsidered as a quality indicator.

Appendix A

Inventory of Administratively-Mediated Variables

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
CAPITAL INPUTS (CI)				
CI- Assistive technology Physical outpatient rehab Simulated rehab environment (R, F)	AHA RASTHOS RHBOPHOS RSIMHOS	Programs providing access to specialized hardware, software, and devices, with adaptations allowing individuals greater independence with mobility, dexterity, or increased communication options.	Possible proxy measure for an organizational commitment to prevention of functional decline during and after hospitalization. Focus on leg power and strength are predictors of improved gait speed and physical performance.	(Chudyk, Jutai, Petrella, & Speechley, 2009) (SR) (Bean et al., 2010) (Mahoney, Sager, & Jalaluddin, 1999) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)
CI- Communication devices (2-way) (NE)	Survey	Enhanced methods to ensure clear, effective, and timely communication among care providers.	Improved information exchange can improve safety for patients (i.e., digital pagers, phones)	(Lindquist, et al., 2011) (Minnick, et al., 1997)
CI- Computer Access/ Support -Computer-based algorithms -Mandatory pathways -Medication alerts -Retrieval of results for previous hosp. -Retrieval of results from NH (R, F)	Survey	Information technology capabilities that potentially influence staff knowledge and staff contact time with patient.	Use of technologies contributes to patient safety.	(Lindquist, et al., 2011) (Agency for Healthcare Research and Quality (AHRQ), 2003b) (Podrazik & Whelan, 2008) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
CI- Electronic health record (R, F)	AHA EHLTH	An electronic health record integrates electronically originated and clinical health information, derived from multiple sources, into one point of access. It replaces the paper medical record as the primary source of patient information.	EMR implementation has shown conflicting findings related to patient outcomes- has been shown to increase nurse staffing levels, but also associated with an increase in complications and no reduction in LOS.	(Furukawa, Raghu, & Shao, 2010) (Motamedi et al., 2011) (SR)
CI- Room-based supplies (R, F)	Survey	Storage of patient care items in room-based locations	Room based supplies decrease to need for providers to leave the patient bedside and increase time with patients.	(Bakker, Robben, & Olde Rikkert, 2011) (SR) (Agency for Healthcare Research and Quality (AHRQ), 2003b) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)
CI- Surveillance (remote) capabilities (R, F)	Survey	Monitoring capabilities that aid early detection of potential problematic patient events.	Early recognition and detection of potential problems may reduce injury and improve outcomes.	(Lindquist & Sendelbach, 2007) (Minnick, Fogg, et al., 2007)
LABOR INPUTS				
LI- Access to psych nurse liaison (R, F)	Survey	Access to a provider who can perform initial patient assessments to determine the appropriate level of psychiatric care.	Depression, delirium, and dementia are common disorders in older adults. Psych nurse liaison availability can improve recognition and treatment of these conditions.	(Farmer, Reynolds, & Cleary, 2008) (Cole et al., 2006)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
LI- BSN Percentage (R, F)	Survey	The number (percentage) of RNs with a baccalaureate degree.	Evidence suggests that a higher proportion of BSN degrees is associated with decreased mortality and incidences of failure to rescue.	(Aiken, Clarke, Sloane, Lake, & Cheney, 2008) (Friese, Lake, Aiken, Silber, & Sochalski, 2008) (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007) (SR) (Agency for Healthcare Research and Quality (AHRQ), 2003b) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)
LI- Certification (Nurse) (R, F)	Survey	Measure of additional certification in specific areas of nursing (critical care, emergency, med/surg)	Evidence suggests that nurse certification is associated with improved outcomes.	(Krapohl, Manojlovich, Redman, & Zhang, 2010) (Lange et al., 2009) (Kendall-Gallagher & Blegen, 2009) (Holmboe et al., 2008) (Nelson et al., 2007)
LI- Geriatric APNs (HR, F)	Survey	Access to advanced practice nurses who can provide targeted geriatric assessment and management input to guide patient care	Older adults are at a higher risk of iatrogenic injury during hospitalization. Geriatric trained APNs can promote screening, prevention, and optimal	(Bakker, et al., 2011) (SR) (Podrazik & Whelan, 2008) (Institute of Medicine (IOM), et al., 2000)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
			management practices to improve patient outcomes.	
LI- Geriatric Social Workers/ Case Managers (R, F)	Survey	Providers with enhanced knowledge of the needs of older patients related to resource availability and home care needs.	Evidence suggests that geriatric case management reduces hospital readmissions.	(Institute of Medicine (IOM), et al., 2000) (Gravelle et al., 2007)
LI- Geriatricians (HR, F)	Survey	Physicians with post-graduate education and experience in the medical care of older patients	Geriatricians have enhanced knowledge of the needs of older adults in all areas of clinical care. This carries the potential to improve outcomes.	(Ko, 2011) (Malone et al., 2010) (Institute of Medicine (IOM), et al., 2000) (Callahan, Thomas, Goldhirsch, & Leipzig, 2002)
LI- Hospitalists (R, F)	AHA HSPTL FTEHSP	Physicians whose primary professional focus is the care of hospitalized medical patients.	The presence of hospitalists has been associated with modest improvements in performance on publicly reported process measures.	(Vasilevskis, Knebel, Dudley, Wachter, & Auerbach, 2010)
LI- Intensivists (R, F)	AHA INTCAR FTEINT	Board certified physicians who are additionally certified in the subspecialty of critical care medicine; or physicians board certified in emergency medicine who have completed a critical care fellowship in an accredited program.	Care in an intensivist model ICU is associated with a reduction in mortality following trauma, particularly in the elderly.	(Nathens et al., 2006) (Minnick, Fogg, et al., 2007)
LI- Multi-disciplinary consultation teams -Communication -Collaboration -Coordination	Survey	A team of providers representing multiple areas of expertise, including nursing, geriatrics, nutrition, pharmacy, case	Multidisciplinary teams address comprehensive and complex needs of hospitalized older adults.	(Bakker, et al., 2011) (SR) (Hall, 2005)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
(HR, F)		management, and other fields.		(Inouye, et al., 1999)
LI- Nurse Staffing -Proportion of RNs -RN experience -Nurse/Pt Ratio -Mix of nursing staff -Number of FTEs -Turnover (R, F)	Survey AHA FTEN FTEO	Measure that reflects the quality of nursing work.	A number of variables have demonstrated relationships between nurse staffing and patient outcomes. A recent SR recommends caution regarding objectivity and scientific basis of research.	(Patrician, Loan, McCarthy, Brosch, & Davey, 2010) (Flynn & McKeown, 2009) (SR) (Hall, 2005) (Hill, 2010) (Dunton, Gajewski, Klaus, & Pierson, 2007) (Savitz, et al., 1999) (Kane, et al., 2007) (SR) (Agency for Healthcare Research and Quality (AHRQ), 2007b) (Agency for Healthcare Research and Quality (AHRQ), 2003a) (Aiken, et al., 2008) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007) (Minnick & Mion, 2009)
LI- Psych consultation services	Survey	Provides organized psychiatric consultation services to departments	Depression and cognitive impairment are	(Farmer, et al., 2008)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
Psych geriatric services (R, F)		on psychological aspects of medical care that may be generic or specific to individual patients. Provides care to emotionally disturbed elderly patients, including those admitted for diagnosis and those admitted for treatment.	more common in older patients and are associated with poor outcomes. Psych services provide an additional intervention for management of these conditions.	(Siddiqi, Holt, Britton, & Holmes, 2009) (Cole, et al., 2006) (Mittal, Majithia, Kennedy, & Rhudy, 2006)
LI- Trauma Case Managers (R, F)	Survey	Providers with enhanced knowledge of the needs of trauma patients – coordinator of allied health services	Evidence suggests that trauma case management reduces hospital LOS and improves missed injury detection rates.	(Curtis, Lien, Chan, Grove, & Morris, 2002)
ORGANIZATIONAL FACETS				
OF- Absenteeism (NE)	Survey	Lack of a physical presence at a given setting and time when there is a social expectation to be there.	Absenteeism disrupts the continuity of patient care. Few studies have measured the effect on patient outcomes.	(O'Brien-Pallas, Li, Wang, Meyer, & Thomson, 2010) (Hall, 2005)
OF- Adoption of ACOVE Quality Indicators (HR, F)	Survey	Measure of the extent to which recognized evidence-based processes of care are initiated and implemented in hospitals.	ACOVE indicators are associated with improved outcomes in hospitalized elders.	(Bakker, et al., 2011) (SR) (Podrazik & Whelan, 2008) (Arora et al., 2007) (Wenger, et al., 2001)
OF- Anxiety reduction measures -Noise reduction -Carpeting -Soft music -Lighting & Color -Clocks (R, NF)	Survey	Measures taken by hospital staff to allay anxiety in patients- provision of soothing features in the physical environment.	Stress reduction measures can facilitate sleep/rest and decrease the stress response. Evidence shows that modifications to the physical environment prevent adverse outcomes.	(Missildine, Bergstrom, Meininger, Richards, & Foreman, 2010) (Choiniere, 2010) (Lindquist & Sendelbach, 2007)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
				(Agency for Healthcare Research and Quality (AHRQ), 2003a)
OF- Comprehensive geriatric assessment (HR, F)	Survey	Multidimensional, multidisciplinary diagnostic instrument designed to collect data on the medical, psychosocial and functional capabilities and limitations of elderly patients.	CGA increases the likelihood that all patient care needs are addressed. Evidence shows that CGA improves outcomes.	(Institute of Medicine (IOM), et al., 2000) (Ellis, et al., 2011) (Reuben, Frank, Hirsch, McGuigan, & Maly, 1999)
OF- ED Triage System (R, F)	AHA TRIAGE	Type of triage system used by the emergency department on a daily basis to determine which patients should be seen and in what order.	Under-triage of older patients is documented in the literature.	(Platts-Mills et al., 2010)
OF- Family presence (with patients) -Sleep arrangements -Policies for open Visitation (HR, F)	Survey	Measures that promote and facilitate family presence with patients.	Visiting policies that promote family attendance during hospitalization can reduce patient risk exposure and emotional isolation.	(Institute for Patient & Family Centered Care, 2011) (Leape et al., 2009) (Berwick & Kotagal, 2004)
OF- Geriatric Education (HR, NF)	Survey	Required education related to geriatric care	Enhanced knowledge of best practices in caring for older adults is linked to improved outcomes.	(Lange, et al., 2009) (Institute of Medicine (IOM), et al., 2000) (Chang, Hancock, Hickman, et al., 2006) (Kovner, Mezey, & Harrington,

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
				2002)
OF- Geriatric Emergency Department Interventions (GEDI) -Soundproof curtains -Hearing devices -Noise reduction -Clocks/calendars -Lighting -Bedside commodes -Visual aids -Protocol interventions (R, F)	Survey	Structural and process of care modifications that address the special care needs of older patients in the emergency department.	Initiating geriatric-specific care in the ED may contribute to a continuum of care that improves outcomes	(Hwang & Morrison, 2007)
OF- Geriatric nursing care models (HR, NF)	Survey	Models of nursing care that demonstrate competence in providing care to geriatric patients, and in which the environment is structured around the needs of older patients.	Models of care with geriatric focus are more likely to address geriatric specific needs. Evidence has demonstrated improvements in outcomes.	(Bakker, et al., 2011) (SR) (Institute of Medicine (IOM), et al., 2000) (Kane, et al., 2007) (SR) (Inouye, et al., 1999)
OF- Geriatric Resource Programs (NICHE, HELP, GEC, ADGAP, Reynolds) (HR, F)	Prior Study	National initiatives that promote best practices and quality indicators for older adults-established infrastructures offer guidance for hospitals and providers.	Measures that enhance geriatric competency within hospitals can contribute to improved outcomes.	(Bakker, et al., 2011) (SR) (Podrazik & Whelan, 2008) (Institute of Medicine (IOM), et al., 2000) (Lindquist & Sendelbach, 2007)
OF- Geriatric services (R, F)	AHA GERSVHOS	The branch of medicine dealing with the physiology of aging and the diagnosis and treatment of disease affecting the aged.	Proxy measure for enhanced attention to the needs of geriatric patients.	(Bakker, et al., 2011) (SR) (Podrazik & Whelan, 2008) (Institute of Medicine (IOM), et al., 2000)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
				(Lindquist & Sendelbach, 2007)
OF- Geriatric-focused services -Skilled nursing beds -Intermediate nursing care - Acute long term care - Adult Day Care -Alzheimer's center -Assisted living services -Home health services -Meals on wheels -Retirement housing -Transportation to health services (R, F)	AHA SNBD88 ICFBD88 ACULTBD ADULTHOS ALZHOS ASSTLHOS HOMEHHOS MEALSHOS RETIRHOS TPORTHOS	Programs and services provided by hospitals that are related to care of older adults.	Proxy measure for enhanced interest/focus on the needs of older adults	(Institute of Medicine (IOM), et al., 2000)
OF- Health status indicators (R, F)	AHA HSIND	Measures used to quantify various aspects of a populations health status. Does the hospital use health status indicators to design new services or modify existing services?	Proxy measure for organizational commitment to outcome improvement. The use of summary measures by organizations shifts focus from inputs to outcomes. Measures allow for comparisons over time and benchmarking.	(Parrish, 2010)
OF- Magnet status (R, F)	Survey	A proxy measure of quality nursing care, better nurse staffing strategies, shared governance, autonomy, and nurse empowerment.	Magnet hospitals are associated with higher quality of care ratings by nurses and a decrease in adverse events in patients.	(Kramer, Maguire, & Brewer, 2011) (Aiken, Havens, & Sloane, 2009) (Kane, et al., 2007) (SR) (Hall, 2005)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
OF- Nursing Handoffs (NE)	Survey	Method and quality of communication from one nurse to another.	Poor communication and variable procedures result in inadequate handoffs, however research has not identified best practices with link to patient outcomes.	(Riesenberg, Leisch, & Cunningham, 2010) (SR)
OF- Nursing Leadership (NE)	Survey	A set of learned behaviors comprising intrinsic traits and personalities inherent in the individual. The role is to create an environment for professional nursing practice that support positive patient outcomes.	Nursing leadership influences process variables that contribute to patient outcomes, however further research is needed to determine its link with outcomes.	(Squires, Tourangeau, Spence Laschinger, & Doran, 2010) (Brady Germain & Cummings, 2010) (SR) (Hall, 2005) (Minnick, Fogg, et al., 2007)
OF- Nursing workload -Patient Classification System (PCS) -Workload Measure System (WMS) -Management Information System (MIS) (R, NF)	Survey	The amount and type of nursing resources needed to care for an individual patient on a daily basis.	Nursing workload and productivity are associated with patient outcomes, however further work is needed to establish a gold standard for measuring workload.	(Patrician, et al., 2010) (Trinkoff et al., 2011) (Hall, 2005) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)
OF- Organizational culture -Group participation -Flattened hierarchy (R, NF)	Survey	Aspects of organizational culture that are related to a patient safety climate	Evidence shows that high levels of group culture and flattened hierarchy are associated with optimal safety climates. Processes for assessing organizational culture needs further study.	(Singer et al., 2009) (Hall, 2005) (Agency for Healthcare Research and Quality (AHRQ), 2003a)
OF- Orthopedic services (NE)	AHA ORTOHOS	Services provided for the prevention or correction of injuries or disorders of the skeletal	A large percentage of HIOAs require orthopedic services and surgery.	(Simunovic et al., 2010) (SR)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
		system and associated muscles, joints and ligaments.	Surgical site infections and increased LOS are higher in older patients. Timing of orthopedic surgery is associated with outcomes. Deterioration in mobility is highest in oldest patients following orthopedic surgery.	(Cram, Vaughan-Sarrazin, & Rosenthal, 2007)
OF- Overtime (NE)	Survey	Hours worked in excess of 40 hours.	Overtime is linked to manifestations of fatigue in workers, however its effect of patient outcomes is understudied.	(O'Brien-Pallas, et al., 2010) (De Castro et al., 2010) (Olds & Clarke, 2010) (Institute of Medicine (IOM), et al., 2000) (Hall, 2005)
OF- Ownership/ physician (R, F)	AHA PHYGP	Is the hospital owned in whole or in part by physicians or a group of physicians?	Physician owned orthopedic hospitals differ significantly from non physician-owned orthopedic hospitals.	(Cram, et al., 2007)
OF- Pain management programs (NE)	AHA PAINHOS	A recognized clinical service or program providing specialized medical care, drugs or therapies for the management of acute or chronic pain and/or the control of symptoms administered by specially trained physicians and other clinicians; and supportive care services, such as counseling on advance directives, spiritual	Acute pain management in older patients is complicated by physiologic changes and pharmacological factors. Adequate pain relief reduces morbidity and LOS, and promotes early mobilization.	(Prowse, 2007) (SR) (Titler et al., 2009) (RCT) (Minnick, et al., 1995)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
		care, and social series to patients with advanced disease and their families.		
OF- Patient representative services (NE)	AHA PATRPHOS	Organized hospital services providing personnel through who patients and staff can seek solutions to institutional problems affecting the delivery of high quality care and services.	Possible proxy measure for an organizational commitment to patient empowerment, shared decision-making and patient-centered care.	(Schwartz, 2002)
OF- Patient-centered Care (NE)	Survey	Care that focuses on the wellbeing of individual patients and includes the patient and family in decision-making.	Evidence shows that patient-centered care improves patient outcomes.	(Sepucha, Fowler Jr., & Mulley Jr., 2004) (Edwards, et al., 2009)
OF- Professional Development opportunities (NE)	Survey	The systematic maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for execution of professional and technical duties.	Professional development is a complex concept. Further study is needed to determine effects of various stakeholders.	(Hall, 2005)
OF- Protocols to reduce indwelling urinary catheters (IUCs) (HR, F)	Survey	Measures to reduce the use of indwelling urinary catheters (primary cause of urinary tract infections).	Evidence shows that a decreased use of IUCs reduces the incidence of UTIs (which can lead to other complications worse outcomes).	(Podrazik & Whelan, 2008)
OF- Quality & Safety Education (R, NF)	Survey	Required education within hospitals related to quality and safety	Provider education to enhance knowledge on best practices for improving quality and safety within hospitals.	(Neuman, et al., 2010) (Long, Burkett, & McGee, 2009) (Oman, Duran, & Fink, 2008)
OF- Span of Control (Nursing) (NE)	Survey	The number of persons who report directly to a single manager supervisor, or leader.	Span of control has a direct effect on performance measures that have	(Lee & Cummings, 2008) (SR)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
			been found to influence patient outcomes.	(Hall, 2005)
OF- Specialty Unit (ACE) (HR, F)	Survey	Units designed to address specific needs of acutely ill hospitalized older adults. Increased attention is given to patient's level of functioning, geriatric illnesses, and discharge planning.	The objective of an ACE unit is to reduce iatrogenic illness and improve clinical outcomes.	(Bakker, et al., 2011) (SR) (Van Craen et al., 2010) (Podrazik & Whelan, 2008) (Institute of Medicine (IOM), et al., 2000) (Lindquist & Sendelbach, 2007) (Jayadevappa, Chhatre, Weiner, & Raziano, 2006) (Jayadevappa, Bloom, Raziano, & Lavizzo-Mourey, 2003)
OF- Surgery Timing (HR, NF)	Survey	Length of time from hospital admission to operating time	Early surgery is associated with lower mortality, lower rates of postoperative pneumonia, and pressures sores among elderly patients with hip fractures.	(Simunovic, et al., 2010) (SR)
OF- Teaching Status (NE)	AHA MAPP8	Member of Council of Teaching Hospital of the AAMC	Evidence shows inconsistent relationships between teaching status and postoperative patient safety indicators.	(Silber et al., 2009) (Vartak, et al., 2008)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
OF- Transition of Care protocols (R, NF)	Survey	A patient-centered approach that ensures effective transfer between sites for geriatric care.	Coordination of setting-specific needs ensures that all patient needs are met. Evidence shows that effective transition of care and discharge planning improves outcomes.	(Podrazik & Whelan, 2008) (Halasyamani et al., 2006) (Agency for Healthcare Research and Quality (AHRQ), 2003a)
OF- Trauma Center Verification Status (R, F)	Prior Study	TC Verification by the American College of Surgeons requiring that a hospital meet up to 364 standards in 21 domains.	One study found that ACS verification is associated with lower mortality than non-ACS verified hospitals. Another study showed no difference.	(Maggio, Brundage, Hernandez-Boussard, & Spain, 2009) (Recinos et al., 2009)
OF- Trauma System Status (R, F)	Prior Study	State trauma systems that involve either all (inclusive) acute care facilities or only a few (exclusive) formally organized high-level centers.	One national study indicated lower odds of death in states with the most inclusive trauma systems.	(Utter, et al., 2006)
OF- Type of Organization (R, F)	AHA CRTRL	Type of authority responsible for establishing policy concerning overall operation of the hospital.	Management type and urban/rural status are predictors of implementation of patient safety systems.	(Jensen, Webster, & Witt, 2009) (Longo, et al., 2007)
OF- Unit design for maximal visualization (R, NF)	Survey	Unit designs that facilitate direct observation of patients.	Direct observation can enhance early detection of potential problems	(Bakker, et al., 2011) (SR) (Agency for Healthcare Research and Quality (AHRQ), 2003a) (Minnick, et al., 1997) (Minnick, Fogg, et al., 2007)

Variable (Type AMV) & grading for inclusion	Source (i.e., AHA variable fields)	Definition/ Description	Rationale	Reference(s) ** full reference list available on request
OF- Use of sitters (patient attendants) (R, NF)	Survey	Persons available to provide direct monitoring of unsafe patient behavior	Direct observation of patient behavior can reduce risk of adverse events.	(Institute for Clinical Systems Improvement (ICSI), 2010) (Rochefort, Ward, Ritchie, Girard, & Tamblyn, 2011)

SR: Systematic review; IR: Integrative review; R: relevant to study aims; HR: highly relevant to study aims; F: feasible for measurement; NF: not feasible for measurement; NE: not essential to study aims

Appendix B

Dissertation Study Variables

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Administratively-mediated variables (70)	Factors that are shaped by decisions of personnel within organizations				
CAPITAL INPUTS (13)		Variables that entail significant financial investment by a hospital that may impact patient outcomes.				
Computer Support	Computer support for medication compatibility alerts	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
	Computer support for retrieval of previous hospital data	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
	Computer support for retrieval of nursing home data	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
	Computer support for standardized checklist for VAP bundle	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
	Computer support for standardized checklist for CAUTI bundle	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
	Computer (decision) support for pressure ulcer risk assessment	IT measure that contributes to patient safety	Availability of support in a hospital	Categorical 0: Not available 1: Available on some units 2: Available on all units	Survey item	Aim Two Aim Three
Electronic health record	Electronic health record	Electronic integration of information from multiple sources into one point of electronic access	Presence in a hospital	Categorical 0: NO 1: YES	AHA Survey EHLTH	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
ED Room design	Geriatric ED design	Structural modifications that address needs of older patients in the ED	Placement of geriatric patients in specially designed rooms or cubicles	Categorical 0: NO 1: YES	Survey item	Aim Two Aim Three
In-room supplies	Medications	Medications available in patient rooms so that nurse does not have to leave bedside	Available in room	Categorical 0: NO 1: YES	Survey Item	Aim Two Aim Three
	Linens	Linens available in patient rooms so that nurse does not have to leave bedside	Available in room	Categorical 0: NO 1: YES	Survey Item	Aim Two Aim Three
	Basic supplies	Basic supplies available in patient rooms so that nurse does not have to leave bedside	Available in room	Categorical 0: NO 1: YES	Survey Item	Aim Two Aim Three
Access to measures that promote independence	Assistive technology	Proxy measure of organizational commitment to prevention of functional decline	Presence in a hospital	Categorical 0: NO 1: YES	AHA Survey RASTHOS	Aim Two Aim Three
	Physical outpatient rehab	Proxy measure of organizational commitment to prevention of functional decline	Presence in a hospital	Categorical 0: NO 1: YES	AHA Survey RHBOPHOS	Aim Two Aim Three
	Simulated rehab environment	Proxy measure of organizational commitment to prevention of functional decline	Presence in a hospital	Categorical 0: NO 1: YES	AHA Survey RSIMHOS	Aim Two Aim Three
ORGANIZA-TIONAL FACETS (37)		Variables affecting provider autonomy and work environments that may impact patient outcomes.				

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Adoption of ACOVE Indicators (9 indicators related to cognitive and functional status)	Extent to which EBP processes of care are initiated and implemented in hospitals	Level of adoption in a hospital -Multidimen-sional assessment on admission -Functional status assessment on admission -Etiology of delirium -Mobility plan -Delirium risk factor screening -Ambulation by postop day 2 -Postop screening for delirium -Postop comparison of cognition and function to preop measures -Discharge assessment for independence	Categorical 0: No activity 1: Under development 2: Implemented partially on some units 3: Implemented fully on some units 4: Implemented partially throughout hospital 5: Implemented fully throughout hospital	Survey item	Aim One Aim Two Aim Three
	Comprehensive geriatric assessment (CGA)	Multidimensional, multidisciplinary diagnostic instrument designed to collect data on the medical, psychosocial and functional capabilities and limitations of the elderly	Availability of CGA in a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	ED Triage System	System for determining priority in which patients should be seen in the ED	Type of ED triage system	Categorical 1: 3 level 2: 4 level 3: 5 level (ESI) 4: 5 level A, M, or AS 5: Other 6: Do not know	AHA Survey TRIAGE	Aim Two Aim Three
	Family sleep arrangements in ICU	Measures that facilitate family presence with patients	Sleeping arrangements for ICU patients	Categorical 0: Not available 1: Available near room or unit 2: Available in patient rooms	Survey item	Aim Two Aim Three
	Family visitation in ICU	Measures that facilitate family presence with patients	Hours per week in ICU	Continuous # of hours/wk	Survey item	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Geriatric Resource Programs (GRP)	Nationally recognized programs that aim to improve care of hospitalized older adults.	Presence of: -NICHE -HELP -ADGAP -GECs -Reynolds	(ordinal) 0-5 OR 0: None 1: 1 or more	Prior study- data on GRP availability (2009)	Aim Two Aim Three
	Geriatric services	Proxy measure for enhanced attention to the needs of geriatric patients	Presence of geriatric services	Categorical 0: NO 1: YES	AHA Survey GERSVHOS	Aim Two Aim Three
	Geriatric-focused services -Skilled nursing beds -Intermediate nursing beds -Acute long term care -Adult Day Care -Alzheimer's center -Assisted living services -Home health services -Meals on wheels -Retirement housing -Transportation to health services	Proxy measure for enhanced interest/focus on the needs of older adults	Presence of: -Skilled nursing beds -Intermediate nursing beds -Acute long term care -Adult Day Care -Alzheimer's center -Assisted living services -Home health services -Meals on wheels -Retirement housing -Transportation to health services	Categorical 0: NO 1: YES (for each service)	AHA Survey SNBD88 ICFBD88 ACULTBD ADULTHOS ALZHOS ASSTLHOS HOMEHHOS MEALSHOS RETIRHOS TPORTHOS	
	Health status indicators	Quantification of population health- used by hospitals to design or modify services- proxy measure for organizational commitment to outcome improvement	Hospital use of health status indicators	Categorical 0: NO 1:YES	AHA Survey HSIND	Aim Two Aim Three
	Magnet status	Hospitals meeting criteria defined by the ANCC for recognition as a Magnet hospital- represents a proxy measure for nurse autonomy and empowerment	Magnet status in 2009	Categorical 0: Not contemplating at this time 1: No, but plan to apply within 2 years 2: In the process of applying 3: Yes	Survey item	Aim Two Aim Three
	Orthopedic services	Services for prevention and correction of injuries of the skeletal system, muscles, joints, and ligaments	Presence of orthopedic services in a hospital	Categorical 0: NO 1: YES	AHA Survey ORTOHOS	Aim Two Aim Three
	Ownership/ physician	Hospital ownership in whole or in part by physicians or physician group	Is hospital owned by physicians?	Categorical 0: NO 1: YES	AHA Survey PHYGP	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Pain management	Clinical service or program within a hospital that provides specialized care related to pain management	Presence of a pain management program	Categorical 0: NO 1: YES	AHA Survey PAINHOS	Aim Two Aim Three
	Specialty Unit (ACE)	Units designed to address specific need of acutely ill hospitalized older adults.	Presence of a dedicated specialty unit in a hospital	Categorical 0: NO 1:YES	Survey item	Aim Two Aim Three
	Teaching status	Teaching hospital meets one of the following criteria: 1)AMA approved residency program, 2) member of the Council of Teaching Hospitals of the AAMC, or 3) ratio of full-time equivalent interns and residents to beds of 0.25 or greater	Teaching status in 2009	Categorical 0: NO 1:YES	AHA Survey MAPP8	Aim Two Aim Three
	Trauma Center Status	Hospitals that aim to provide optimal care to all injured patients.	State designated trauma center status in 2009	Categorical 1: Level 1 2: Level 2 3: Level 3 or 4 4: Non-TC	Prior study	Aim Two Aim Three
	Trauma ACS-COT verification	Hospitals that are recognized by the American College of Surgeons-Committee on Trauma for meeting nationally recognized standards for optimal care of injured patients.	ACS-COT verification status in 2009	Categorical 0:NO 1:YES	Prior study	Aim Two Aim Three
	Trauma System status	Represents the idea that injured patients are best served through a focus on *all* versus *select* acute care hospitals.	State trauma systems that involve either all (inclusive) acute care facilities or only a few (exclusive) formally organized high-level centers	Categorical 0: Exclusive 1: Inclusive	Prior study	Aim Two Aim Three
	Type of Organization	Type of authority responsible for establishing policy concerning overall hospital operations	Type of organization	Categorical 1: Government, non-federal 2: Private, not for profit 3: Private- investor owned, for profit	AHA Survey CRTRL	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
LABOR INPUTS (20)		*Quantity* of health care providers that impacts patient outcomes OR *Quality* of actions taken by health care providers that impacts patient outcomes.				
	Access to psychiatric nurse liaison	Access to a provider who can perform initial patient assessments to determine need for psychiatric care	Availability in a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	BSN percent	Nurses with a higher level of knowledge-linked to patient safety	Percentage of RNs with a baccalaureate degree or higher	Continuous %	Survey item	Aim Two Aim Three
	Geriatric APNs	Access to advanced practice nurses who can provide targeted assessment and management input	Availability in a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	Geriatric case management	Providers with enhanced knowledge of the needs of older patients related to resource availability and home care needs	Extent of assignment to a geriatric case manager Must be RN Must be SW	Categorical 0: None 1: Some 2: All 0: NO 1: YES 0: NO 1: YES	Survey item	Aim Two Aim Three
	Geriatricians	Physicians with postgraduate education and experience in the medical care o folder patients	Availability in a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	Hospitalists	Physicians whose primary focus is the care o fhospitalized medical patients	Presence of hospitalists Number o f hospitalists	Categorical 0: NO 1: YES Continuous # of FTEs	AHA Survey HSPTL FTEHSP	Aim Two Aim Three
	Intensivists	Physicians with subspecialty of critical care medicine	Presence of intensivists Number o f intensivists	Categorical 0: NO 1: YES Continuous # of FTEs	AHA Survey INTCAR FTEINT	Aim Two Aim Three
	Multi-disciplinary consultation teams	Team of providers representing multiple areas of expertise	Use within a hospital	Categorical 0: NO 1: YES	Survey item	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Nurse certification	Nurses with additional knowledge and expertise in a particular area- linked to patient safety	Percentage of RNs with certification	Continuous %	Survey item	Aim Two Aim Three
	Nurse/ patient ratio	Number of patients assigned to one nurse- linked to patient safety	RN to patient ratio on adult ICU RN to patient ratio on day shift on adult med/surg units	Continuous Count	Survey item	Aim Two Aim Three
	Nurse staffing mix	Percentage of RNs among the total nursing workforce- linked to patient safety	Percentage of RNs/LPNs/Other on adult med/surg unit Percentage of RNs/LPNs/Other on adult med/surg unit	Continuous % %	Survey item	Aim Two Aim Three
	Nurse turnover	Number or percentage of RN workforce that leave an institution over 1 year- linked to patient safety	Percentage of RN turnover for last year	Continuous %	Survey item	Aim Two Aim Three
	Psych consultation services	Provision of organized psychiatric consultation services	Availability within a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	Gero-psychiatric services	Provision of service for emotionally disturbed elders	Availability within a hospital	Categorical 0: Not available 1: Available to select units 2: Available to all units.	Survey item	Aim Two Aim Three
	Patient representative services (PRS)	Provision of personnel through which patients and families can seek solutions to institutional problems affecting delivery of care and services.	Presence of patient representative services	Categorical 0: NO 1: YES	AHA Survey PATRPHOS	Aim Two Aim Three
	Registered nurse experience	Length of experience as an RN- linked to patient safety	Percentage of RN workforce that has worked $\leq$ 1 year Percentage of RN workforce that has worked $\geq$ 5 years	Continuous %	Survey Item	Aim Two Aim Three
	Trauma Case Manager	Providers with enhanced knowledge of needs and resources for trauma patients	Presence of a dedicated trauma case manager	Categorical 0: NO 1:YES	Survey item	Aim Two Aim Three

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
PATIENT CHARACTERISTICS		Covariates that must be included in risk adjustment to eliminate sources of observed variation				
	Age	The cumulative effect of the passage of time on the lifespan	Mean age for HIOAs at individual hospital	Continuous 65-100+	HCUP NIS 2009	Aim Two Aim Three
	Gender	Differences in gender physiology, identity, and role	Percentage of females (HIOAs) at individual hospital	Continuous %	HCUP NIS 2009	Aim Two Aim Three
	Injury severity	TMPM-ICD9- (Trauma Mortality Prediction Model) Regression-based estimate of injury severity- predicted probability of death based on a patient's five worst injuries (derived from ICD9 codes)	Median probability of mortality scores for HIOAs at each hospital	Continuous (0-1)	HCUP NIS (ICD-9 codes)	Aim Two Aim Three
	Co-morbidities	Pre-existing conditions that are unrelated in etiology to the principal diagnosis.- derived from ICD-9 codes and DRGs in administrative datasets	29 comorbid conditions identified through AHRQ Comorbidity software. Each positive comorbidity assigned a point value.	Continuous Comorbidity Index (Total points for all comorbidities at a hospital/total number of HIOAs for the hospital)	HCUP NIS AHRQ Comorbidity software	Aim Two Aim Three
	Isolated hip fractures	Patients with isolated hip fractures represent higher resource use and poorer outcomes.	Primary diagnosis of fracture of the femur neck (ICD9 code 820)	Categorical 0: NO 1: YES Continuous (Percentage) (Number of patients with hip fracture/total number of HIOAs)	HCUP NIS	Aim Two Aim Three
	HIOA volume	Larger volume of trauma patients at institutions leads to consolidation of resources and improved outcomes.	Number of HIOAs	Continuous (Percentage) Number of HIOAs/ total hospital patient volume	HCUP NIS	Aim Two Aim Three
OUTCOMES		End results of particular health care practices and interventions				

	Variables	Conceptual definition	Operational definition	Type Variable	Instrument of measure (& AHA field names)	Aim
	Patient Safety Indicators	A group of measures developed by AHRQ to identify potentially preventable complications and iatrogenic events for patients treated in hospitals. PSIs represent variations in quality of care identified from secondary diagnosis codes that flag potentially preventable complications.	-Decubitus ulcer -Infections due to medical care -Postoperative hemorrhage -Postoperative PE or DVT	Continuous Observed to Expected Ratio (O/E) for each hospital	HCUP NIS AHRQ Comorbidity software	Aim Two Aim Three

Appendix C

Summary of Study AHRQ Patient Safety Indicators

PSI	Definition	Numerator	Denominator	Strength of Evidence	Risk Adjustment
Decubitus Ulcer	Cases of decubitus ulcer per 1000 discharges with a length of stay greater than 4 days.	Discharges with ICD-9-CM code of decubitus ulcer in any secondary diagnosis field among cases meeting the inclusion and exclusion rules for the denominator.	All medical and surgical discharges 18 year and older defined by specific DRGs. Excluded cases: -LOS < 5 days -ICD-9-CM code of decubitus ulcer in the principal dx or in a secondary dx if present on admission, if known - MDC 9 -MDC 14 with -Dx of hemiplegia, paraplegia, or quadriplegia -spina bifida or anoxic brain damage -procedure code for debridement before or on same day as the major operating room procedure -admitted from LTC facility -transferred from an acute care facility	^ Coding 0 Explicit 0 Implicit 0 Staffing	Age Gender DRG Comorbidities

PSI	Definition	Numerator	Denominator	Strength of Evidence	Risk Adjustment
Infections due to medical care (from IV lines and catheters)	Cases of ICD-9-CM codes 9993 or 99662 per 1000 discharges.	Discharges with ICD-9-CM code of 9993 or 99662 in any secondary diagnosis field among cases meeting the inclusion and exclusion rules for the denominator.	All medical and surgical discharges 18 year and older or MDC 14, defined by specific DRGs. Excludes cases: -with ICD-9-CM code of 9993 or 99662 in the principal dx field or secondary dx present on admission, if known -LOS < 2 days -any dx code for immunocompromised state or cancer -with Cancer DRG	0 Coding 0 Explicit 0 Implicit 0 Staffing	Age Gender DRG Comorbidities
Postoperative hemorrhage or hematoma	Cases of hematoma or hemorrhage requiring a procedure per 1000 surgical discharges with an operating room procedure.	Discharges among cases meeting the inclusion and exclusion rules for the denominator with either of the following: -ICD-9-CM codes for postop hemorrhage in any secondary dx field and a code for drainage of hematoma in any procedure code field - ICD-9-CM codes for postop hematoma in any secondary dx field and a code for drainage of hematoma in any procedure code field	All surgical discharges 18 years and older defined by specific DRGs and an ICD-9-CM code for an operating room procedure. Excludes cases: -with preexisting condition of postop hemorrhage or hematoma -where the only OP procedure is postop control of hemorrhage or drainage of hematoma -where a procedure for postop control of hemorrhage or drainage of hematoma occurs before the first OR procedure -MDC 14	± Coding ± Explicit + Implicit 0 Staffing	Age Gender DRG Comorbidities

PSI	Definition	Numerator	Denominator	Strength of Evidence	Risk Adjustment
Postoperative PE or DVT	Cases of deep vein thrombosis (DVT) or pulmonary embolism (PE) per 1000 surgical discharges with an operating room procedure.	Discharges among cases meeting thee inclusion and exclusion rules for the denominator with ICD-9-CM codes for DVT or PE in any secondary dx field.	All surgical discharges age 18 and older defined by specific DRGs and an ICD-9-CM code for an OR procedure. Exclude cases: -with preexisting DVT or PE on admission where a procedure for interruption of vena cava is the only OR procedure -where a procedure for interruption of vena cava occurs before or on the same day as the first OP procedure -MDC 14	+ Coding + Explicit + Implicit ± Staffing	Age Gender DRG Comorbidities

Coding: Sensitivity is the proportion of patients who suffered an adverse event, based on detailed chart review or prospective data collection, for who that event was coded on a discharged abstract or Medicare claim

Explicit: process (construct): Adherence to specific, evidence-based or expert-endorsed processes of care, such as appropriate use of effective therapies. The construct is that hospitals that provide better processes of care should experience fewer adverse events.

Implicit process (construct): Adherence to the "standard of care" for similar patients, based on global assessment of quality by physician chart reviewers. The construct is that hospitals that provide better overall care should experience fewer adverse events.

Staffing (construct): The construct is that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experience physicians should have fewer adverse events.

Symbols: ^ Published evidence suggests that the indicator lacks validity in this domain

0 No published evidence regarding this domain of validity

± Published evidence suggests that the indicator may be valid in this domain, but different studies offer conflicting results

+ Published evidence suggests that the indicator is valid, or is likely to be valid in this domain

Abbreviations: MDC 9 = major skin disorder- skin, subcutaneous tissue, breast; MDC 14 = pregnancy, childbirth, and puerperium

Appendix D

Study Survey

Name of Hospital:_____ City: _____

1. In your adult medical/surgical ICUs, sleeping arrangements (defined as reclining sleeping chairs, cots, or pullout beds) for family members or significant others are:

_____ Not available

_____ Available in patient rooms

_____ Available in an area near the patient room or unit

- Check here if availability varies by ICU _____

2. Are geriatric patients in your emergency department placed in rooms or cubicles specially designed for geriatric patients? _____ Yes _____ No

3. Is your organization a designated Magnet facility?

_____ Yes

_____ We are in the process of applying

_____ No, but we plan to apply within the next 2 years

_____ We are not contemplating at this time

4. Indicate the availability of the following in-patient resources.

	Available to ALL adult nursing units	Available to select adult nursing units	Not available
Psychiatric nurse liaison			
Geriatric advanced practice nurse(s)			
Geriatrician(s)			

Psychiatric consultation services			
Gero-psychiatric consultation services			

5. Indicate which of the following describe case management at your institution.
   - The extent to which geriatric patients (≥ age 65) are assigned to a case manager:
     _____ All _____ Some _____ None
   - A geriatric case manager must be a registered nurse. _____ Yes _____ No
   - A geriatric case manager must be a social worker. _____ Yes _____ No
   - A geriatric case manager must be either a registered nurse OR social worker.
     _____ Yes _____ No
   - Our institution has a dedicated trauma case manager. _____ Yes _____ No

6. In your ICUs, which of the following are room-based (e.g., available to the nurse without having to leave the room)?

_____ Medications

_____ Linens

_____ Basic supplies (e.g., tape, dressings)

7. Indicate the availability of computerized support for the following activities:

	All adult units	Some adult units	Not available
Medication compatibility alerts			
Retrieval of previous hospitalization data			

Retrieval of nursing home data			
Standardized checklist for VAP bundle			
Standardized checklist for CAUTI bundle			
Decision support tree for pressure ulcer risk assessment and treatment			

8. Indicate the extent to which your hospital has a dedicated specialty unit for frail older patients (e.g., ACE unit).

_____ No specialty unit

_____ Specialty unit admits frail and non-frail patients

_____ Specialty unit admits only frail patients

9. What is the typical RN to patient ratio:
   on the adult ICU(s)?
   1 RN to _____ Patients

   on day shift on adult medical-surgical units? 1 RN to _____ Patients

10. Indicate all approaches to patient care used at your facility:

	All adult units	Some adult units	Not available
Multi-disciplinary teams			
Multi-disciplinary trauma team for adults			
Comprehensive geriatric assessment (standardized instrument to collect data on medical, psychosocial, functional capabilities, and limitations of elderly patients)			

11. For each of the following protocols, indicate the extent of its implementation for older patients (age ≥ 65):

	No activity	Under development	Implemented partially on some units	Implemented fully on some units	Implemented partially throughout the hospital	Implemented fully throughout the hospital
Older adults admitted to the hospital have a multi-dimensional assessment of cognition (e.g., memory, calculation, attention).						
Older adults admitted to the hospital have an assessment for functional status (e.g., bathing, dressing).						
Older adults who develop acute confusion (delirium) during the hospital stay have a documented assessment for cause (etiology).						
Older adults have a documented plan to increase mobility within 48 hours of admission.						
Older adults who undergo surgery have a documented screening for risk factors for delirium prior to surgery.						
Older adults who were ambulatory prior to surgery are ambulated by postoperative day #2.						

	No activity	Under development	Implemented partially on some units	Implemented fully on some units	Implemented partially throughout the hospital	Implemented fully throughout the hospital
Older adults who have surgery are screened for delirium for 3 days postop.						
Older adults who have surgery are assessed at discharge for cognitive and functional status; and a documented comparison is made to preoperative levels.						
Upon discharge, older adults are assessed for level of independence and need for home health.						

12. How many hours per week are visitors allowed in the ICU(s)? (Example: 15 min. every 2 hours M-F + 15 min. every hour WE = 180 + 360 = 540 minutes [9 hours])

- _____ total hours per week
- Can visiting hours be lengthened subject to nurse discretion? _____ Yes _____ No

13. Approximately what percent of the RN workforce at your hospital hold a CCRN or other relevant nursing certification? _____ %

14. Approximately what percent of RNs in your organization hold the BSN or higher nursing degrees? _____ %

15. Approximately what percent of the overall nursing workforce on your adult medical/surgical units are:

RNs		_____ %
LVNs or LPNs	_____ %	
Other personnel	_____ %	
Total		100%

Approximately what percent of the overall nursing workforce on your ICUs are:

RNs		_____ %
LVNs or LPNs	_____ %	
Other personnel	_____ %	
Total		100%

16. What percent of the RN workforce at your hospital have:
    worked ≤ 1 year _____ %

    worked ≥ 5 years _____ %

17. For the last year (fiscal or calendar) for which you have data, what was your institution's RN turnover? _____ % (Please do not include *within* institution turnover such as occurs when nurses take positions in different units within the hospital in your calculations.)

THANK YOU FOR PARTICIPATING IN THIS SURVEY

Title of person completing the survey (optional):

_____

Please indicate if you may be contacted for additional clarification:

Name: _____

Email: _____

Telephone number: ( ) _____

If you are interested in receiving a short summary of results, please indicate name of person to receive the report, and email:

Name: _____

Hospital name: _____

Email address: _____

Appendix E

Content Validation Summary: Maxwell AMV Survey Instrument

ITEM	CNO1	CNO2	CNO3	CNO4	CNO5	CNO6	CVI	Comments
	Section 1: Capital Inputs							
2 (ED design)	3	3	3	3	4	4	1.0	
6 (Room-based supplies)	3	4	4	3	2	4	0.83	Not a capital but operating expense
7 (Computerized support)	4	4	4	3	4	4	1.0	
	Section 2: Organizational Facets							
1 (Sleep Arrange-ments)	2	2	3	3	1	3	0.50	May fit better under capital inputs due to the cost in providing sleeping devices and/or special units Not relevant to organizational facets- seems to relate more to capital expenditure
3 (Magnet)	3	4	4	3	3	3	1.0	
8 (ACE unit)	2	2	3	2	4	3	0.50	May fit better under capital inputs due to the cost in providing sleeping devices and/or special units
10 (Comprehensive geriatric assessment)	4	4	4	3	2	4	0.83	
11 (ACOVE indicators) a	4	4	4	4	4	4	1.0	Re: #7- Highly relevant as structures or procedures but not necessarily as work traits that affect worker autonomy (that confused me)

ITEM	CNO1	CNO2	CNO3	CNO4	CNO5	CNO6	CVI	Comments
b	4	4	4	4	4	4	1.0	
c	4	4	4	4	4	4	1.0	
d	4	4	4	4	4	4	1.0	
e	4	4	4	4	4	4	1.0	
f	4	4	4	4	4	4	1.0	
g	4	4	4	4	4	4	1.0	
h	4	4	4	4	4	4	1.0	
i	4	4	4	4	4	4	1.0	
12 (ICU visitor sleeping)	3	4	4	3	4	4	1.0	
	Section 3: Labor Inputs							
9 (Ns/Pt ratio)	4	4	3	4	4	3	1.0	
16 (IP resources)	4	4	3	4	4	4	1.0	
5 (Case Management)	4	4	3	3	3	2	0.83	
10 (Multi-discip. team)	3	2	3	3	3	3	0.83	Multi-disciplinary team usage may fall best under organizational facets
13 (Nurse certification)	3	4	4	4	3	3	1.0	
14 (% BSN)	3	4	4	3	3	3	1.0	
15 (Nursing workforce-M/S)	4	4	4	3	4	3	1.0	
15 (Nursing workforce-ICU)	4	4	4	3	4	3	1.0	
16 (% Ns work longevity)	4	3	3	3	3	3	1.0	
17 (RN turnover)	4	4	4	4	3	3	1.0	
	Comments: "I believe all items are relevant, especially with bedside nurse education level a highest priority."							

CNO: Chief nursing officer; CVI: Content Validity Index
Relevance ratings: 4: Highly relevant; 3: Quite relevant; 2: Somewhat relevant; 1: Not relevant

Section 4: Items that were unclear: Items #1, #6, #8, #10, #11 (see comments above)

Section 5: Items rated as "not relevant": None

How long did it take to complete the survey (in minutes)? 10, 15, 12, 15, 15 (Mean: 13.4 minutes)

Were the items in the survey easily retrievable? Y: 5 N: 0

- # 16- "This item is more difficult- it requires HR intervention that would take 1-2 days. TMC's break point is at 2 years, so we lose our staff between the 2-5 year mark. If they stay > 5 years, we usually keep them in some role."

Appendix F

Preliminary Postcard

(Postcard)

RE: GERIATRIC TRAUMA SURVEY

Dear (name):

In a week you will receive a survey on hospital factors related to care of older adults. Findings from the survey, which takes about 15 minutes to complete, will provide direction regarding adoption of measures to prevent functional and cognitive decline, as well as occurrence of adverse events such as infections among elderly trauma patients. Several hospital associations (PA, KS, WA) have expressed an interest in the study as they seek to improve quality and safety in their respective hospitals. Your participation in the study will be very important. The survey can also be completed online at: http://www.nursing.vanderbilt.edu/HIOAstudy

Sincerely,

Cathy A. Maxwell, RN, PhD(c) (Doctoral Student- Vanderbilt University School of Nursing)

Email: cathy.maxwell@vanderbilt.edu

Appendix G

Survey Cover Letter

Geriatric Trauma Study

Participant Study Invitation

Dear (name & title):

This is to invite your participation in a research study as a part of my doctoral experience at Vanderbilt University School of Nursing. The study will provide insight regarding the importance of organizational factors that impact needs of hospitalized elders. Several hospital associations such as the *Hospital and Health System Association of Pennsylvania*, *Kansas Hospital Association*, and the *Washington State Hospital Association* have expressed an interest in the study as they seek to improve quality and safety in their respective hospitals. Knowledge gained from this study will also enhance understanding regarding the occurrence of adverse outcomes during hospitalization. Your input is important and greatly valued.

The survey takes approximately 15 minutes to complete. Your participation is voluntary. Your answers will be kept confidential and will be presented only in aggregate and in such a way as to preserve institutional and personal privacy. The study has been reviewed and approved by the Vanderbilt University IRB. Submission of the survey constitutes informed consent.

Please return the enclosed survey by [data] in the addressed/stamped envelope. You may also complete the survey on line at [web link here]. This website (REDCap) is a secure, web-based application designed to support data capture for research studies.

If you are interested in the findings of the study, I will be happy to email a brief summary of results by Spring 2012. You may provide contact information at the end of the survey.

Thank you for your participation. Your contribution is very important. If you have any questions, contact me (cathy.maxwell@vanderbilt.edu) or Dr. Lorraine Mion (Lorraine.c.mion@vanderbilt.edu).

Sincerely

Cathy A. Maxwell, RN, PhD(c)
Doctoral Candidate
Vanderbilt University School of Nursing

1367 Big Sky Drive
Hamilton, Georgia 31811
706-573-8853

cathy.maxwell@vanderbilt.edu

You may also complete the survey electronically by tying the following address into your web-browser.

PLEASE RETURN THE SURVEY BY SEPTEMBER 7, 2011

http://www.nursing.vanderbilt.edu/HIOAstudy

Appendix H

Follow up Cover Letter (2nd mailing)

Geriatric Trauma Study

Participant Study Invitation

Dear (name & title):

A survey was mailed to you over the past two weeks that may provide insight on the importance of particular organizational factors, including nursing-specific elements that impact needs of hospitalized elders. If you have already completed the survey, please disregard this letter. Knowledge gained from the study will enhance understanding regarding the occurrence of adverse events during hospitalization. Your participation as chief nursing officer is important and valued.

The survey takes approximately 15 minutes to complete. Your participation is voluntary. Your answers will be kept confidential and will be presented only in aggregate and in such a way as to preserve institutional and personal privacy. The study has been reviewed and approved by the Vanderbilt University IRB. Submission of the survey constitutes informed consent.

Please return the enclosed survey by [data] in the addressed/stamped envelope. You may also complete the survey on line at [web link here].

If you are interested in the findings of the study, I will be happy to email a brief summary of results by Spring 2012. You may provide contact information at the end of the survey.

Thank you for your participation. Your contribution is very important. If you have any questions, contact me (cathy.maxwell@vanderbilt.edu) or Dr. Lorraine Mion (Lorraine.c.mion@vanderbilt.edu).

Sincerely,

Cathy A. Maxwell, RN, PhD(c)
Doctoral Candidate
Vanderbilt University School of Nursing

1367 Big Sky Drive
Hamilton, Georgia 31811
706-573-8853

cathy.maxwell@vanderbilt.edu

You may also complete the survey electronically by tying the following address into your web-browser.

PLEASE RETURN THE SURVEY BY SEPTEMBER 17, 2011

http://www.nursing.vanderbilt.edu/HIOAstudy

Follow up Cover Letter (3rd mailing)

Geriatric Trauma Study

Participant Study Invitation

Dear (name & title):

An important survey related to care of hospitalized elders was mailed to you over the past few weeks. This is a final appeal for your participation to contribute to nursing research that may advance understanding of the needs of older patients, as well as factors related to occurrence of adverse events. Your input is important and greatly valued. If you have already completed this survey, I am truly appreciative.

The survey takes approximately 15 minutes to complete. Your participation is voluntary. Your answers will be kept confidential and will be presented only in aggregate and in such a way as to preserve institutional and personal privacy. The study has been reviewed and approved by the Vanderbilt University IRB. Submission of the survey constitutes informed consent.

Please return the enclosed survey by [data] in the addressed/stamped envelope. You may also complete the survey on line at [web link here].

If you are interested in the findings of the study, I will be happy to email a brief summary of results by Spring 2012. You may provide contact information at the end of the survey.

Thank you for your participation. Your contribution is very important. If you have any questions, contact me (cathy.maxwell@vanderbilt.edu) or Dr. Lorraine Mion (Lorraine.c.mion@vanderbilt.edu).

Sincerely,

Cathy A. Maxwell, RN, PhD(c)
Doctoral Candidate
Vanderbilt University School of Nursing

1367 Big Sky Drive
Hamilton, Georgia 31811
706-573-8853

cathy.maxwell@vanderbilt.edu

You may also complete the survey electronically by tying the following address into your web-browser.

PLEASE RETURN THE SURVEY BY SEPTEMBER 27, 2011

http://www.nursing.vanderbilt.edu/HIOAstudy

Appendix I

Table 3.8. Diagram of Dataset Construction: Categories, Variables, and Levels of Measurement

Hospital ID	Demographics	Administratively-Mediated Variables			ACOVE Indicators	Patient Characteristics	Outcomes
		Capital Inputs	Organizational Facets	Labor Inputs			
Survey ID (N)	State (N) Control (ownership) (N) Location (N) AHA Bedsize (O) New Bedsize (O) HCUP Bedsize(O) Teaching Status (N) Trauma Center Level (O) Trauma Center Status(D) Trauma System (D) Geriatric Acute Care Models (D) Geriatric Resource Programs (C)	<u>Computerized Support</u> Medication compatibility alerts(N) Retrieval of Previous Hospital Data(N) Retrieval of NH Data (N) Standardized checklist for VAP(N) Standardized checklist for CAUTI (N) Decision support for PU Risk Assessment(N) <u>In-Room Supplies</u> Medications (N) Linens (N) Basic Supplies (N) <u>Access to Measures Promoting Independence</u> Assistive Technology (N) Physical Rehabilitation (N) Simulated Rehab Environment (N) <u>Other</u> Electronic Health Record (N)	<u>Geriatric-focused Services</u> Home Health Services (D) Meals on Wheels (D) Transportation to Health Services (D) Comprehensive Geriatric Assess (D) Specialty Unit (D) Geriatric Services(D) Skilled Nursing Beds (D) <u>Trauma-focused Services</u> TC Status (D) TC Verification Status (D) Trauma System Status (D) <u>Other</u> Type Triage (N) Health Status Indicators (D) Orthopedic Services (D) Pain Man. Program (D) Teaching Status (D) Electronic Health Record (D) ICU Visiting hours (C) ICU Visitor Sleeping (D) Magnet (D) Trauma Center Level (O) Trauma Center Status (D) Trauma System (D) Geriatric Acute Care Models (D) Geriatric Resource Programs (C)	Percent BSN (C) Percent Nurse Certification (C) RN/Pt Ratio ICU (C) RN/Pt Ratio MS (C) Recent RNs/LPNs/Other -ICU(C) Percent RNs/LPNs/Other- M/S (C) Percent RN Turnover (C) Percent RN workforce < 1 year (C) Percent RN workforce ≥ 5 years (C) Hospitalist FTEs/Total Beds (C) Intensivist FTEs/Total ICU Beds (C) Psych Nurse Liaison (D) Psych Consultation (D) Gero-psych Consultation (D) Geriatric APNs (D) Case Manager for all Older Adults (D) Trauma CM (D) RN CMs (D) Geriatricians (D) Hospitalists (D) Intensivists (D) Multidiciplinary Teams (D) Multidisciplinary Trauma Team (D) Patient Rep Services (D)	Multi-dimensional Assessment of Cognition (O) (D) Assessment for Functional Status (O) (D) Documented assessment for etiology of delirium (O) (D) Documented plan to mobilize within 48 hours of admission (O) (D) Documented screening for risk factors for delirium (O) (D) Ambulatory surgical patients ambulated by day 2 postop (O) (D) Surgical patients screened for delirium for 3 days postop (O) (D) Surgical patients assessed at discharge for cognitive and functional status with comparison to preop levels (O) (D) Assessment for level of independence and need for home health on discharge (O) (D)	Comorbidities Sums (29) (C) Total Points (29) Total Comorbidities Total Points (C) Total discharges per hospital (C) Total HIOA discharges per hospital (C) HIOA Index (Total HIOA DCs/Total DCs (C) Hip Fractures (Sum) (C) Comorbidity Index (CM Points/Total HIOA DCs) (C) TMPM (Median) (C) TMPM (% patients > 25%) (C) Mean Age (C) Median Age (C) SD Age (C) Percent female (C)	ACOVE Index (ALL) (9) (Range 0-45) (C) PSI #12- Postop PE or DVT- O/E Ratio (C)

N: Nominal; O: Ordinal; C: Continuous; D: Dichotomous

Appendix J

Permissions

Re: FW: ICISS
Turner Osler [tosler@uvm.edu]
You replied on 6/15/2011 1:15 PM.
Sent: Tuesday, June 14, 2011 8:28 PM

To:
Maxwell, Cathy

Cc:
Kilgo, Patrick D [pkilgo@emory.edu]; Wayne Meredith [merediw@wfubmc.edu]; Glance, Laurent [Laurent_Glance@URMC.Rochester.edu]

Attachments:
TMPM-ICD9.pdf (407 KB)[Open as Web Page]; tosler.vcf (749 B)

```
Cathy,
     I'd recommend that you use a newer score (the Trauma
Mortality
Prediction Model, TMPM for short) that we published a
couple of years
ago in the Annals of Surgery (attached).
     If your interested, I have software that I can send to
you that
will compute TMPM for you.
-turner

On 6/14/2011 8:42 PM, Maxwell, Cathy wrote:
> Dr. Osler,
> Hi! I am a PhD student at Vanderbilt University. See
emails below. Dr. Kilgo has referred me to you for
assistance with SRRs for ICISSs.
>
> Thank you!
>
> Cathy Maxwell
> cathy.maxwell@vanderbilt.edu
> ____________________________________
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RE: request
Van Walraven, Carl [cvanwalraven@ohri.ca]
Sent: Sunday, January 29, 2012 7:42 AM
To:
Maxwell, Cathy

Dear Dr. Maxwell:

Thanks for the letter.
I'm glad to hear that the index worked out well.
The index is open to all; you can use it in any publication.
Best of luck with your dissertation.

Carl

References

AcademyHealth. (2008). What is HSR? Retrieved 06/05/2011, from http://www.academyhealth.org/About/content.cfm?ItemNumber=831&navItemNumber=514

Agency for Healthcare Research and Quality (AHRQ). (2003a). AHRQ's patient safety initiative: Building foundations, reducing risk: Interim report to the senate committee on appropriations Retrieved 06/05/2011, from http://www.ahrq.gov/qual/pscongrpt/

Agency for Healthcare Research and Quality (AHRQ). (2003b). Patient safety and quality: An evidence-based handbook for nurses Retrieved 06/05/2011, from http://www.ahrq.gov/qual/nurseshdbk/

Agency for Healthcare Research and Quality (AHRQ). (2007a). Guide to patient safety indicators (Version 3.0). Retrieved 09/05/2011, from http://www.qualityindicators.ahrq.gov/downloads/software/sas/v30a/psi_guide_v30a.pdf

Agency for Healthcare Research and Quality (AHRQ). (2007b). Nurse staffing and quality of patient care Retrieved 06/05/2011, from http://www.ahrq.gov/clinic/tp/nursesttp.htm

Agency for Healthcare Research and Quality (AHRQ). (2008). Hcup net nationwide in-patient sample. National statistics. Retrieved 06/05/2011, from http://hcupnet.ahrq.gov

Agency for Healthcare Research and Quality (AHRQ). (2009). Hcup net nationwide in-patient sample, national statistics. Retrieved 06/05/2011, from http://hcupnet.ahrq.gov

Agency for Healthcare Research and Quality (AHRQ). (2010). 2010 national healthcare quality & disparities report. Retrieved 06/05/2011, from http://www.ahrq.gov/qual/qrdr10.htm

Aiken, L. H., Clarke, S. P., Sloane, D. M., Lake, E. T., & Cheney, T. (2008). Effects of hospital care environment on patient mortality and nurse outcomes. *The Journal of nursing administration, 38*(5), 223-229. doi: 10.1097/01.NNA.0000312773.42352.d7

Aiken, L. H., Havens, D. S., & Sloane, D. M. (2009). The magnet nursing services recognition program: A comparison of two groups of magnet hospitals. *Journal of Nursing Administration, 39*(7/8), S5-S14. doi: 10.1097/NNA.0b013e3181aeb469

American Hosptial Association (AHA). (2010). AHA data, insights, resources: Health care statistics & market research: AHA data. Retrieved 06/05/2011, from http://www.ahadata.com/ahadata/html/ahahf.html

Andreou, R. E., Koru-Sengul, T., Linkins, L., Bates, S. M., Ginsberg, J. S., & Kearon, C. (2008). Differences in clinical presentation of deep vein thrombosis in men and women. *Journal of Thrombosis and Haemostasis, 6*(10), 1713-1719. doi: 10.1111/j.1538-7836.2008.03110.x

Ang, D. N., Rivara, F. P., Nathens, A., Jurkovich, G. J., Maier, R. V., Wang, J., & MacKenzie, E. J. (2009). Complication rates among trauma centers. *Journal of the American College of Surgeons, 209*(5), 595-602. doi: 10.1016/j.jamcollsurg.2009.08.003

Arora, V. M., Johnson, M., Olson, J., Podrazik, P. M., Levine, S., DuBeau, C. E., . . . Meltzer, D. O. (2007). Using assessing care of vulnerable elders quality indicators to measure quality of hospital care for vulnerable elders. *Journal of the American Geriatrics Society, 55*(11), 1705-1711. doi: 10.1111/j.1532-5415.2007.01444.x

Arora, V. M., Plein, C., Chen, S., Siddique, J., Sachs, G. A., & Meltzer, D. O. (2009). Relationship between quality of care and functional decline in hospitalized vulnerable elders. *Medical Care, 47*(8), 895-901. doi: 10.1097/MLR.0b013e3181a7e3ec

Bachmann, S., Finger, C., Huss, A., Egger, M., Stuck, A. E., & Clough-Gorr, K. M. (2010). Inpatient rehabilitation specifically designed for geriatric patients: Systematic review and meta-analysis of randomised controlled trials. *British Medical Journal, 340*, c1718. doi: 10.1136/bmj.c1718

Bakker, F. C., Robben, S. H. M., & Olde Rikkert, M. G. M. (2011). Effects of hospital-wide interventions to improve care for frail older inpatients: A systematic review. *BMJ Quality & Safety, 20*(8), 680-691. doi: 10.1136/bmjqs.2010.047183

Bean, J. F., Kiely, D. K., LaRose, S., Goldstein, R., Frontera, W. R., & Leveille, S. G. (2010). Are changes in leg power responsible for clinically meaningful improvements in mobility in older adults? *Journal of the American Geriatrics Society, 58*(12), 2363-2368. doi: 10.1111/j.1532-5415.2010.03155.x

Berwick, D. M., & Kotagal, M. (2004). Restricted visiting hours in ICUs. *JAMA: The Journal of the American Medical Association, 292*(6), 736-737. doi: 10.1001/jama.292.6.736

Bochicchio, G. V., Joshi, M., Knorr, K. M., & Scalea, T. M. (2001). Impact of nosocomial infections in trauma: Does age make a difference? *The Journal of Trauma and Acute Care Surgery, 50*(4), 612-619. doi: 10.1097/00005373-200104000-00004

Bowles, K. H., Holmes, J. H., Ratcliffe, S. J., Liberatore, M., Nydick, R., & Naylor, M. D. (2009). Factors identified by experts to support decision making for post acute referral. *Nursing Research, 58*(2), 115-122. doi: 10.1097/NNR.0b013e318199b52a

Brady Germain, P., & Cummings, G. G. (2010). The influence of nursing leadership on nurse performance: A systematic literature review. *Journal of Nursing Management, 18*(4), 425-439. doi: 10.1111/j.1365-2834.2010.01100.x

Callahan, E., Thomas, D., Goldhirsch, S., & Leipzig, R. (2002). Geriatric hospital medicine. *The Medical clinics of North America, 86*(4), 707-729.

Campbell, S. E., Seymour, D. G., Primrose, W. R., & ACME plus project. (2004). A systematic literature review of factors affecting outcome in older medical patients admitted to hospital. *Age and Ageing, 33*(2), 110-115. doi: 10.1093/ageing/afh036

Celso, B., Tepas, J., Langland-Orban, B., Pracht, E., Papa, L., Lottenberg, L., & Flint, L. (2006). A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. *The Journal of Trauma and Acute Care Surgery, 60*(2), 371-378. doi: 10.1097/01.ta.0000197916.99629.eb

Centers for Disease Control and Prevention (CDC). (2009). Web-based injury statistics query and reporting system (WISQARS^{TM}). Retrieved 09/05/2011, from http://www.cdc.gov/injury/wisqars/index.html

Chang, D. C., Handly, N., Abdullah, F., Efron, D. T., Haut, E. R., Haider, A. H., . . . Cornwell, E. E. (2008). The occurrence of potential patient safety events among trauma patients: Are they random? *Annals of Surgery, 247*(2), 327-334. doi: 10.1097/SLA.0b013e31815aab0d

Chang, E., Hancock, K., Hickman, L., Glasson, J., & Davidson, P. (2006). Outcomes of acutely ill older hospitalized patients following implementation of tailored models of care: A repeated measures (pre- and post-intervention) design. *International Journal of Nursing Studies, 44*(7), 1079-1092. doi: 10.1016/j.ijnurstu.2006.04.017

Chiasson, T. C., Manns, B. J., & Stelfox, H. T. (2009). An economic evaluation of venous thromboembolism prophylaxis strategies in critically ill trauma patients at risk of bleeding. *PLoS Medicine, 6*(6), e1000098. doi: 10.1371/journal.pmed.1000098

Choiniere, D. B. (2010). The effects of hospital noise. *Nursing Administration Quarterly, 34*(4), 327-333. doi: 10.1097/NAQ.0b013e3181f563db

Chong, C., Savige, J., & Lim, W. (2010). Medical problems in hip fracture patients. *Archives of Orthopaedic and Trauma Surgery, 130*(11), 1355-1361. doi: 10.1007/s00402-009-1038-y

Chudyk, A. M., Jutai, J. W., Petrella, R. J., & Speechley, M. (2009). Systematic review of hip fracture rehabilitation practices in the elderly. *Archives of Physical Medicine and Rehabilitation, 90*(2), 246-262. doi: 10.1016/j.apmr.2008.06.036

Clancy, C. M. (2009). Ten years after to err is human. *American Journal of Medical Quality, 24*(6), 525-528. doi: 10.1177/1062860609349728

Clark, D. E., & Chu, M. K. (2002). Increasing importance of the elderly in a trauma system. *The American journal of emergency medicine, 20*(2), 108-111. doi: 10.1053/ajem.2002.31576

Clark, D. E., DeLorenzo, M. A., Lucas, F. L., & Wennberg, D. E. (2005). Injuries among older americans with and without Medicare. *American Journal of Public Health, 95*(2), 273-278. doi: 10.2105/ajph.2003.036871

Cole, M. G., McCusker, J., Elie, M., Dendukuri, N., Latimer, E., & Belzile, E. (2006). Systematic detection and multidisciplinary care of depression in older medical inpatients: A randomized trial. *Canadian Medical Association Journal, 174*(1), 38-44. doi: 10.1503/cmaj.050519

Comfort, E. H. (2008). Reducing pressure ulcer incidence through braden scale risk assessment and support surface use. *Advances in Skin & Wound Care, 21*(7), 330-334. doi: 10.1097/01.ASW.0000323519.08306.ea

Costa Jr, P., Williams, T., Somerfield, M., Albert, M., Folstein, M., Gilman, S., . . . Kaszniak, A. (1996). Recognition and initial assessment of Alzheimer's disease and related dementias. Clinical practice guideline no. 19. Rockville, MD: US Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research.

Cram, P., Vaughan-Sarrazin, M., & Rosenthal, G. (2007). Hospital characteristics and patient populations served by physician owned and non physician owned orthopedic specialty hospitals. *BMC Health Services Research, 7*(1), 155. doi: 10.1186/1472-6963-7-155

Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of Internal Medicine, 118*(3), 219-223. doi: 10.1059/0003-4819-118-3-199302010-00011

Curtis, K., Lien, D., Chan, A., Grove, P., & Morris, R. (2002). The impact of trauma case management on patient outcomes. *The Journal of Trauma and Acute Care Surgery, 53*(3), 477-482. doi: 10.1097/00005373-200209000-00014

De Castro, A. B., Fujishiro, K., Rue, T., Tagalog, E. A., Samaco-Paquiz, L. P. G., & Gee, G. C. (2010). Associations between work schedule characteristics and occupational injury and illness. *International Nursing Review, 57*(2), 188-194. doi: 10.1111/j.1466-7657.2009.00793.x

de Jonghe, J. F. M., Kalisvaart, K. J., Dijkstra, M., van Dis, H., Vreeswijk, R., Kat, M. G., . . . van Gool, W. A. (2007). Early symptoms in the prodromal phase of delirium: A prospective cohort study in elderly patients undergoing hip surgery. *American Journal of Geriatric Psychiatry, 15*(2), 112-121. doi: 10.1097/01.JGP.0000241002.86410.c2

de Saint-Hubert, M., Schoevaerdts, D., Cornette, P., D'Hoore, W., Boland, B., & Swine, C. (2010). Predicting functional adverse outcomes in hospitalized older patients: A systematic review of screening tools. *The Journal of Nutrition, Health & Aging, 14*(5), 394-399. doi: 10.1007/s12603-010-0086-x

de Saint-Hubert, M., Schoevaerdts, D., Poulain, G., Cornette, P., & Swine, C. (2009). Risk factors predicting later functional decline in older hospitalized patients. *Acta Clinica Belgica, 64*(3), 187-194.

Delaney, C., Zutshi, M., Senagore, A., Remzi, F., Hammel, J., & Fazio, V. (2003). Prospective, randomized, controlled trial between a pathway of controlled rehabilitation with early ambulation and diet and traditional postoperative care after laparotomy and intestinal resection. *Diseases of the Colon and Rectum, 46*(7), 851-859. doi: 10.1007/s10350-004-6672-4

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2008). *Internet, mail, and mixed-mode surveys: The tailored design method*. Hoboken, NJ: Wiley Publishing.

Dunton, N., Gajewski, B., Klaus, S., & Pierson, B. (2007). The relationship of nursing workforce characteristics to patient outcomes. *Online J Issues Nurs, 12*(3), 1-15. Retrieved from http://www.medscape.com/viewarticle/569394

Eccles, M., Clarke, J., Livingston, M., Freemantle, N., & Mason, J. (1998). North of England evidence based guidelines development project: Guideline for the primary care management of dementia. *British Medical Journal, 317*(7161), 802-808. doi: 10.1136/bmj.317.7161.802

Edwards, P., Roberts, I., Clarke, M., DiGuiseppi, C., Pratap, S., Wentz, R., . . . Cooper, R. (2009). Methods to increase response rates to postal questionnaires. *Cochrane Database System Review, 3*, 1465. doi: 10.1002/14651858.MR000008.pub4

Elie, M., Cole, M. G., Primeau, F. J., & Bellavance, F. (1998). Delirium risk factors in elderly hospitalized patients. *Journal of General Internal Medicine, 13*(3), 204-212. doi: 10.1046/j.1525-1497.1998.00047.x

Elixhauser, A., Steiner, C., Harris, D. R., & Coffey, R. M. (1998). Comorbidity measures for use with administrative data. *Medical Care, 36*(1), 8-27.

Ellis, G., Whitehead, M. A., O'Neill, D., Langhorne, P., & Robinson, D. (2011). Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database System Review, 7*. Retrieved from

http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD006211.pub2/abstract doi:10.1002/14651858.CD006211.pub2

Ely, E. W., Inouye, S. K., Bernard, G. R., Gordon, S., Francis, J., May, L., . . . Dittus, R. (2001). Delirium in mechanically ventilated patients. *JAMA: The Journal of the American Medical Association, 286*(21), 2703-2710. doi: 10.1001/jama.286.21.2703

Fallon, W. F. J., Rader, E., Zyzanski, S., Mancuso, C., Martin, B., Breedlove, L., . . . Campbell, J. (2006). Geriatric outcomes are improved by a geriatric trauma consultation service. *The Journal of Trauma and Acute Care Surgery, 61*(5), 1040-1046. doi: 10.1097/01.ta.0000238652.48008.59

Farmer, T. C., Reynolds, C. F., & Cleary, P. D. (2008). Quality of depression care for people with coincident chronic medical conditions. *General Hospital Psychiatry, 30*(6), 528-535. doi: 10.1016/j.genhosppsych.2008.07.002

Fields, S. D., MacKenzie, C. R., Charlson, M. E., & Perry, S. W. (1986). Reversibility of cognitive impairment in medical inpatients. *Archives of Internal Medicine, 146*(8), 1593-1596. doi: 10.1001/archinte.1986.00360200165027

Fink, A. (2009). *How to conduct surveys: A step-by-step guide*. Thousand Oaks, CA: Sage Publications, Inc.

Fisher, S. R., Kuo, Y.-f., Graham, J. E., Ottenbacher, K. J., & Ostir, G. V. (2010). Early ambulation and length of stay in older adults hospitalized for acute illness. *Archives of Internal Medicine, 170*(21), 1942-1943. doi: 10.1001/archinternmed.2010.422

Flynn, M., & McKeown, M. (2009). Nurse staffing levels revisited: A consideration of key issues in nurse staffing levels and skill mix research. *Journal of Nursing Management, 17*(6), 759-766. doi: 10.1111/j.1365-2834.2009.01023.x

Fowler, F. J. (2009). *Survey research methods*. Thousand Oaks, CA: Sage Publications, Inc.

Friedman, S. M., Mendelson, D. A., Bingham, K. W., & Kates, S. L. (2009). Impact of a comanaged geriatric fracture center on short-term hip fracture outcomes. *Archives of Internal Medicine, 169*(18), 1712-1717. doi: 10.1001/archinternmed.2009.321

Friese, C. R., Lake, E. T., Aiken, L. H., Silber, J. H., & Sochalski, J. (2008). Hospital nurse practice environments and outcomes for surgical oncology patients. *Health Services Research, 43*(4), 1145-1163. doi: 10.1111/j.1475-6773.2007.00825.x

Furukawa, M. F., Raghu, T. S., & Shao, B. B. M. (2010). Electronic medical records, nurse staffing, and nurse-sensitive patient outcomes: Evidence from California

hospitals, 1998–2007. *Health Services Research, 45*(4), 941-962. doi: 10.1111/j.1475-6773.2010.01110.x

Gaugler, J., Duval, S., Anderson, K., & Kane, R. (2007). Predicting nursing home admission in the U.S.: A meta-analysis. *BMC Geriatrics, 7*(13), 1-14. doi: 10.1186/1471-2318-7-13

Geerts, W. H., Code, K. I., Jay, R. M., Chen, E., & Szalai, J. P. (1994). A prospective study of venous thromboembolism after major trauma. *New England Journal of Medicine, 331*(24), 1601-1606. doi: 10.1056/NEJM199412153312401

Glance, L. G., Osler, T. M., Mukamel, D. B., Meredith, W., & Dick, A. W. (2011). Expert consensus vs empirical estimation of injury severity: Effect on quality measurement in trauma. *Archives of Surgery, 144*(4), 326-332. doi: 10.1001/archsurg.2009.8

Glance, L. G., Osler, T. M., Mukamel, D. B., Meredith, W., Wagner, J., & Dick, A. W. (2009). TMPM-ICD9: A trauma mortality prediction model based on ICD-9-cm codes. *Annals of Surgery, 249*(6), 1032-1039. doi: 10.1097/SLA.0b013e3181a38f28

Goode, C. J., Pinkerton, S., McCausland, M. P., Southard, P., Graham, R., & Krsek, C. (2001). Documenting chief nursing officers' preference for BSN-prepared nurses. *Journal of Nursing Administration, 31*(2), 55-59.

Gorra, A., Clark, D., Mullins, R., & DeLorenzo, M. (2008). Regional variation in hospital mortality and 30-day mortality for injured Medicare patients. *World Journal of Surgery, 32*(6), 954-959. doi: 10.1007/s00268-007-9410-y

Gravelle, H., Dusheiko, M., Sheaff, R., Sargent, P., Boaden, R., Pickard, S., . . . Roland, M. (2007). Impact of case management (Evercare) on frail elderly patients: Controlled before and after analysis of quantitative outcome data. *BMJ, 334*(7583), 31. doi: 10.1136/bmj.39020.413310.55

Gregory, J. J., Kostakopoulou, K., Cool, W. P., & Ford, D. J. (2010). One-year outcome for elderly patients with displaced intracapsular fractures of the femoral neck managed non-operatively. *Injury, 41*(12), 1273-1276. doi: 10.1016/j.injury.2010.06.009

Grossman, M., Scaff, D. W., Miller, D., III, J. R., Hoey, B., & Anderson, H. L. I. (2003). Functional outcomes in octogenarian trauma. *The Journal of Trauma and Acute Care Surgery, 55*(1), 26-32. doi: 10.1097/01.TA.0000072109.52351.0D

Halasyamani, L., Kripalani, S., Coleman, E., Schnipper, J., van Walraven, C., Nagamine, J., . . . Manning, D. (2006). Transition of care for hospitalized elderly patients—development of a discharge checklist for hospitalists. *Journal of Hospital Medicine, 1*(6), 354-360. doi: 10.1002/jhm.129

Hall, L. M. G. (2005). *Quality work environments for nurse and patient safety*. Sudbury, MA: Jones & Bartlett Learning.

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics, 42*(2), 377-381. doi: 10.1016/j.jbi.2008.08.010

Hattori, H., Kamiya, J., Shimada, H., Akiyama, H., Yasui, A., Kuroiwa, K., . . . Fukata, S. (2009). Assessment of the risk of postoperative delirium in elderly patients using E-PASS and the NEECHAM confusion scale. *International Journal of Geriatric Psychiatry, 24*(11), 1304-1310. doi: 10.1002/gps.2262

Haut, E. R., Chang, D. C., Pierce, C. A., Colantuoni, E., Efron, D. T., Haider, A. H., . . . Pronovost, P. J. (2009). Predictors of posttraumatic deep vein thrombosis (DVT): Hospital practice versus patient factors-an analysis of the national trauma data bank (NTDB). *The Journal of Trauma and Acute Care Surgery, 66*(4), 994-1001. doi: 10.1097/TA.0b013e3181991adc

Healthcare Cost and Utilization Project (HCUP). (2009). Overview of the nationwide inpatient sample (NIS). Retrieved 09/05/2011, from http://www.hcup-us.ahrq.gov/nisoverview.jsp

Hickey, A. N. N., Clinch, D., & Groarke, E. P. (1997). Prevalence of cognitive impairment in the hospitalized elderly. *International Journal of Geriatric Psychiatry, 12*(1), 27-33. doi: 10.1002/(sici)1099-1166(199701)12:1<27::aid-gps446>3.0.co;2-f

Hickman, L., Newton, P., Halcomb, E. J., Chang, E., & Davidson, P. (2007). Best practice interventions to improve the management of older people in acute care settings: A literature review. *Journal of Advanced Nursing, 60*(2), 113-126. doi: 10.1111/j.1365-2648.2007.04417.x

Hildreth, A. N., Enniss, T., Martin, R. S., Miller, P. R., Mitten-Long, D., Gasaway, J., . . . Meredith, J. W. (2010). Surgical intensive care unit mobility is increased after institution of a computerized mobility order set and intensive care unit mobility protocol: A prospective cohort analysis. *The American Surgeon, 76*(8), 818-822.

Hill, K. S. (2010). Improving quality and patient safety by retaining nursing expertise. *OJIN: The Online Journal of Issues in Nursing* Retrieved 09/05/2011, from http://www.medscape.com/viewarticle/729397

Holmboe, E. S., Wang, Y., Meehan, T. P., Tate, J. P., Ho, S.-Y., Starkey, K. S., & Lipner, R. S. (2008). Association between maintenance of certification examination scores and quality of care for Medicare beneficiaries. *Archives of Internal Medicine, 168*(13), 1396-1403. doi: 10.1001/archinte.168.13.1396

Hoogerduijn, J. G., Schuurmans, M. J., Duijnstee, M. S. H., De Rooij, S. E., & Grypdonck, M. F. H. (2007). A systematic review of predictors and screening instruments to identify older hospitalized patients at risk for functional decline. *Journal of Clinical Nursing, 16*(1), 46-57. doi: 10.1111/j.1365-2702.2006.01579.x

Hsia, R. Y., Wang, E., Saynina, O., Wise, P., Perez-Stable, E. J., & Auerbach, A. (2011). Factors associated with trauma center use for elderly patients with trauma: A statewide analysis, 1999-2008. *Archives of Surgery, 146*(5), 585-592. doi: 10.1001/archsurg.2010.311

Hwang, U., & Morrison, R. S. (2007). The geriatric emergency department. *Journal of the American Geriatrics Society, 55*(11), 1873-1876. doi: 10.1111/j.1532-5415.2007.01400.x

Inouye, S. K., Bogardus, S. T., Charpentier, P. A., Leo-Summers, L., Acampora, D., Holford, T. R., & Cooney, L. M. (1999). A multicomponent intervention to prevent delirium in hospitalized older patients. *New England Journal of Medicine, 340*(9), 669-676. doi: 10.1056/NEJM199903043400901

Inouye, S. K., Foreman, M. D., Mion, L. C., Katz, K. H., & Cooney, L. M., Jr. (2001). Nurses' recognition of delirium and its symptoms: Comparison of nurse and researcher ratings. *Archives of Internal Medicine, 161*(20), 2467-2473. doi: 10.1001/archinte.161.20.2467

Inouye, S. K., Viscoli, C. M., Horwitz, R. I., Hurst, L. D., & Tinetti, M. E. (1993). A predictive model for delirium in hospitalized elderly medical patients based on admission characteristics. *Annals of Internal Medicine, 119*(6), 474-481. doi: 10.1059/0003-4819-119-6-199309150-00005

Institute for Clinical Systems Improvement (ICSI). (2010). Falls (acute care), prevention of (protocol) Retrieved 09/05/2011, from http://www.icsi.org/guidelines_and_more/protocols_/patient_safety___reliability_protocols/falls__acute_care___prevention_of__protocol_/falls__acute_care___prevention_of__protocol__24254.html

Institute for Patient & Family Centered Care. (2011). Changing hospital "visiting" policies and practices: Supporting family presence and participation Retrieved 09/05/2011, from http://www.ipfcc.org/visiting.pdf

Institute of Medicine (IOM), Kohn, L. T., Corrigan, J., & Donaldson, M. S. (2000). *To err is human: Building a safer health system* (Vol. 6). Washington, D. C.: National Academy Press.

Jayadevappa, R., Bloom, B. S., Raziano, D. B., & Lavizzo-Mourey, R. (2003). Dissemination and characteristics of acute care for elders (ACE) units in the

United States. *International Journal of Technology Assessment in Health Care, 19*(01), 220-227. doi: 10.1017/S0266462303000205

Jayadevappa, R., Chhatre, S., Weiner, M., & Raziano, D. B. (2006). Health resource utilization and medical care cost of acute care elderly unit patients. *Value in Health, 9*(3), 186-192. doi: 10.1111/j.1524-4733.2006.00099.x

Jensen, P. H., Webster, E., & Witt, J. (2009). Hospital type and patient outcomes: An empirical examination using AMI readmission and mortality records. *Health Economics, 18*(12), 1440-1460. doi: 10.1002/hec.1435

Jha, A. K., Li, Z., Orav, E. J., & Epstein, A. M. (2005). Care in U.S. Hospitals — the hospital quality alliance program. *New England Journal of Medicine, 353*(3), 265-274. doi: 10.1056/NEJMsa051249

Kaafarani, H. M. A., Borzecki, A. M., Itani, K. M. F., Loveland, S., Mull, H. J., Hickson, K., . . . Rosen, A. K. (2011). Validity of selected patient safety indicators: Opportunities and concerns. *Journal of the American College of Surgeons, 212*(6), 924-934. doi: 10.1016/j.jamcollsurg.2010.07.007

Kane, R. L., Shamliyan, T. A., Mueller, C., Duval, S., & Wilt, T. J. (2007). The association of registered nurse staffing levels and patient outcomes: Systematic review and meta-analysis. *Medical Care, 45*(12), 1195-1204. doi: 10.1097/MLR.0b013e3181468ca3

Kendall-Gallagher, D., & Blegen, M. A. (2009). Competence and certification of registered nurses and safety of patients in intensive care units. *American Journal of Critical Care, 18*(2), 106-113. doi: 10.4037/ajcc2009487

Ko, F. C.-Y. (2011). The clinical care of frail, older adults. *Clinics in Geriatric Medicine, 27*(1), 89-100.

Kovner, C., & Gergen, P. J. (1998). Nurse staffing levels and adverse events following surgery in U.S. Hospitals. *Journal of Nursing Scholarship, 30*(4), 315-321. doi: 10.1111/j.1547-5069.1998.tb01326.x

Kovner, C. T., Mezey, M., & Harrington, C. (2002). Who cares for older adults? Workforce implications of an aging society. *Health Affairs, 21*(5), 78-89. doi: 10.1377/hlthaff.21.5.78

Kramer, M., Maguire, P. A. T., & Brewer, B. B. (2011). Clinical nurses in magnet hospitals confirm productive, healthy unit work environments. *Journal of Nursing Management, 19*(1), 5-17. doi: 10.1111/j.1365-2834.2010.01211.x

Krapohl, G., Manojlovich, M., Redman, R., & Zhang, L. (2010). Nursing specialty certification and nursing-sensitive patient outcomes in the intensive care unit. *American Journal of Critical Care, 19*(6), 490-498. doi: 10.4037/ajcc2010406

Lang, P., Michel, J., & Zekry, D. (2009). Frailty syndrome: A transitional state in a dynamic process. *Gerontology, 55*(5), 539-549. doi: 10.1159/000211949

Lange, J., Wallace, M., Gerard, S., Lovanio, K., Fausty, N., & Rychlewicz, S. (2009). Effect of an acute care geriatric educational program on fall rates and nurse work satisfaction. *The Journal of Continuing Education in Nursing, 40*(8), 371-379. doi: 10.3928/00220124-20090723-03

Larsen, K., Hansen, T. B., Thomsen, B., Christiansen, T., & Søballe, K. (2009). Cost-effectiveness of accelerated perioperative care and rehabilitation after total hip and knee arthroplasty. *The Journal of Bone and Joint Surgery (American), 91*(4), 761-772. doi: 10.2106/JBJS.G.01472

Leape, L., Berwick, D., Clancy, C., Conway, J., Gluck, P., Guest, J., . . . Isaac, T. (2009). Transforming healthcare: A safety imperative. *Quality and Safety in Health Care, 18*(6), 424-428. doi: 10.1136/qshc.2009.036954

Lee, H. O. W., & Cummings, G. G. (2008). Factors influencing job satisfaction of front line nurse managers: A systematic review. *Journal of Nursing Management, 16*(7), 768-783. doi: 10.1111/j.1365-2834.2008.00879.x

Lindenberger, E. C., Landefeld, C. S., Sands, L. P., Counsell, S. R., Fortinsky, R. H., Palmer, R. M., . . . Covinsky, K. E. (2003). Unsteadiness reported by older hospitalized patients predicts functional decline. *Journal of the American Geriatrics Society, 51*(5), 621-626. doi: 10.1034/j.1600-0579.2003.00205.x

Lindquist, L., Go, L., Fleisher, J., Jain, N., & Baker, D. (2011). Improvements in cognition following hospital discharge of community dwelling seniors. *Journal of General Internal Medicine, 26*(7), 765-770. doi: 10.1007/s11606-011-1681-1

Lindquist, R., & Sendelbach, S. E. (2007). Maximizing safety of hospitalized elders. *Critical Care Nursing Clinics of North America, 19*(3), 277-284. doi: 10.1016/j.ccell.2007.05.002

Long, L. E., Burkett, K., & McGee, S. (2009). Promotion of safe outcomes: Incorporating evidence into policies and procedures. *Nursing Clinics of North America, 44*(1), 57-70. doi: 10.1016/j.cnur.2008.10.013

Longo, D., Hewett, J., Ge, B., & Schubert, S. (2007). Hospital patient safety: Characteristics of best-performing hospitals. *Journal of healthcare management/American College of Healthcare Executives, 52*(3), 188-205.

Longo, D. R., Hewett, J. E., Ge, B., & Schubert, S. (2005). The long road to patient safety. *JAMA: The Journal of the American Medical Association, 294*(22), 2858-2865. doi: 10.1001/jama.294.22.2858

Luke, D. (2004). *Multi-level modeling: Series: Quantitative application in the social sciences*. Thousand Oaks, CA: Sage Publications, Inc.

Lundström, M., Edlund, A., Karlsson, S., Brännström, B., Bucht, G., & Gustafson, Y. (2005). A multifactorial intervention program reduces the duration of delirium, length of hospitalization, and mortality in delirious patients. *Journal of the American Geriatrics Society, 53*(4), 622-628. doi: 10.1111/j.1532-5415.2005.53210.x

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research, 35*(6), 382-385.

MacKenzie, E. J., Rivara, F. P., Jurkovich, G. J., Nathens, A. B., Frey, K. P., Egleston, B. L., . . . Scharfstein, D. O. (2006). A national evaluation of the effect of trauma-center care on mortality. *New England Journal of Medicine, 354*(4), 366-378. doi: 10.1056/NEJMsa052049

MacKenzie, E. J., Rivara, F. P., Jurkovich, G. J., Nathens, A. B., Frey, K. P., Egleston, B. L., . . . Scharfstein, D. O. (2007). The national study on costs and outcomes of trauma. *The Journal of Trauma and Acute Care Surgery, 63*(6), S54-S67. doi: 10.1097/TA.0b013e31815acb09

MacKenzie, E. J., Weir, S., Rivara, F. P., Jurkovich, G. J., Nathens, A. B., Wang, W., . . . Salkever, D. S. (2010). The value of trauma center care. *The Journal of Trauma and Acute Care Surgery, 69*(1), 1-10. doi: 10.1097/TA.0b013e3181e03a21

Maggio, P. M., Brundage, S. I., Hernandez-Boussard, T., & Spain, D. A. (2009). Commitment to COT verification improves patient outcomes and financial performance. *The Journal of Trauma and Acute Care Surgery, 67*(1), 190-195. doi: 10.1097/TA.0b013e3181a51b2f

Mahoney, J. E., Sager, M. A., & Jalaluddin, M. (1999). Use of an ambulation assistive device predicts functional decline associated with hospitalization. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 54*(2), M83-M88. doi: 10.1093/gerona/54.2.M83

Malone, M. L., Vollbrecht, M., Stephenson, J., Burke, L., Pagel, P., & Goodwin, J. S. (2010). Acute care for elders (ACE) tracker and e-geriatrician: Methods to disseminate ACE concepts to hospitals with no geriatricians on staff. *Journal of the American Geriatrics Society, 58*(1), 161-167. doi: 10.1111/j.1532-5415.2009.02624.x

Mamon, J., Steinwachs, D. M., Fahey, M., Bone, L. R., Oktay, J., & Klein, L. (1992). Impact of hospital discharge planning on meeting patient needs after returning home. *Health Services Research, 27*, 155-175.

Marcantonio, E., Ta, T., Duthie, E., & Resnick, N. M. (2002). Delirium severity and psychomotor types: Their relationship with outcomes after hip fracture repair. *Journal of the American Geriatrics Society, 50*(5), 850-857. doi: 10.1046/j.1532-5415.2002.50210.x

Marcantonio, E. R., Goldman, L., Mangione, C. M., Ludwig, L. E., Muraca, B., Haslauer, C. M., . . . Lee, T. H. (1994). A clinical prediction rule for delirium after elective noncardiac surgery. *JAMA: The Journal of the American Medical Association, 271*(2), 134-139. doi: 10.1001/jama.1994.03510260066030

Marcin, J. P., & Romano, P. S. (2004). Impact of between-hospital volume and within-hospital volume on mortality and readmission rates for trauma patients in California*. *Critical Care Medicine, 32*(7), 1477-1483. doi: 10.1097/01.CCM.0000127781.08985.03

Marshall, L., Harbin, V., Hooker, J., Oswald, J., & Cummings, L. (2012). Safety net hospital performance on national quality of care process measures. *Journal for Healthcare Quality, 34*(2), 21-31. doi: 10.1111/j.1945-1474.2011.00186.x

Maxwell, C., & Mion, L. C. (2010, Unpublished Study-a). *Availability of geriatric resources: A descriptive study by states and trauma centers.*

Maxwell, C., & Mion, L. C. (2010, Unpublished Study-b). *Hospitalized injured older adults: A systematic review of predictors and outcomes.*

McConnell, K. J., Newgard, C. D., Mullins, R. J., Arthur, M., & Hedges, J. R. (2005). Mortality benefit of transfer to level I versus level ii trauma centers for head-injured patients. *Health Services Research, 40*(2), 435-458. doi: 10.1111/j.1475-6773.2005.0u367.x

McCusker, J., Cole, M., Dendukuri, N., Belzile, É., & Primeau, F. (2001). Delirium in older medical inpatients and subsequent cognitive and functional status: A prospective study. *Canadian Medical Association Journal, 165*(5), 575-583.

McCusker, J., Cole, M., Dendukuri, N., Han, L., & Belzile, É. (2003). The course of delirium in older medical inpatients. *Journal of General Internal Medicine, 18*(9), 696-704. doi: 10.1046/j.1525-1497.2003.20602.x

McCusker, J., Kakuma, R., & Abrahamowicz, M. (2002). Predictors of functional decline in hospitalized elderly patients. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 57*(9), M569-M577. doi: 10.1093/gerona/57.9.M569

Menachemi, N., Chukmaitov, A., Saunders, C., & Brooks, R. G. (2008). Hospital quality of care: Does information technology matter? The relationship between information technology adoption and quality of care. *Health Care Management Review, 33*(1), 51-59. doi: 10.1097/01.HMR.0000304497.89684.36

Mezey, M., Kobayashi, M., Grossman, S., Firpo, A., Fulmer, T., & Mitty, E. (2004). Nurses improving care to health system elders (NICHE): Implementation of best practice models. *Journal of Nursing Administration, 34*(10), 451-457. doi: 10.1097/00005110-200410000-00005

Min, L., Yoon, W., Mariano, J., Wenger, N. S., Elliott, M. N., Kamberg, C., & Saliba, D. (2009). The vulnerable elders-13 survey predicts 5-year functional decline and mortality outcomes in older ambulatory care patients. *Journal of the American Geriatrics Society, 57*(11), 2070-2076. doi: 10.1111/j.1532-5415.2009.02497.x

Minnick, A. (2001). Conducting an outcomes assessment. In R. Kleinpell (Ed.), *Outcomes assessment in advanced practice nursing* (pp. 91-102). New York: Springer.

Minnick, A., Young, W., & Roberts, M. (1995). 2,000 patients relate their hospital experiences. *Nursing Management, 26*(12), 25-31.

Minnick, A. F., Fogg, L., Mion, L. C., Catrambone, C., & Johnson, M. E. (2007). Resource clusters and variation in physical restraint use. *Journal of Nursing Scholarship, 39*(4), 363-370. doi: 10.1111/j.1547-5069.2007.00194.x

Minnick, A. F., & Mion, L. C. (2009). Nurse labor data: The collection and interpretation of nurse to patient ratios. *The Journal of nursing administration, 39*(9), 377-381. doi: 10.1097/NNA.0b013e3181b3b656

Minnick, A. F., Mion, L. C., Johnson, M. E., Catrambone, C., & Leipzig, R. (2007). Prevalence and variation of physical restraint use in acute care settings in the US. *Journal of Nursing Scholarship, 39*(1), 30-37. doi: 10.1111/j.1547-5069.2007.00140.x

Minnick, A. F., Roberts, M. J., Young, W. B., Kleinpell, R. M., & Marcantonio, R. J. (1997). What influences patients' reports of three aspects of hospital services? *Medical Care, 35*(4), 399-409.

Missildine, K., Bergstrom, N., Meininger, J., Richards, K., & Foreman, M. D. (2010). Sleep in hospitalized elders: A pilot study. *Geriatric Nursing, 31*(4), 263-271. doi: 10.1016/j.gerinurse.2010.02.013

Mittal, D., Majithia, D., Kennedy, R., & Rhudy, J. (2006). Differences in characteristics and outcome of delirium as based on referral patterns. *Psychosomatics, 47*(5), 367-375. doi: 10.1176/appi.psy.47.5.367

Morris, B. A., Benetti, M., Marro, H., & Rosenthal, C. K. (2010). Clinical practice guidelines for early mobilization hours after surgery. *Orthopaedic Nursing, 29*(5), 290-316. doi: 10.1097/NOR.0b013e3181ef7a5d

Motamedi, S. M., Posadas-Calleja, J., Straus, S., Bates, D. W., Lorenzetti, D. L., Baylis, B., . . . Ghali, W. A. (2011). The efficacy of computer-enabled discharge communication interventions: A systematic review. *BMJ Quality & Safety, 20*(5), 403-415. doi: 10.1136/bmjqs.2009.034587

Mudge, A. M., Giebel, A. J., & Cutler, A. J. (2008). Exercising body and mind: An integrated approach to functional independence in hospitalized older people. *Journal of the American Geriatrics Society, 56*(4), 630-635. doi: 10.1111/j.1532-5415.2007.01607.x

Mundy, L. M., Leet, T. L., Darst, K., Schnitzler, M. A., & Dunagan, W. C. (2003). Early mobilization of patients hospitalized with community-acquired pneumonia. *Chest, 124*(3), 883-889. doi: 10.1378/chest.124.3.883

Munin, M. C., Rudy, T. E., Glynn, N. W., Crossett, L. S., & Rubash, H. E. (1998). Early inpatient rehabilitation after elective hip and knee arthroplasty. *JAMA: The Journal of the American Medical Association, 279*(11), 847-852. doi: 10.1001/jama.279.11.847

Murphy, E. A. (2011). A key step for hospitalized elders: Comment on "early ambulation and length of stay in older adults hospitalized for acute illness". *Archives of Internal Medicine, 171*(3), 268-269. doi: 10.1001/archinternmed.2011.1

Nathens, A. B., Rivara, F. P., MacKenzie, E. J., Maier, R. V., Wang, J., Egleston, B., . . . Jurkovich, G. J. (2006). The impact of an intensivist-model ICU on trauma-related mortality. *Annals of Surgery, 244*(4), 545-554. doi: 10.1097/01.sla.0000239005.26353.49

Needleman, J., Buerhaus, P. I., Mattke, S., Stewart, M., Zelevinsky, K., & Health Resources Service Administration. (2001). Nurse staffing and patient outcomes in hospitals: Report no. 230-99-0021. Boston, MA: Harvard School of Public Health.

Nelson, A., Powell-Cope, G., Palacios, P., Luther, S., Black, T., Hillman, T., . . . Gross, J. (2007). Nurse staffing and patient outcomes in inpatient rehabilitation settings. *Rehabilitation Nursing: The Official Journal of the Association of Rehabilitation Nurses, 32*(5), 179-202.

Neuman, M. D., Speck, R. M., Karlawish, J. H., Schwartz, J. S., & Shea, J. A. (2010). Hospital protocols for the inpatient care of older adults: Results from a statewide survey. *Journal of the American Geriatrics Society, 58*(10), 1959-1964. doi: 10.1111/j.1532-5415.2010.03056.x

O'Brien-Pallas, L., Li, X. M., Wang, S., Meyer, R. M., & Thomson, D. (2010). Evaluation of a patient care delivery model: System outcomes in acute cardiac care. *CJNR (Canadian Journal of Nursing Research), 42*(4), 98-120.

Olds, D. M., & Clarke, S. P. (2010). The effect of work hours on adverse events and errors in health care. *Journal of Safety Research, 41*(2), 153-162. doi: 10.1016/j.jsr.2010.02.002

Oman, K. S., Duran, C., & Fink, R. (2008). Evidence-based policy and procedures: An algorithm for success. *Journal of Nursing Administration, 38*(1), 47-51. doi: 10.1097/01.NNA.0000295634.18463.4d

Papanikolaou, P. N., Christidi, G. D., & Ioannidis, J. P. A. (2006). Patient outcomes with teaching versus nonteaching healthcare: A systematic review. *PLoS Med, 3*(9), 1603-1615. doi: 10.1371/journal.pmed.0030341

Parrish, R. G. (2010). Measuring population health outcomes. *Preventing Chronic Disease: Public Health Research, Practice, and Policy, 7*(A71). Retrieved from http://www.cdc.gov/pcd/issues/2010/jul/pdf/10_0005.pdf

Patrician, P. A., Loan, L., McCarthy, M., Brosch, L. R., & Davey, K. S. (2010). Towards evidence-based management: Creating an informative database of nursing-sensitive indicators. *Journal of Nursing Scholarship, 42*(4), 358-366. doi: 10.1111/j.1547-5069.2010.01364.x

Pierce, C. A., Haut, E. R., Kardooni, S., Chang, D. C., Efron, D. T., Haider, A., . . . Cornwell, E. E. I. (2008). Surveillance bias and deep vein thrombosis in the national trauma data bank: The more we look, the more we find. *The Journal of Trauma and Acute Care Surgery, 64*(4), 932-937. doi: 10.1097/TA.0b013e318166b808

Platts-Mills, T. F., Travers, D., Biese, K., McCall, B., Kizer, S., LaMantia, M., . . . Cairns, C. B. (2010). Accuracy of the emergency severity index triage instrument for identifying elder emergency department patients receiving an immediate life-saving intervention. *Academic Emergency Medicine, 17*(3), 238-243. doi: 10.1111/j.1553-2712.2010.00670.x

Podrazik, P. M., & Whelan, C. T. (2008). Acute hospital care for the elderly patient: Its impact on clinical and hospital systems of care. *Medical Clinics of North America, 92*(2), 387-406. doi: 10.1016/j.mcna.2007.11.004

Polancich, S., Restrepo, E., & Prosser, J. (2006). Cautious use of administrative data for decubitus ulcer outcome reporting. *American Journal of Medical Quality, 21*(4), 262-268. doi: 10.1177/1062860606288244

Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Powell, A. E., Davies, H. T. O., & Thomson, R. G. (2003). Using routine comparative data to assess the quality of health care: Understanding and avoiding common

pitfalls. *Quality and Safety in Health Care, 12*(2), 122-128. doi: 10.1136/qhc.12.2.122

Prowse, M. (2007). Postoperative pain in older people: A review of the literature. *Journal of Clinical Nursing, 16*(1), 84-97. doi: 10.1111/j.1365-2702.2005.01482.x

Recinos, G., DuBose, J. J., Teixeira, P. G. R., Barmparas, G., Inaba, K., Plurad, D., . . . Belzberg, H. (2009). ACS trauma centre designation and outcomes of post-traumatic ards: NTDB analysis and implications for trauma quality improvement. *Injury, 40*(8), 856-859. doi: 10.1016/j.injury.2008.11.001

Reuben, D., Frank, J., Hirsch, S., McGuigan, K., & Maly, R. (1999). A randomized clinical trial of outpatient comprehensive geriatric assessment coupled with an intervention to increase adherence to recommendations. *Journal of the American Geriatrics Society, 47*(3), 269-276.

Riesenberg, L. A., Leisch, J., & Cunningham, J. M. (2010). Nursing handoffs: A systematic review of the literature. *AJN The American Journal of Nursing, 110*(4), 24-34. doi: 10.1097/01.NAJ.0000370154.79857.09

Riley, G. F. (2009). Administrative and claims records as sources of health care cost data. *Medical Care, 47*(7_Supplement_1), S51-S55. doi: 10.1097/MLR.0b013e31819c95aa

Rochefort, C. M., Ward, L., Ritchie, J. A., Girard, N., & Tamblyn, R. M. (2011). Registered nurses' job demands in relation to sitter use: Nested case-control study. *Nursing Research, 60*(4), 221-230. doi: 10.1097/NNR.0b013e318221b6ce

Rotondo, M. F., Bard, M. R., Sagraves, S. G., Toschlog, E. A., Schenarts, P. J., Goettler, C. E., . . . Robertson, M. J. (2009). What price commitment: What benefit? The cost of a saved life in a developing level I trauma center. *The Journal of Trauma and Acute Care Surgery, 67*(5), 915-923. doi: 10.1097/TA.0b013e3181b848e7

Rubenstein, L., Stuck, A., Siu, A., & Wieland, D. (1991). Impacts of geriatric evaluation and management programs on defined outcomes: Overview of the evidence. *Journal of the American Geriatrics Society, 39*(9), 8S-16S.

Savitz, L. A., Jones, C. B., & Bernard, S. (1999). Nursing-sensitive quality indicators for acute care settings and ANA's safety and quality initiative. Retrieved 09/05/2011, from http://www.ahrq.gov/downloads/pub/advances/vol4/Savitz.pdf

Scheetz, L. J. (2005). Differences in survival, length of stay, and discharge disposition of older trauma patients admitted to trauma centers and nontrauma center hospitals. *Journal of Nursing Scholarship, 37*(4), 361-366. doi: 10.1111/j.1547-5069.2005.00062.x

Schwartz, L. (2002). Is there an advocate in the house? The role of health care professionals in patient advocacy. *Journal of Medical Ethics, 28*(1), 37-40. doi: 10.1136/jme.28.1.37

Sepucha, K. R., Fowler Jr., F. J., & Mulley Jr., A. G. (2004). Policy support for patient-centered care: The need for measurable improvements in decision quality. *Health Affairs*. doi: 10.1377/hlthaff.var.54

Siddiqi, N., Holt, R., Britton, A., & Holmes, J. (2009). Interventions for preventing delirium in hospitalised patients. *Cochrane Database of Systematic Reviews (Online)*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005563.pub2/abstract doi:10.1002/14651858.CD005563.pub2

Silber, J. H., Rosenbaum, P. R., Romano, P. S., Rosen, A. K., Wang, Y., Teng, Y., . . . Volpp, K. G. (2009). Hospital teaching intensity, patient race, and surgical outcomes. *Archives of Surgery, 144*(2), 113-120. doi: 10.1001/archsurg.2008.569

Simunovic, N., Devereaux, P. J., Sprague, S., Guyatt, G. H., Schemitsch, E., DeBeer, J., & Bhandari, M. (2010). Effect of early surgery after hip fracture on mortality and complications: Systematic review and meta-analysis. *Canadian Medical Association Journal, 182*(15), 1609-1616. doi: 10.1503/cmaj.092220

Singer, S. J., Gaba, D. M., Falwell, A., Lin, S., Hayes, J., & Baker, L. (2009). Patient safety climate in 92 US hospitals: Differences by work area and discipline. *Medical Care, 47*(1), 23-31. doi: 10.1097/MLR.0b013e31817e189d

Small, G. W., Rabins, P. V., Barry, P. P., Buckholtz, N. S., DeKosky, S. T., Ferris, S. H., . . . Tune, L. E. (1997). Diagnosis and treatment of Alzheimer disease and related disorders. *JAMA: The Journal of the American Medical Association, 278*(16), 1363-1371. doi: 10.1001/jama.1997.03550160083043

Smith, E. B., Parvizi, J., & Purtill, J. J. (2011). Delayed surgery for patients with femur and hip fractures-risk of deep venous thrombosis. *The Journal of Trauma and Acute Care Surgery, 70*(6), E113-E116. doi: 10.1097/TA.0b013e31821b8768

Squires, M. A. E., Tourangeau, A. N. N., Spence Laschinger, H. K., & Doran, D. (2010). The link between leadership and safety outcomes in hospitals. *Journal of Nursing Management, 18*(8), 914-925. doi: 10.1111/j.1365-2834.2010.01181.x

Titler, M. G., Herr, K., Brooks, J. M., Xie, X.-J., Ardery, G., Schilling, M. L., . . . Clarke, W. R. (2009). Translating research into practice intervention improves management of acute pain in older hip fracture patients. *Health Services Research, 44*(1), 264-287. doi: 10.1111/j.1475-6773.2008.00913.x

Toker, S., Hak, D. J., & Morgan, S. J. (2011). Deep vein thrombosis prophylaxis in trauma patients. *Thormbosis, 40*(60), 1-11. doi: 10.115/2011/505373

Tornetta, P., Mostafavi, H., Riina, J., Turen, C., Reimer, B., Levine, R., . . . Homel, P. (1999). Morbidity and mortality in elderly trauma patients. *The Journal of Trauma and Acute Care Surgery, 46*(4), 702-706.

Trinkoff, A. M., Johantgen, M., Storr, C. L., Gurses, A. P., Liang, Y., & Han, K. (2011). Nurses' work schedule characteristics, nurse staffing, and patient mortality. *Nursing Research, 60*(1), 1-8. doi: 10.1097/NNR.0b013e3181fff15d

Utter, G. H., Maier, R. V., Rivara, F. P., Mock, C. N., Jurkovich, G. J., & Nathens, A. B. (2006). Inclusive trauma systems: Do they improve triage or outcomes of the severely injured? *The Journal of Trauma and Acute Care Surgery, 60*(3), 529-537. doi: 10.1097/01.ta.0000204022.36214.9e

Van Craen, K., Braes, T., Wellens, N., Denhaerynck, K., Flamaing, J., Moons, P., . . . Milisen, K. (2010). The effectiveness of inpatient geriatric evaluation and management units: A systematic review and meta-analysis. *Journal of the American Geriatrics Society, 58*(1), 83-92. doi: 10.1111/j.1532-5415.2009.02621.x

van Walraven, C., Austin, P. C., Jennings, A., Quan, H., & Forster, A. J. (2009). A modification of the elixhauser comorbidity measures into a point system for hospital death using administrative data. *Medical Care, 47*(6), 626-633. doi: 10.1097/MLR.0b013e31819432e5

VanGeest, J. B., Johnson, T. P., & Welch, V. L. (2007). Methodologies for improving response rates in surveys of physicians. *Evaluation and the Health Professions, 30*(4), 303-321. doi: 10.1177/0163278707307899

Vartak, S., Ward, M. M., & Vaughn, T. E. (2008). Do postoperative complications vary by hospital teaching status? *Medical Care, 46*(1), 25-32. doi: 10.1097/MLR.0b013e3181484927

Vasilevskis, E. E., Knebel, R. J., Dudley, R. A., Wachter, R. M., & Auerbach, A. D. (2010). Cross-sectional analysis of hospitalist prevalence and quality of care in California. *Journal of Hospital Medicine, 5*(4), 200-207. doi: 10.1002/jhm.609

Watkin, L., Blanchard, M. R., Tookman, A., & Sampson, E. L. (2012). Prospective cohort study of adverse events in older people admitted to the acute general hospital: Risk factors and the impact of dementia. *International Journal of Geriatric Psychiatry, 27*(1), 76-82. doi: 10.1002/gps.2693

Weir, S., Salkever, D. S., Rivara, F. P., Jurkovich, G. J., Nathens, A. B., & Mackenzie, E. J. (2010). One-year treatment costs of trauma care in the USA. *Expert Review of Pharmacoeconomics and Outcomes Research, 10*(2), 187-197. doi: 10.1586/erp.10.8

Wenger, N. S., Roth, C. P., Shekelle, P., & the, A. I. (2007). Introduction to the assessing care of vulnerable elders-3 quality indicator measurement set. *Journal of the American Geriatrics Society, 55*(52), S247-S252. doi: 10.1111/j.1532-5415.2007.01328.x

Wenger, N. S., Shekelle, P. G., & ACOVE Investigators. (2001). Assessing care of vulnerable elders: ACOVE project overview. *Annals of Internal Medicine, 135*(Part 2), 642-646.

Whittington, K. T., & Briones, R. (2004). National prevalence and incidence study: 6-year sequential acute care data. *Advances in Skin & Wound Care, 17*(9), 490-494.

Young, W. B., Minnick, A. F., & Marcantonio, R. (1996). How wide is the gap in defining quality care?: Comparison of patient and nurse perceptions of important aspects of patient care. *Journal of Nursing Administration, 26*(5), 15-20.