FACTORS ASSOCIATED WITH INPATIENT FALLS AND INJURIOUS FALLS IN ACUTE CARE HOSPITALS

BY

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Abstract

Inpatient falls and injurious falls in acute care settings have significant impact on patients. Despite the implementation of several federal initiatives in preventing falls and injurious falls, inpatient falls and injurious falls still are prevalent in the United States. Inpatient falls and injurious falls are a complicated phenomenon and can be contributed to multilevel factors including organization at the hospital and unit levels, nursing care process, and patient-specific factors. However, gaps exist in the literature on the associations of injurious falls with multilevel factors.

The purpose of this study was to examine the associations of injurious falls in acute care hospitals with multilevel factors including hospital and unit structure, nursing care process, and patient-specific factors. The modified Donabedian Structure–Process–Outcome (SPO) model was used as a conceptual framework to guide the study.

This cross-sectional, correlational study used July 2013 to June 2014 data from the National Database of Nursing Quality Indicators® (NDNQI®). The STATA (Version 14) was used to conduct hierarchical regression analyses to examine the significance of association of injurious falls with multilevel factors including organizational structure (i.e., hospital size, teaching status, and Magnet® status), unit structure (i.e., nurse staffing and unit type), nursing care process (i.e., falls without employee assistance, fall risk assessment, implementation of fall prevention protocol, and physical restrain use) and unit patient population factors for patients who fell (i.e., gender, and fall risk status). The results of the study suggested hospital structure (i.e. teaching status), unit structure (i.e. surgical unit and RN hours per patient day), unit nursing care process (i.e. falls without employee assistance), unit patient population characteristics (i.e. at fall risk) and 1000 patient days were significantly associated with incidence of injurious falls.

The findings from this study provide further knowledge on multilevel factors contributing to inpatient injurious falls. Nurse leaders, researchers and policy makers may develop, implement and improve fall prevention programs based on the identified risk factors. The study also provides important implications for future research on injurious fall prevention in acute care hospitals.

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Chapter 1

Introduction

Problem and Significance

Falls among patients in acute care settings are prevalent and a serious concern for patient care. Inpatient falls are the most common incidents reported in acute care hospitals (Anderson, Boshier, & Hanna, 2012; Cameron et al., 2012; National Patient Safety Agency [NPSA], 2007; Oliver, Healey, & Haines, 2010). In the United States (U.S.), there are about one million inpatient falls annually with the average fall rates ranging from three to five falls per 1000 patient days in acute care hospitals (Oliver et al., 2010). The fall incidence is higher among hospitalized older adults (65 and older) compared to younger adult patients, ranging from four to fourteen falls per 1000 patient days (Anderson et al., 2012).

Falls during hospitalization have a number of adverse consequences for patients, especially older adults. Among patients experiencing a fall, about 30 to 50% have injuries caused by the fall and 10 to 15% suffer from serious injuries such as traumatic brain injury or hip fractures (Deandrea et al., 2013). With fall-related injuries, older adults may have reduced mobility and functional ability that further can decrease independent living and quality of life (Oliver et al., 2010). Due to the injury caused by inpatient falls, older adults may have to be placed in a long-term nursing care facility for rehabilitation and recovery before returning home (Oliver et al., 2010).

Moreover, falls can have a negative psychological impact on older adults. Chung and colleagues (2009) found that approximately 50% of older adults with a history of falls developed the fear of falling, and about one third of these older adults developed chronic post-traumatic stress disorder. Because of fear of falling, 13 to 50% of older adults restrict their physical and

social activities, causing further functional decline, depression, social isolation, and decreased quality of life (Huang, Chi, & Hu, 2013; Zijlstra et al., 2007).

Inpatient falls can result in an extra financial burden to patients and healthcare facilities. Injurious falls result in prolonged length of hospital stay that increases direct patient care costs. On average, when comparing patients with serious fall-related injuries to those without falls, their length of stay (LOS) increased by six to twelve days with an additional cost of $13,316 (Wong et al., 2011). In addition, indirect costs associated with fall-related injuries cause loss of income, potential placement in a skilled nursing facility or nursing home, and litigation expenses (Oliver et al., 2010; Wong et al., 2011).

Several national initiatives and policies have emphasized preventing falls and their associated adverse consequences. The U.S. Department of Health and Human Services (DHHS, 2010) proposes reducing falls and fall-related serious injuries and death as one major goal in the Healthy People 2020. Since October 1, 2008, the Centers for Medicare and Medicaid Services (CMS) have implemented a new policy regarding reimbursement to hospitals. According to the new policy, hospitals are no longer eligible to receive reimbursement for treatment of preventable injuries, such as inpatient fall-related injuries. The purpose of this new policy is to encourage hospitals to proactively prevent inpatient falls and other preventable events, improve care quality, and reduce healthcare costs (Mattie & Webster, 2008).

The National Quality Forum (NQF) has included patient falls and fall-related injuries as one of the major nursing-sensitive care outcome measures (2004). These national initiatives underscore the importance of preventing inpatients falls. In last decades, both single factor and multifactorial fall prevention interventions have been developed and implemented in hospitals to prevent inpatient falls and fall-related injuries. Single interventions include: (a) Vitamin D and

calcium supplements, (b) exercise, (c) environmental change, and (d) assistive technology use such as bed exit alarms, (e) staff education, (f) service model modification, and (g) patient education. Multifactorial interventions incorporate several single intervention components (Cameron et al., 2010). Although some interventions especially the multifactorial interventions have shown positive effect in reducing inpatient falls, falls and fall-related injuries still are prevalent in hospitals. In a recent study, Bouldin and colleagues (2013) found a total of 315,817 falls (3.56 falls per 1000 patient days) and 82,332 injurious falls (0.93 injurious falls per 1000 patient days, 26.1%) in the U.S. hospitals between July 1, 2006 and September 30, 2008.

Review of the Literature

Given the prevalence and significant consequences of inpatient falls and fall-related injuries, it is important to prevent falls, especially injurious falls among adult patients in acute care settings. It is critical to identify diverse factors associated with inpatient falls and injurious falls, considering patient-specific and hospital organizational factors among adult patients.

Patient Risk Factors of Falls

Patient risk factors are categorized into medical conditions and non-medical characteristics. Common medical conditions identified as significant risk factors for inpatient falls include: (a) cognitive impairments (Costa-Dias et al., 2014; Härlein, Halfens, Dassen, & Lahmann, 2011; Neumann, Hoffmann, Golgert, Hasford, & von Renteln-Kruse, 2013); (b) impaired mobility (Corsinovi et al., 2009; Härlein et al., 2011; Neumann et al., 2013); (c) urinary incontinence (Chen, van Nguyen, Shen, & Chan, 2011); and (d) stroke (Chen et al., 2011; Costa-Dias et al., 2014; Schmid et al., 2010; Tommasini, Talamini, Bidoli, Sicolo, & Palese, 2008). Taking certain medications with sedative hypnotic effects such as psychoactives also is a

significant risk factor for inpatient falls (Costa-Dias et al., 2014; Mion et al., 2012; Oliver, Daly, Martin, & McMurdo, 2004; Rhalimi, Helou, & Jaecker, 2009).

Among non-medical characteristics, advanced age has been identified as the major risk factor for falls (Brand & Sundararajan, 2010; Chari, McRae, Varghese, Ferrar, & Haines, 2013; Corsinovi et al., 2009; Costa-Dias et al., 2014; Härlein et al., 2011). Among inpatient falls, approximately one-half occur in adult inpatients 60 years and older (Costa-Dias et al., 2014; Mion et al., 2012). Patients with advanced age (80 years or older) are exposed at the highest risk of having a fall and fall-related injuries while hospitalized compared to any other age groups (Brand & Sundararajan, 2010; Mion et al., 2012). Thus, advanced age, especially age above 80 years old, has been identified consistently as a significant factor for increasing fall-related injuries (Brand & Sundararaja, 2010; Chari et al., 2013; Fischer et al., 2005; Krauss et al., 2007; Williams, Szekendi, & Thomas, 2014).

In contrast to age, gender is still controversial in the current literature. While some studies identify being a male as a significant risk factor for inpatient falls (Chen et al., 2011; Neumann et al., 2013); other studies find females have increased risk for inpatient falls (Chari et al., 2013; Schwendimann, Bühler, de Geest, & Milisen, 2008; Tommasini et al., 2008). In addition, while being a female is identified as risk factor for fall-related injuries in many studies (Brand & Sundararaja, 2010; Chari et al., 2013; Williams et al., 2014); other studies find being a male is associated with increased risk of fall-related injuries (Krauss et al., 2007; Staggs, Mion, & Shorr, 2014).

In the literature, several other factors have been identified. Having a history of a previous fall is one major risk factor (Mecocci et al., 2005; Neumann et al., 2013; Oliver et al., 2004). Taking certain medications, such as antipsychotic agents, opiates or diuretic non-

antihypertensive agents, is associated with fall-related injuries (Mion et al., 2012). Elimination-related falls (e.g., falls related to toileting) also increase the risk for injuries resulting from falls (Hitcho et al., 2004).

Organizational Risk Factors of Falls

In the literature, studies on inpatient falls and organizational factors focus on four different aspects: (a) hospital characteristics, (b) unit characteristics, (c) nurse staffing characteristics, and (d) nursing care process factors. Each aspect is summarized below.

Hospital characteristics. In general, small hospitals (< 250 beds) have less prevalence of falls compared to large hospitals (>= 250 beds) (Krauss et al., 2007). Additionally, falls in small hospitals (< 300 beds) are associated with higher risk for injuries secondary to falls (Dunton, Gajewski, Taunton, & Moore, 2004; Staggs et al., 2014).

Teaching or Magnet® status of hospitals also is found to be associated with the incidence of falls and fall-related injuries. Teaching hospitals have less fall-related injuries compared to non-teaching hospitals (Staggs et al., 2014). Research shows that hospitals with Magnet® recognition report lower inpatient fall rates compared to those without Magnet® recognition (Dunton, Gajewski, Klaus, & Pierson, 2007; Lake, Shang, Klaus, & Dunton, 2010). Dunton and colleagues (2007) found that patient fall rates in Magnet® hospitals were 10.3% lower than that in non-Magnet® hospitals. Similarly, Lake and colleagues (2010) report an average of a 5% lower inpatient fall rate in Magnet® hospitals compared to non-Magnet® hospitals.

Unit characteristics. The prevalence of falls and fall-related injuries differ among types of care units. Intensive care units have significantly lower fall and fall-related injury rates than other units (Chelly et al., 2006; Dunton et al., 2004; Härlein et al., 2011; Williams et al., 2014). Patients in geriatric units are at significantly high risk for falls and fall-related injuries (Härlein et

al., 2011; Heinze, Halfens, & Dassen 2007; Schwendimann et al., 2008). Medical units have the highest fall rates and fall-related injury rates while surgical units have the lowest fall rates and fall-related injury rates among medical, surgical, and medical-surgical units (Bouldin et al, 2013; Schwendimann et al., 2008; Staggs et al., 2014; Williams et al., 2014). In addition, medical, medical-surgical, and telemetry units have the highest rates of major injuries or death (Williams et al., 2014).

Nurse staffing characteristics. Although many studies have reported significant association between patient fall incidences and nurse staffing, study findings on the association between nurse staffing and inpatient falls are still equivocal. In general, lower inpatient fall rates are associated with higher total nursing hours, higher registered nurse (RN) hours, and a higher proportion of RN hours (Dunton et al., 2004; Lake et al., 2010; Staggs & Dunton, 2014), while a higher proportion of temporary RN hours (e.g., staffing provided from non-hospital employed nurses) are associated with higher incidence of both inpatient falls and fall-related injuries (Bae, Kelly, Brewer, & Spencer, 2014). As the most common measures of nurse staffing, total nursing hours per patient day (TNHPPD) include hours provided by RNs, licensed practical nurses (LPNs), and unlicensed assistive personnel (UAP); RN hours per patient day (RNHPPD) are the nursing care hours per patient day provided by RNs; and RN skill mix is the proportion of RN hours to total nursing hours (Bae et al., 2014; Dunton et al., 2004; Dunton et al., 2007; Lake & Cheung, 2006; Lake et al., 2010). Using the National Database of Nursing Quality Indicators® (NDNQI®) in a study, Dunton and colleagues (2007) found negative associations between inpatient fall rates with both TNHPPD and RN skill mix (i.e., proportion of total nursing hours provided by RNs): with one hour increase in TNHPPD, and one percentage increase in the proportion of RN hours per patient day, the fall rates were 1.9% and 0.7% lower, respectively.

Lake and colleagues (2010) reported significantly negative associations between RNHPPD and fall rates and positive associations between non-RNHPPD (r = -.29, .12, .10 for RNHPPD, LPNHPPD, and UAPHPPD, respectively, p <.001) utilizing NDNQI® data. They found that specifically for every additional RNHPPD, the fall rate decreased by 2% while for every additional LPN hours per patient day (LPNHPPD) and UAP hours per patient day (UAPHPPD), the fall rate increased by 2.9% and 1.5%, respectively (Lake et al., 2010). However, several systematic reviews and meta-analyses of staffing-outcomes studies in acute care hospitals did not show the association between RN staffing and inpatient falls (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Lake & Cheung, 2006).

The effect of nurse staffing also varies among different types of units. Dunton and colleagues (2004) found 15 total nursing hours per patient day (TNHPPD) as a cut-off point for significant negative associations between nurse staffing and fall rates in different units. The study findings of Dunton et al. suggest that for step-down, medical, and medical-surgical units, patient falls increased when TNHPPD were less than 15; for surgical units, patient falls increased when TNHPPD were greater than 15. Significant negative associations were found between RN hours and fall rates for step-down and medical units; however, they were not present for medical-surgical or surgical units. For fall-related injuries, TNHPPD (up to 9 hours per patient day) and RN hours were significantly (p < .05), negatively associated with fall-related injuries for medical units and step-down units, respectively (Dunton et al., 2004). As hours decreased (both TNHPPD and RNHPPD), fall-related injuries increased on these units.

In addition to TNHPPD, RNHPPD and RN skill mix, nurse turnover rate is also found to be associated with inpatient falls and related injuries. Kane and colleagues (2007) reported that the patient fall rate increased by 0.2% when nurse turnover rate increased by 2%. However, Bae,

Mark, and Fried (2010) found fewer inpatient falls on the nursing units with low levels of turnover (0 - 3.3%) than the units with no turnover (p <.05).

Nursing care process factors. In the literature, factors related to nursing care process are found to be contributing to inpatient falls and related injuries. For example, unassisted falls by employees are associated with an increased risk for injuries resulted from a fall (Krauss et al., 2007; Staggs et al., 2014). Chari and colleagues (2013) found that falls witnessed or assisted by staff were 50% less likely to be associated with fractures than unwitnessed falls. In addition, the use of physical restraints is positively associated with occurrences of inpatient falls and related injuries (Evans, Wood, & Lambert, 2002; Titler, Shever, Kanak, Picone, & Qin, 2011). Although one major purpose of physical restraints is to prevent patient falls, for example, among patients with delirium (Kwok et al., 2013), research has shown that physical restraint use is not an effective way to prevent falls and related injuries (Berzlanovich, Schöpfer, & Keil, 2012). Using physical restraints has been associated with increased risk for falls, injuries and even death (Berzlanovich et al., 2012; Evans et al., 2002; Titler et al., 2011; Tzeng & Yin, 2013).

Research also has shown significant associations of falls or injurious falls with uses of fall risk assessment or fall prevention protocols performed or implemented on individual patients. Patients are less likely to experience injuries if they are assessed for their fall risk upon hospital admission (Chari et al., 2013). Nurses often use standard fall risk assessment tools to assess fall risk status of individual patients. Among the commonly used fall risk assessment tools, Morse Falls Score (MFS) and the SRATIFY Score are widely validated (Oliver et al., 2010). In addition to fall risk assessment, when fall prevention protocols are implemented on the patients, the patients are less likely to experience fall-related injuries (Staggs et al., 2014).

Gaps in the Literature

Inpatient falls is a complicated phenomenon that involves different factors, including patient-specific factors, environmental factors, organizational factors and patient-staff interaction factors in the hospital (Oliver et al., 2010). However, existing studies on inpatient falls separately focus on patient-specific factors such as demographic factors and medical conditions (Chari et al., 2013; Fischer et al., 2005; Mion et al., 2012), or organizational factors including hospital and unit characteristics as well as nurse staffing factors (Bae et al., 2014; Bouldin et al., 2013; Dunton et al., 2007; Lake et al., 2010; Patrician et al., 2011). Although there have been studies examining organizational factors such as hospital and unit types with some patient-specific factors (Krauss et al., 2007; Staggs et al., 2014; Williams et al., 2014), no studies have examined multilevel factors associated with inpatient falls to explore the combination effects of patient-specific, organizational, and nursing care process factors. It is important to include patient-specific factors in examining factors associated with inpatient falls. First, patient characteristics have a defining role in patient outcomes, specifically inpatient falls or injurious falls in this study (Lake & Cheung, 2006). In addition, since differences in patient characteristics across clinical settings such as hospitals or nursing units may affect the likelihood of a clinical outcome (Lezzoni, 2003), it is important to control patient differences across different settings to obtain reliable relationships between the outcome (inpatient falls or injurious falls) and organizational factors (Lake & Cheung, 2006).

Research Questions

Given the gaps in the literature on the exploration of factors related to inpatient falls and fall-related injuries in acute care hospitals, three studies were proposed to identify multilevel factors — patient factors, nursing care process factors, unit and hospital factors — that contribute

to inpatient falls and related injuries and explore factors that need to be incorporated in fall prevention programs in acute care hospitals. Using the National Database of Nursing Quality Indicators® (NDNQI®) data from July 2013 through June 2014, three research questions were explored:

1. What are the major risk factors for falls and fall-related injuries reported in medical, surgical, medical-surgical, and step-down units in acute care hospitals?
2. What organizational structure (i.e., hospital size, teaching status, and Magnet® status), unit structure (i.e., nurse staffing and unit type), nursing care process (i.e., falls without employee assistance, fall risk assessment, implementation of fall prevention protocol, and physical restrain use) and patient factors (i.e., gender, and fall risk status) are associated with inpatient injurious falls?
3. What factors could be included in developing and implementing fall prevention programs in clinical practice?

Conceptual Framework

The conceptual framework for the study was based on the modified Donabedian's Structure–Process–Outcome (SPO) model by Coyle and Battles (1999). Donabedian defines quality of healthcare as the function of three basic components: structure, process, and outcomes of care (1966). According to Donabedian, structure refers to the attributes of the healthcare settings in which care takes place, including physical resources (i.e., equipment, facilities, and finance), human resources (i.e., health care providers and other personnel), and organizational properties (i.e., organizational structure). The process refers to how the healthcare service is provided and received that involves the care provider's services and interactions with the patients, as well as the patient's activities and attitudes. Outcomes are defined as the

measurement of the effectiveness of the care and treatment provided to patients, including patient outcomes (e.g., patient health and wellness), and patient satisfaction with care (Donabedian, 1966, 1988, 1992). Donabedian explains that all three components related to the quality of care must be evaluated together to assess quality of care effectively (Donabedian, 1966, 1988, 1992).

In 1999, Coyle and Battles modified Donabedian's SPO model for measuring quality of care to include the antecedents of medical care. Coyle and Battles (1999) suggest that antecedent conditions including patient factors can affect the structure, process and outcomes of medical care. The antecedent conditions of patient factors defined by Coyle and Battles emphasize individual patient's characteristics. According to Coyle and Battle, patient factors include genetics, socio-demographics, and health status, as well as personal beliefs and preferences.

Based on an extensive literature review, previous studies separately reported significant factors associated with falls and injurious falls: (a) patient characteristics (i.e., age, gender, and fall risk) (Brand & Sundararaja, 2010; Chari et al., 2013; Williams et al., 2014); (b) hospital structure (i.e., hospital bed size, teaching or Magnet status®) (Dunton et al., 2004; Dunton et al., 2007; Lake et al., 2010; Staggs et al., 2014), (c) unit structure (i.e., unit type and nurse staffing) (Dunton et al., 2004; Dunton et al., 2007; Lake et al., 2010; Staggs et al., 2014; Williams et al., 2014); and (d) nursing care process, such as uses of a fall risk assessment, a fall prevention protocol, a fall assisted by employee, and physical restraints in use (Evans et al., 2002; Krauss et al., 2007; Staggs et al., 2014). The study integrated all of the identified factors of inpatient falls and injurious falls using the modified Donabedian's SPO model.

For this study, a conceptual framework was developed based on the modified Donabedian's SPO model to examine multilevel factors associated with injurious falls among inpatients (see Figure 1-1). The outcome was inpatient injurious falls. Patient factors included

patient gender, and fall risk status. Structure factors included hospital characteristics (i.e., hospital size, Magnet® status, teaching status) and unit factors (i.e., unit types: medical, surgical, medical-surgical, and step-down units; and nurse staffing: total nursing hours per patient day, RN hours per patient day, RN skill mix, and nurse turnover rate). Process factors consisted of services and patient interaction with healthcare professionals: (a) falls without employee assistance, (b) fall risk assessment, (c) implementation of fall prevention protocol, and (d) physical restraint use (see Figure 1). Thus, this study was the first attempt at investigating the complex phenomenon of falls and injurious falls at multiple levels.

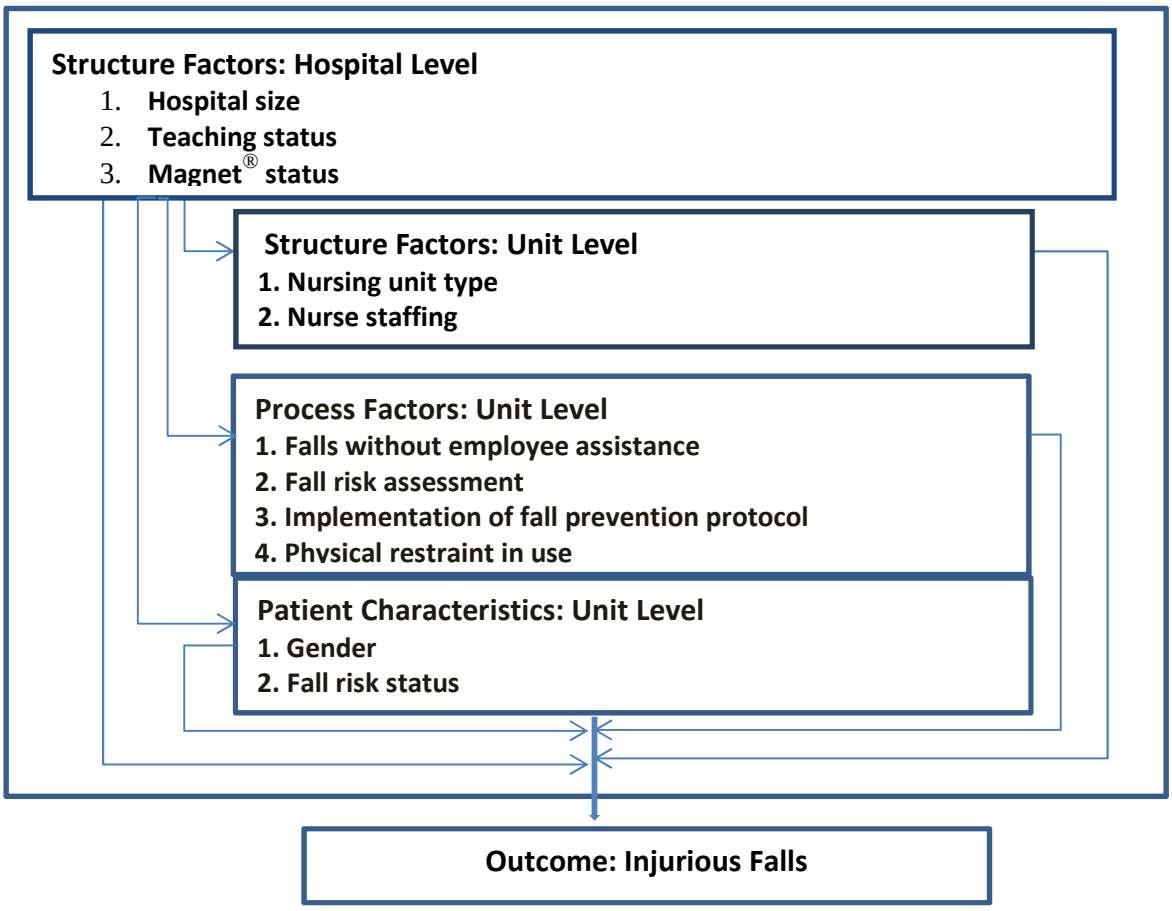

Figure 1-1. Conceptual framework of the modified Donabedian's SPO model to examine multilevel factors associated with inpatient injurious falls

Research Scopes and Methods for Manuscripts

Three studies were proposed. Different research foci, scopes and research methods are described for each Manuscript.

Manuscript 1: Older Adult Inpatient Falls in Acute Care Hospitals: Intrinsic, Extrinsic, and Environmental Factors

Purpose

The purpose of this study was to identify risk factors for inpatient falls in older adult patients (65 years or older) in acute care hospitals reported in current literature. Four specific

research questions were proposed:

1. What is the fall rate in older adult patients in acute care settings?
2. What are the major risk factors for falls in older adult patients in acute care hospitals regarding patient characteristics and care settings?
3. What are the fall-related outcomes in older adult patients in acute care hospitals?
4. What conceptual and methodological issues should be considered for research and practice?

Methods

An integrative literature review was conducted to answer the proposed research questions. Twenty three studies were selected from literature searches conducted in five electronic databases including PubMed, the Cochrane Library, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), MEDLINE, and PsycINFO. Manual searching also was completed using Google Scholar based on the reference lists from retrieved articles. The literature of interest was limited to 10 years of recent peer-reviewed publications. Search terms consisted of: (a) fall(s); (b) predictor(s), risk factor(s) or characteristics; (c) older adult(s) or elderly; (d) patient(s), inpatient(s) or hospitalized, and (e) acute care settings or hospitals. Studies meeting the following inclusion criteria were included: (a) participants were hospitalized inpatients age 17 or above; (b) study settings were acute care hospitals; (c) quantitative measure was used to assess fall risk; (d) studies published in peer-reviewed academic journals; and (e) studies were written in English. Exclusion criteria included: (a) participants age 16 or below were included; (b) age of study participants were not specified or reported; (c) study settings were outpatient settings, including home, community resident settings, psychiatric settings, or

rehabilitation settings; and (d) grey literature including dissertation, conference proceeding paper or abstract, and editorials (see Figure 1-2).

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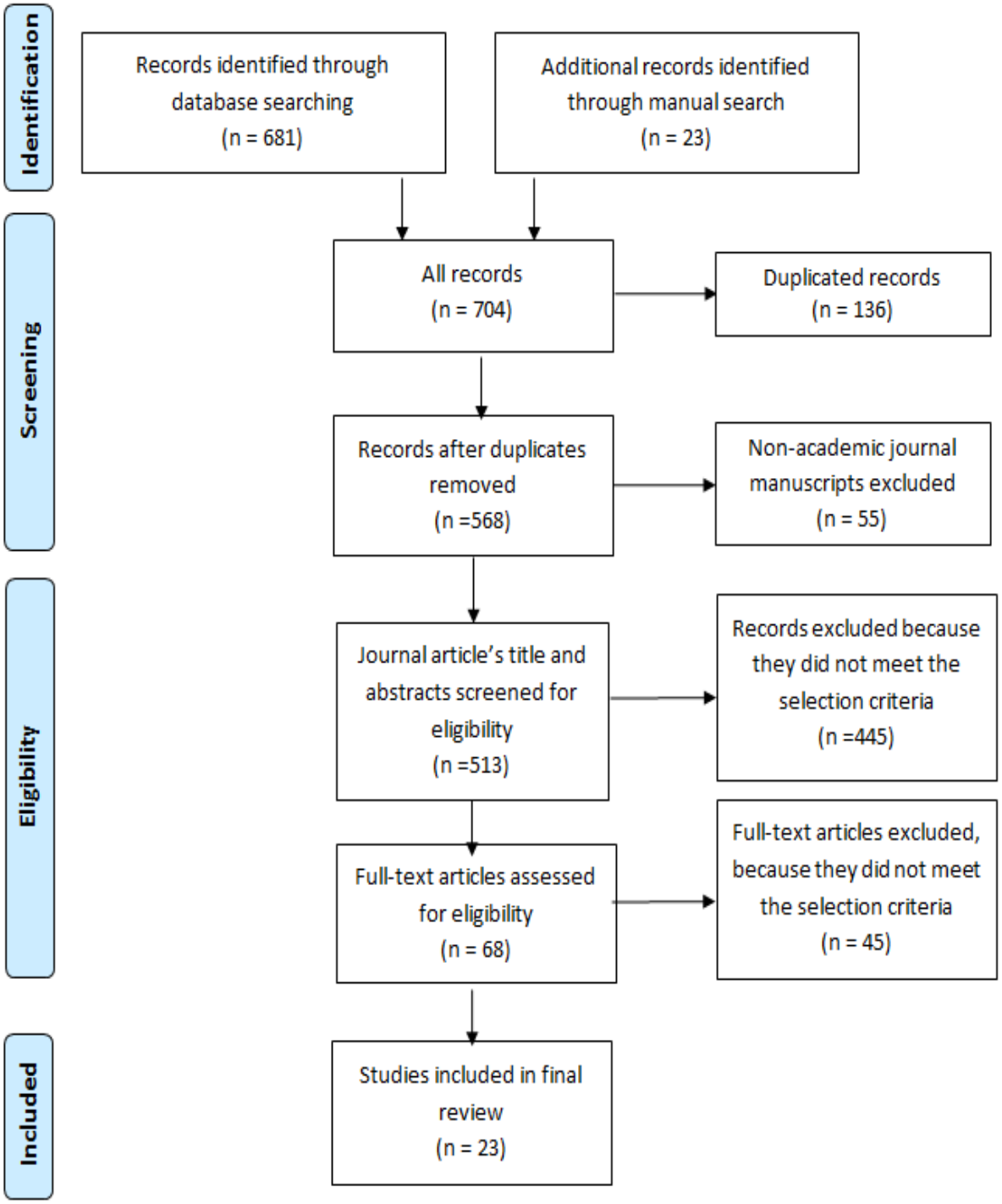

Figure 1-2. Flow chart of search strategy

Manuscript 2: Multilevel Factors Associated with Injurious Falls in Acute Care Hospitals

Purpose

The purpose of this study was to examine multilevel factors contributing to injurious falls among patients in acute care hospitals using July 2013 through June 2014 data from the National Database of Nursing Quality Indicators® (NDNQI®). The associations of injurious falls with multilevel factors such as hospital organizational factors, unit factors, and nursing process factors as well as patient factors were examined using cross-sectional, exploratory correlational designs. The major research question proposed for the study was: what organizational structure (i.e., hospital size, teaching status, and Magnet® status), unit structure (i.e., nurse staffing and unit type), nursing care process (i.e., falls without employee assistance, fall risk assessment, implementation of fall prevention protocol, and physical restrain use) and patient factors (i.e., gender, and fall risk status) are associated with inpatient fall-related injuries?

Methods

Overview of NDNQI®. The NDNQI® was first established in 1998 by the American Nurses Association (ANA) with the goal of developing a database to provide comparative information on nursing indicators to acute care hospitals for nursing care quality improvement (NDNQI®, nd). Since 2014, it is a proprietary database of the Press Ganey Associates, Inc. As the only national nursing quality measurement program, the NDNQI® provides the quarterly and annual reports of structure, process, and outcome indicators of unit-level performance data with over 2,000 hospital participants in the U.S. (NDNQI®, nd). Currently, the NDNQI® implements 19 indicators including nurse staffing indicators (e.g., skill mix, nursing hours per patient day) and patient outcome indicators (e.g., patient falls/fall-related injury levels, hospital/unit-acquired pressure ulcers). Among the 19 indictors, 10 measures including falls and fall-related injuries

are the National Quality Forum (NQF) endorsed nursing-sensitive care performance measures (NDNQI®, 2014a).

The NDNQI® has established standard guidelines for participating hospitals to collect and submit nursing-sensitive measures. These guidelines provide specific instructions about the procedures for data collection and submission (NDNQI®, 2014a). In addition to data collection and submission guidelines, standard definitions of the NDNQI® indicators and specific guidelines for unit management also are provided (NDNQI®, 2014b, 2014c). For each participating hospital, a designated, trained NDNQI® site coordinator is responsible for data collection and submission to NDNQI® by following the NDNQI® guidelines. The site coordinator collects quarterly nurse staffing and patient outcomes data through the hospital's information, staffing and risk management systems and submits these data through a secure website (Dunton et al., 2007; Montalvo, 2007; NDNQI®, 2014a).

Setting and sample. For the purpose of this study, the analyses only included adult patients aged 18 years and older who were admitted into and had a fall on medical, surgical, medical-surgical units, or step-down units in NDNQI® participating hospitals. These hospitals include general acute care hospitals (primarily offers services for medical-surgical patients) and specialized hospitals such as cardiac specialty hospitals (exclusively for cardiac patients), oncology specialty hospitals (exclusively for oncology patients), and orthopedic specialty hospitals (exclusively for patients with joint and bone diseases) (NDNQI®, 2014a). Exclusion criteria were: (a) patients younger than 18 years old; (b) patients without a fall while hospitalized on the medical, surgical, medical-surgical, or step-down units; (c) units in rehabilitation hospitals or rehabilitation units in acute care hospitals; (d) units in psychiatric hospitals or psychiatric units

in acute care hospitals; (e) units in pediatric hospitals or pediatric units in acute care hospitals; and (f) intensive care units, labor-delivery units, and post-partum units in acute care hospitals.

Data acquisition and storage. The NDNQI® data related to nurse staffing, patient falls, and fall-related injuries on medical, surgical, medical-surgical and step-down units in acute care hospitals were obtained from the NDNQI® research staff. Data were de-identified and stored on a password-protected site. A Midwestern academic medical center Institutional Review Board (IRB) reviewed the study and determined the study to be non-human subject research.

Data cleaning and management. The NDNQI® has developed several ways to ensure quality of collected data. During data entry and submission process, the site coordinator receives immediate warning messages regarding possible data entry errors. The site coordinator also receives data error reports on incomplete or missing data prior to the quarterly deadline. Once data are submitted to the NDNQI®, affiliated statisticians review the quarterly data for outliers or significant changes across months in the quarter (Dunton et al., 2007; NDNQI®, 2014a). The reporting hospitals review suspected errors and correct the errors. Otherwise, the data with suspected errors are deleted. The site coordinator also is asked to review quarterly data summary reports for ensuring data accuracy and completeness. The intermediate and preliminary results are continuously notified to and monitored by the NDNQI®. The NDNQI® then correct the errors based on hospital's notification (NDNQI®, 2014a).

Once the investigator obtained the data from NDNQI®, the investigator primarily was responsible for data cleaning and management with the supervision of a biostatistician. The investigator coded or recoded the data as needed by following the standardized data coding guide specified in the NDNQI® data codebook and ensured data fit selected data analysis methods.

The investigator consulted a biostatistician and faculty supervisors when encountering problems in data cleaning or management.

Study variables and measures. A hierarchical regression model with seventeen independent or controlling variables was used to examine the associations between injurious falls and multilevel factors. Each of the variables is operationalized below.

Dependent variable. Injurious falls are the dependent or outcome variable. Only patients with at least one injurious fall were included. In NDNQI® data, a fall is defined as "sudden, unintentional descent, with or without injury to the patient, that results in the patient coming to rest on the floor, on or against some other surface (e.g., a counter), on another person, or on an object (e.g., a trash can) (NDNQI®, 2014d, p.2)". Injurious falls are falls resulting in any injuries. Based on the level of injuries caused by falls, injurious falls are categorized into five levels: none (no signs or symptoms of injury), minor (with pain, bruise or abrasion or requiring ice or dressing, wound cleaning, and limb elevation), moderate (with muscle/joint strain or require steri-strips or skin glue, suturing and splinting), major (with fracture, internal injury or requiring surgery, neurological consultation, or blood transfusion), and death (NDNQI®, 2014d). For the purpose of this study, inpatient falls at the patient level were first coded into a dichotomous variable: injurious falls vs non-injurious falls. For patients with falls, falls resulting in no injury were coded as "0" (non-injurious falls), and falls resulting in injuries such as minor, moderate, major injuries or death were coded as "1" (injurious falls). Previous studies support the dichotomous classification of injurious falls (Fischer et al., 2005; Krauss et al., 2007; Wong et al., 2011). The individual patient level data then were aggregated to unit level; the total number of patients with falls and the total number of patients with injurious falls on the unit were calculated. Compared to falls without injuries, injurious falls have important

clinical significance. Serious fall-related injuries such as suturing, fractures, or death are costly to patients and healthcare facilities. A serious fall-related injury may result in an average increased cost of $13,316 with an increased LOS of 6-12 days, admission to long-term nursing care facility, and litigation expenses (Oliver et al., 2010; Wong et al., 2011).

Independent variables. Independent variables included patient, structure, and process factors. These factors were either at the unit or the hospital level.

Patient factors. Patient factors (i.e., gender, and fall risk status) were collected at individual level for each patient who had a fall and were aggregated to unit level. Gender was reported as either male (coded as "1") or female (coded as "0"). Patient fall risk status was assessed by the nurse and reported in the NDNQI®. It was determined based on the most recent fall risk assessment, a dichotomous variable: no risk (coded as "0") or yes has fall risk (coded as "1") (NDNQI®, 2014d). These patient characteristics were aggregated to the unit level. Gender and fall risk status were aggregated into proportions that were continuous variables at the unit level. Gender was the proportion of male patients among total number of patients on the unit and fall risk status was the proportion of patients identified at fall risk among total number of patients on the unit.

Structure factors. Structure factors included two levels of factors: hospital level and unit level. Hospital level structure factors included the size of the hospital, and the status of the hospital (teaching vs. non-teaching; Magnet® vs. non-Magnet®). All of these hospital characteristics were either categorical or dichotomous variables as level 2 variables in the model (see Figure 1-1, p. 13). The size of the hospital was determined by the number of staffed beds designated by the hospital (NDNQI®, 2014b): small (staffed beds less than 100 [coded as "0"]), medium (equal to or greater than 100 but less than 300 [coded as "1"]), and large (equal to or

greater than 300 [coded as “2”]). Regarding hospital teaching status, a hospital was classified as teaching hospital if the hospital was an academic center or serves as a clinical facility for medical residencies (coded as “1”); otherwise the hospital was classified as non-teaching hospital (coded as “0”). Similarly, a hospital was assigned to Magnet® status if currently recognized as a nursing Magnet® facility (coded as “1”) or non-Magnet® status (coded as “0”) if not currently recognized (NDNQI®, 2014b).

Unit level structure factors included unit type and nurse staffing characteristics. Unit types included four categorical variables: adult medical (coded as “0”), surgical (coded as “1”), medical-surgical (coded as “2”), and step-down units (coded as “3”). An adult medical unit was a single acuity general care unit in which 90% or more patients are admitted for medical services, such as internal medicine, cardiology or oncology while an adult surgical unit was a single unit where at least 90% patients are admitted for surgical services such as general surgery, orthopedics or neurosurgery. An adult medical-surgical unit was defined as a single general care unit in which patients are admitted for medical, surgical or family practice services but the unit does not meet the 90% criteria for medical or surgical unit type (NDNQI®, 2014c). In NDNQI®, a step-down unit was “a single acuity unit in which at least 90% of the patients are a lower level of acuity than patients in a critical care unit yet a higher level of acuity that is provided on a general care (i.e., medical or surgical) unit (NDNQI®, 2014c).”

Nurse staffing on the unit included five continuous variables: total nursing hours per patient day (TNHPPD), RN hours per patient day (RNHPPD), non-RNHPPD, RN skill mix, and nurse turnover rates (RN and Advanced Practice Registered Nurse [APRN]) since these measures of nurse staffing are most commonly used in this area (Bae et al., 2010; Bae et al., 2014; Dunton et al., 2004; Dunton et al., 2007; Lake & Cheung, 2006; Lake et al., 2010). In

NDNQI®, TNHPPD was defined as "the number of productive hours worked by nursing staff with direct care responsibilities divided by patient days (NDNQI®, 2014b, p. 6)," which was the total hours worked by all nursing staff including RN hours, licensed practical nurse (LPN)/licensed vocational nurse (LVN) hours, and unlicensed assistive personnel (UAP) hours as well as mental health technicians (MHT) hours (NDNQI®, 2014b). RNHPPD was defined as the total number of productive hours provided by RNs with direct care responsibilities divided by patient days (NDNQI®, 2014b). Non-RNHPPD was the amount of TNHPPD subtracting RNHPPD. RN skill mix is a measure with the percentage of total nursing care hours provided by RNs, which was calculated by dividing the total number of RN staff and agency hours worked by the total number of nursing hours and multiplied by 100 (NDNQI®, 2014b). Nurse turnover rate (turnover of RNs and Advance Practice Registered Nurses [APRNs]) was defined as the sum of the number of individual RN and APRN staff "who left each month divided by the number of full and part time employed individuals on the last day of the month. This number was averaged and then multiplied by 100%" (NDNQI®, 2014b).

Process factors. Nursing process factors were unit level factors, including fall risk assessment, implementation of fall prevention protocol, restraint use, and falls without employee assistance. In NDNQI®, these factors are reported for each individual patient experiencing a fall and are dichotomous variables. Fall risk assessment was measured by whether a fall risk assessment is performed on the patient prior to the fall ("yes, assessed" coded as "0"; "not assessed or no documentation" coded as "1"). Implementing fall prevention protocol was measured by whether a documented fall prevention protocol had been implemented prior to the fall ("yes, implemented" coded as "0"; "not implemented" coded as "1"). Falls with employee assistance were defined as falls in which "any staff member (whether a nursing service employee

or not) was with the patient and attempted to minimize the impact of the fall by slowing the patient's descent (NDNQI®, 2014d, p.3)". Falls with employee assistance were coded as "0" and falls without employee assistance were coded as "1". Physical restraint(s) in use was measured by any physical restraints or side rails are in use at the time of patient fall ("yes, used" coded as "1"; "not used" coded as "0") (NDNQI®, 2014d).

The four dichotomous nursing care process factors for individual patients were aggregated into proportions that were continuous variables at the unit level. Fall risk assessment rate was the proportion of the number of falls with fall risk assessment performed among total number of falls on the nursing unit. The rate of implementation of fall prevention protocol was the proportion of the number of falls with fall prevention protocol implemented among total number of falls on the nursing unit. The rate of unassisted falls was the proportion of the number of falls without employee assistance among total number of falls on the nursing unit. The rate of physical restraints in use was the proportion of the number of falls with physical restraint(s) in use on the patients among total number of falls on the nursing unit.

Reliability and validity. The nursing quality indicators included in NDNQI® are NQF-endorsed measures that have demonstrated reliability and validity (NQF, 2015). NQF has established and implemented standard guidelines for testing and evaluating the scientific acceptability of measure properties to ensure measure reliability and validity (NQF, 2011). Specifically, the following measures are included in 19 NQF-endorsed measures based on strong reliability and validity: patient fall and fall-related injury rates, fall screening, fall prevention intervention, skill mix, and nursing care hours per patient day (NQF, 2015).

For quality indictors included in NDNQI®, a study is conducted on one indicator to evaluate its reliability every year (Dunton et al., 2007). The most recent psychometrics of

reliability and validity were examined regarding fall-related injuries measure (Garrad, Boyle, Simon, Dunton & Gajewski, 2014). Garrard and colleagues used an intra-class correlation coefficient (ICC) estimate and factor analysis to assess the reliability and validity of the fall-related injuries measure. The study results suggested strong reliability (*ICC* = .85) and validity (comparative fit index [*CFI*] = 0.914; Tucker Lewis Index [*TLI*] = 0.910; and root mean square error of approximation [*RMSEA*] = 0.048) (Garrard et al., 2014). Studies on nursing care hours per patient day, one major measure included in NDNQI® data, support the reliability of the nursing care hours and patient day measurement (Choi, Boyle, & Dunton, 2014; Klaus, Dunton, Gajewski, & Potter, 2013; Simon, Yankovskyy, Klaus, Gajewski, & Dunton, 2011).

Data analysis

All statistical analyses were performed using STATA version 14 (StataCorp, 2015). The hierarchical regression model was used to examine the significance of associations of fall-related injuries with each of the independent variables in hospital characteristics, unit types, nurse staffing, nursing care process, and patient-specific variables. In the study, the dependent variable, the number of injurious falls was a count variable. Seventeen independent variables were either continuous or categorical as described above.

For the study, hierarchical regression was appropriate given the hierarchical clusters involved. Unlike multivariate regression, which assumes independence among outcomes of individuals, hierarchical regression acknowledges the correlation within hierarchical clusters (Austin, Tu, & Alter, 2003). Multivariate regression may cause ecological fallacy (Blakely & Woodward, 2000) because patient outcomes may be associated with the individual characteristics of each patient at the lowest level of the hierarchy, the unit characteristics at the middle level of the hierarchy, and the hospital characteristics at the highest level of the hierarchy.

Given the hierarchical/clustered characteristics of variables involved in the study, the 2-level hierarchical regression model is a reasonable selection for the purpose of the study. The 2-level hierarchical regression model incorporated an intraclass correlation among patients in the same unit while a second level correlation among units within the same hospital. The model therefore was able to estimate the correlational relationships between the dependent variable and the independent variables more meaningfully. Incidence rate ratios (*IRR*s) and 95% confidence intervals (*CI*s) are calculated through hierarchical regression.

Ethical Considerations

For the primary data collection of NDNQI®, participating hospitals were voluntary and anonymous. In NDNQI® database, all hospital identifying information such as the hospital name, ID number and address were deleted (Lake et al., 2010; Montalvo, 2007). In addition, no staff or patient identifiers were collected. However, the NDNQI® is considered a limited dataset according to Health Insurance Portability and Accountability Act (HIPAA) regulations since NDNQI® collect patient outcome information (NDNQI®, nd). For this secondary data analysis study, non-human subject determination was obtained from a Midwestern academic medical center IRB prior to conducting the data management and analysis.

Study Limitations

This study used July 2013 through June 2014 NDNQI® data for a secondary data analysis. Since participating in NDNQI® is voluntary, the participating hospitals may have characteristics different from those non-participating hospitals. Thus, the findings of the secondary data analysis using NDNQI® data may not be generalized to all hospitals. In addition, the findings may be not be generalized to all adult patients hospitalized because the study sample only included adult patients who had a fall while hospitalized. Patients who did not have a fall

were not included. This could be a limitation because patients might be identified at high risk for fall but did not fall.

Since the NDNQI® data is self-reported by participating hospitals, intra-rater reliability might be impacted, which could threaten the internal validity of the study (Shadish, Cook, & Campbell, 2002). Missing data could be another limitation in the study. In NDNQI®, it is optional to report certain data related to individual patient falls. Therefore, missing data could be a threat to both internal and external validity of the study (Shadish et al., 2002).

This manuscript will be submitted to *Journal of Nursing Care Quality* for consideration for publication. The leading author will be Yunchuan Zhao working with co-authors including Marjorie Bott, Heejung Kim, Jianghua He, Shin Hye Park, and Nancy Dunton.

Manuscript 3: Clinical Inference to Develop Comprehensive Nursing Intervention Fall Prevention Programs: Evidence-Based Practice Paper

Purpose

The purpose of this manuscript was to apply significant findings from the hierarchical regression analysis conducted in manuscript two that could be used to develop comprehensive nursing fall intervention programs. Manuscript three focused on synthesizing study findings from manuscript two to clinical implications for effective fall prevention programs in acute care hospitals. Specifically, the following research questions were proposed in the study:

1. Based on literature review, what are the common fall prevention programs aimed at preventing falls and injurious falls among adult patients in acute care hospitals?
2. Based on literature review, what are the reported outcomes for the common fall prevention programs in acute care hospitals?

3. Based on Manuscript two findings, what are the implications for current practice for fall prevention?

Methods

To answer the research questions listed above, a literature review of current fall prevention programs in acute care hospitals was conducted. Based on the findings from manuscript two and the literature review on current fall prevention programs in hospitals, clinical implications on effective fall prevention program development in acute care hospitals were discussed.

Five electronic databases including PubMed, the Cochrane Library, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), MEDLINE, and PsycINFO were searched. The literature of interest were limited to 10 years of recent peer-reviewed publications. The following search terms were used: (a) fall prevention or injury prevention; (b) fall protocol (s); (c) patient(s), inpatient(s) or hospitalized, (d) acute care settings or hospitals. These terms were combined through the OR/AND operator to find potential studies that met the inclusion and exclusion criteria. A hand search using the reference lists from retrieved articles for review also was examined for additional papers.

The following inclusion criteria were used for article selection: (a) studies are conducted in adult inpatient units including medical, surgical, medical-surgical, or step-down units in acute care settings; (b) quantitative measures are used to measure the effectiveness of fall prevention programs; (c) studies are published in peer-reviewed academic journals; and (d) studies are written in English. Exclusion criteria included: (a) studies are conducted in outpatient settings, including home, community resident settings, psychiatric settings, or rehabilitation settings; (b) studies are not conducted among adult inpatients in medical, surgical, medical-surgical, or step-

down units; and (c) grey literature including dissertation, conference proceeding paper or abstract, and editorials.

This manuscript will be submitted to *Nurse Leader* for consideration for publication. The leading author will be Yunchuan Zhao working with co-authors including Marjorie Bott, Heejung Kim, Jianghua He, Shin Hye Park, and Nancy Dunton.

Definition of Terms

Falls with employee assistance: A fall in which the patient's descent is slowed by a staff member with the attempt to minimize the impact of the fall (NDNQI®, 2014d).

Centers for Medicare and Medicaid (CMS): A U.S. federal government agency that includes a consortium of business lines that oversee health plans supported by the government.

Fall: An unintentional, sudden descent of a person to the ground, another person or an object (NDNQI®, 2014d).

Injurious fall: A fall of a person resulting in any injuries including minor (with pain, bruise or abrasion or requiring ice or dressing, wound cleaning, and limb elevation), moderate (with muscle/joint strain or require steri-strips or skin glue, suturing and splinting), major (with fracture, internal injury or requiring surgery, neurological consultation, or blood transfusion), and death (NDNQI®, 2014d)

Magnet® recognition: The designation awarded to a hospital by the American Nurses Credentialing Center (ANCC) to recognize the hospital for its nursing excellence and quality care (ANCC, 2014).

Medical unit: An adult acuity general care unit in which 90% or more patients are admitted for medical services, such as internal medicine, cardiology or oncology (NDNQI®, 2014c).

Medical-surgical unit: An adult general care unit in which patients are admitted for medical, surgical or family practice services but the unit does not meet the 90% criteria for medical or surgical unit type (NDNQI®, 2014c).

National Database for Nursing Quality Indicators® (NDNQI®): A national nursing quality measurement program managed by the Press Ganey Associates, Inc.

National Quality Forum (NQF): A nonprofit, public service organization that reviews, endorses, and recommends use of standardized healthcare performance measures.

Non-RN hours per patient day (Non-RN HPPD): The amount of hours worked by all nursing staff with direct care responsibilities divided by patient days (TNHPPD) subtracting RN hours per patient day (RNHPPD)

Physical restraint: A device or equipment that is deliberately aimed to prevent a person's free body movement (Retsas, 1998).

RN hours per patient day (RNHPPD): The nursing care hours per patient day provided by RNs.

RN skill mix: The proportion of total nursing care hours provided by RNs, expressed as percentage (NDNQI®, 2014b).

Step-down unit: A single acuity unit in which at least 90% of the patients are a lower level of acuity than patients in a critical care unit yet a higher level of acuity than patients in a general medical or surgical unit (NDNQI®, 2014c).

Surgical unit: An adult acuity unit where at least 90% patients are admitted for surgical services such as general surgery, orthopedics or neurosurgery (NDNQI®, 2014c).

The U.S. Department of Health and Human Services (DHHS): A U.S. federal government agency that is responsible for protecting Americans' health and providing essential human services.

Total nursing hours per patient day (TNHPPD): The number of hours worked by all nursing staff with direct care responsibilities divided by patient days (NDNQI®, 2014b).

Summary

The current national focus on patient safety urges acute care hospitals to identify and prevent adverse events including inpatient falls and injurious falls. Inpatient injurious falls in acute care hospitals are a complicated phenomenon that involves multilevel factors. In chapter one, the significance of the problem was identified. Based on current literature on the impact of inpatient falls and injurious falls, and the modified Donabedian's SPO model, strategies for three manuscripts to examine the factors associated with inpatient falls and injurious falls were discussed. Related terms were defined. The study will add positive contributions to the research on inpatient falls and injurious falls. The study findings will provide evidence for healthcare facilities to develop effective fall prevention programs for preventing falls and injurious falls.

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Chapter 2

Older Adult Inpatient Falls in Acute Care Hospitals:

Intrinsic, Extrinsic, and Environmental Factors

This manuscript was published in the *Journal of Gerontological Nursing* in 2015. The manuscript presents an integrative review of the literature regarding multidimensional risk factors for falls in older adult patients in acute care hospitals. The manuscript was co-authored by Heejung Kim, PhD, RN.

Abstract

This integrative literature review of 23 studies aimed to identify multidimensional risk factors of falls among older adult patients in acute care hospitals. The incidence rate of fall-related injuries ranged from 6.8 to 72.1%. Advanced age was a major intrinsic risk factor, while being a patient in a geriatric unit was a significant extrinsic factor for inpatient falls and fall-related injuries based on statistical significance obtained from quantitative data analyses. Other critical risk factors were: (1) cognitive impairment; (2) impaired mobility; (3) prolonged length of hospital stay; and (4) previous fall history. Environmental/situational factors such as patient ambulation and fall locations also contributed to inpatient falls. In clinical practice, nurses need to know who are the most vulnerable patients in the hospital and develop the comprehensive interventions decreasing intrinsic, extrinsic, and environmental risk factors. Prospective mixed-method studies are needed to examine psychosocial factors and consequences of falls by interviewing patients.

Keywords: inpatient falls, risk factors, older adult patients, acute care settings

Introduction

Inpatient falls are prevalent and a serious concern with patient care. In acute care hospitals, patient falls are the most common incidents reported (Anderson, Boshier, & Hanna, 2012; Cameron et al., 2012; National Patient Safety Agency [NPSA], 2007; Oliver, Healey, & Haines, 2010) ranging from three to five falls per 1000 patient bed days in the Unites States (U.S.), constituting about one million inpatient falls annually (NPSA, 2007; Oliver et al., 2010). Its consequences are associated with increasing burden to patients and care facilities. A recently published study using data from the National Database of Nursing Quality Indicators (NDNQI®) found a total of 315,817 falls (rate = 3.56 falls/1000 patient days) and 82,332 (26.1%) fall-related injuries (rate = 0.93/1000 patient days) in U.S. hospitals between July 1, 2006, and September 30, 2008 (Bouldin et al., 2013). The proportions of falls resulting in injuries range from 30% to 50% (Oliver et al., 2010) with 10 - 15% of falls resulting in serious injuries such as cranial trauma or fractures (Deandrea et al., 2013), leading to a prolonged length of stay, increased direct patient care cost and healthcare resource use (NPSA, 2007; Oliver et al., 2010). Compared to non-fallers, patients with serious fall-related injuries have to stay additional six to twelve days with an average additional cost of $13,316 (Wong et al., 2011). Fall-related indirect costs such as litigation cost, loss of income, and placement in a skilled nursing facility or nursing home also can occur as the result of inpatient falls in the hospital (Oliver et al, 2010; Wong et al., 2011).

Older adult patients aged 65 or older (U.S. Census Bureau, 2010) are the most vulnerable population to falls and relevant consequences. Higher fall incidences were reported in older adult patients (Anderson et al., 2012; Cameron et al., 2012; NPSA, 2007; Oliver et al., 2010) ranging from four to fourteen falls per 1000 patient bed days (Anderson et al., 2012). Serious fall-related injuries in older adults can cause reduced mobility and functioning ability, resulting

in loss of independency and decreased quality of life (Oliver et al., 2010). Among older adults with a history of falls, approximately 50% have the fear of falling and 27% develop chronic post-traumatic stress disorder (Chung et al., 2009). Due to fear of falling, 13 to 50% of older adults restrict their physical and social activities, which can further cause functional decline, depression, social isolation, and decreased quality of life (Fletcher, Guthrie, Berg, & Hirdes, 2010; Hawkins et al., 2011).

Given the consequences of falls with hospitalized patients and an increasing financial burden to the health care system, several federal policies have been developed and enacted to prevent inpatient falls. Reducing falls and fall-associated deaths and serious injuries is one of the major goals of the Healthy People 2020 (U.S. Department of Health and Human Services, 2010). The Agency for Health Care Research and Quality (AHRQ) developed a toolkit to prevent inpatient falls in hospitals (AHRQ, 2013). To reduce the cost associated with inpatient falls and fall-related injuries and improve patient care quality, the Centers for Medicare and Medicaid Services (CMS) has implemented a new policy since October 1, 2008 (CMS, 2008), that eliminated the reimbursement to hospitals for treatment of injuries resulting from falls occurring during hospitalization.

However, there is an existing gap in literature (specifically targeting the older adult inpatients), impeding achievement of these national goals. In recent years, several reviews have investigated risk factors for falls in hospitalized older adult patients. However, the review focused on older adults either in rehabilitation hospitals (Vieira, Freund-Heritage, & da Costa, 2011) or in nursing homes (Deandrea et al., 2013). There have not been any reviews focusing on unique risk factors for falls among older adult patients in acute care hospitals. Different care settings are likely to associate with admitted patient characteristics, interventional efforts at unit

level, and environmental factors at a hospital level. For example, older adult patients in acute care hospitals often have chronic or acute conditions that may affect their independence and mobility (NPSA, 2007; Palmisano-Mills, 2007). With the chronic/acute diseases or surgeries older adult patients have, they may need pain relief and/or other medications (Oliver et al., 2010). The different environment in the hospital can further affect their mobility and independence. All of these can potentially place older adult patients in acute care hospitals at higher risk for falls than those in other facilities or home (Deandrea et al., 2013; NPSA, 2007; Oliver et al., 2010).

Given the gap on the studies of risk factors for falls among older adult patients in acute care hospitals, this study aims to identify risk factors for inpatient falls in older adult patients in acute care hospitals through an integrative literature review. Four research questions are proposed here:

1. What is the fall prevalence in older adult patients in acute care settings?
2. What are the major risk factors for falls in older adult patients in acute care hospitals regarding patient characteristics and care settings?
3. What are the fall-related outcomes in older adult patients in acute care hospitals?
4. What conceptual and methodological issues should be considered for research and practice?

Methods

For this integrative literature review, an initial literature search was conducted from September to December, 2014. The literature of interest was limited to 10 years of recent publications from 2004 to 2014 to examine the most up-to-date information regarding inpatient falls, especially in older adult inpatients. Searching was completed through multiple electronic

databases including PubMed, the Cochrane Library, the Cumulative Index of Nursing and Allied Health Literature, MEDLINE, and PsycINFO. Based on reference lists obtained from retrieved articles, manual searching was completed using Google Scholar. A librarian specializing in healthcare literature was consulted for search terms and strategy. The following terms were used (in combination) while searching the databases: (1) fall(s); (2) predictor(s), risk factor(s) or characteristics; (3) older adult(s) or elderly; (4) patient(s), inpatient(s) or hospitalized, and (5) acute care setting or hospitals. Initial results were in a total of 681 items and a final of 23 studies were selected for the review (see Figure 2.1).

Titles, abstracts and full texts were examined by applying the following inclusion and exclusion criteria. Studies were included if:

1. Study participants were hospitalized inpatients aged 17 or above;
2. Study settings were acute care hospitals;
3. Studies used a quantitative measure of fall risk;
4. Studies were published in peer-reviewed academic journals; and
5. Studies were written in English.

We excluded studies with the following characteristics:

1. Study participants aged 16 or below were included;
2. The age of study participants was not specified or reported;
3. Study settings were outpatient settings, including home, community resident settings, psychiatric settings, or rehabilitation settings; and
4. Grey literature including dissertation, conference proceeding paper or abstract, and editorials.

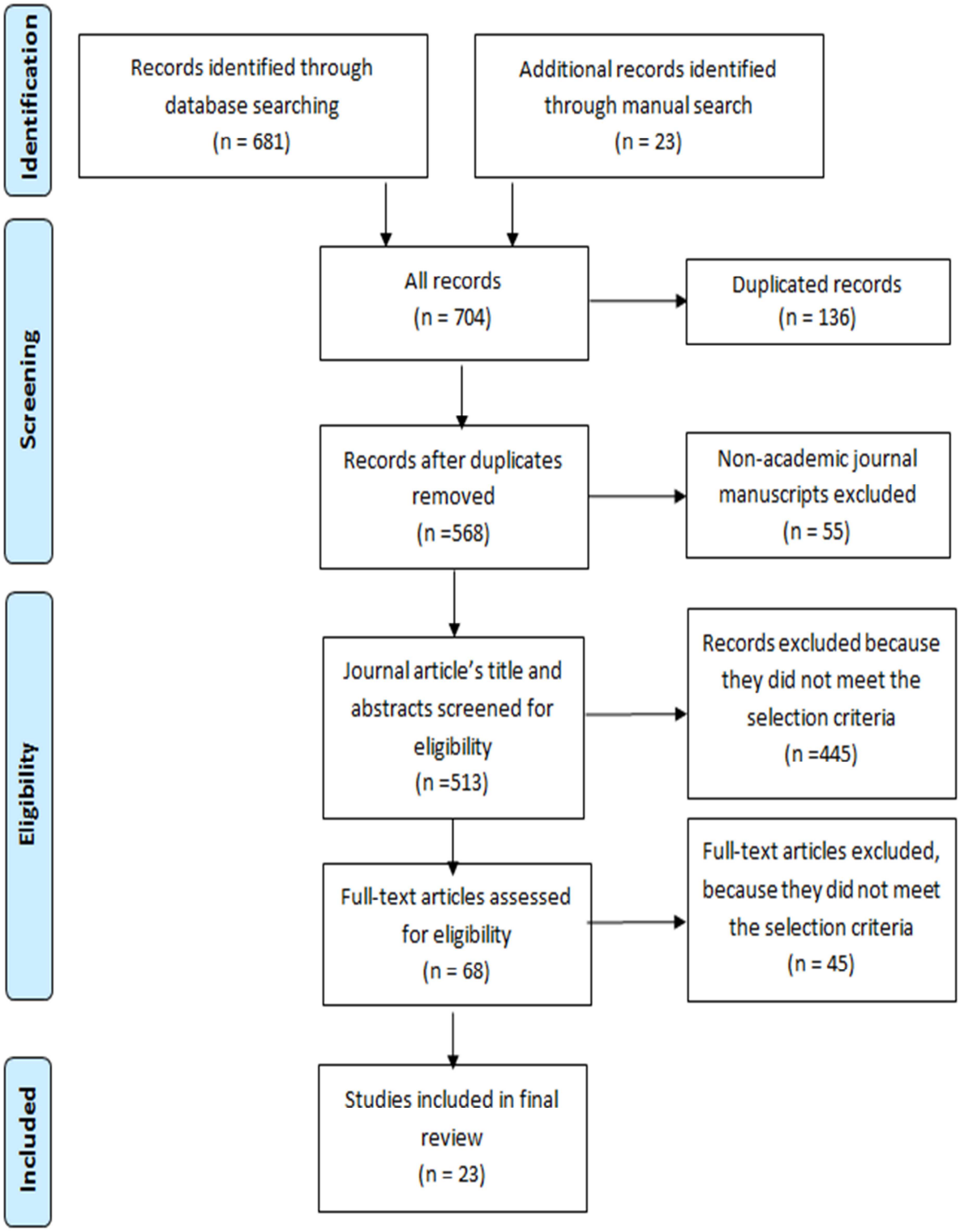

Figure 2-1. Flow chart of search strategy

Initially, we tried to retrieve studies whose participants were only adults, aged 65 or older. Only 9 of 23 studies met strict eligibility criteria, although the majority of study participants in other studies were older adults. Thus, we decided to select studies whose adult inpatients were aged 17 or older, and specified age characteristics with more details in data analysis. When the age of study participant was a wide range from 17 to older, we checked the proportion of older adults aged 65 or more. We decided to include the study if the proportion was greater than 50%. If the article explained falls in older adults in general including systemic review, Cochrane review, literature review, or expert opinion, we used it as background information and examined their references, but did not include it in the analysis table.

Results

Description of 23 Selected Studies

Table 2-1 lists the characteristics of the selected studies. All 23 selected studies were quantitative observational design, conducted in a single (17 studies, 74%) or multiple acute care hospital settings (6 studies, 26%). The majority of the studies were cross-sectional studies (70%) with 5 case-control studies (21%) and 2 longitudinal studies (9%). The majority of the studies (74%) were retrospective, while six of them (26%) were prospective cohort studies. Among 23 studies included in the review, most studies were conducted in the Unites States (39%) and Europe (39%), while five other studies (22%) were conducted in Australia.

The numbers of study participants ranged from 71 to 34,972 depending on the study design. An average age of participants ranged from 57.8 to 85.9 years, and the percentage of male participants ranged from 37% to 72%. Major medical conditions of study participants included: (1) cognitive impairment/confusion/dementia/neurological diseases, (2) cardiovascular diseases/hypertension, (3) urinary/fecal incontinence, (4) musculoskeletal problems, (5)

visual/hearing impairment, and (6) cancer. Overall fall prevalence ranged from 0.41 to 7.8 falls per 1000 patient bed days or 0.1 to 57.7 falls per year.

Table 2-1.

Characteristics of 23 Selected Studies (Chronologically ordered)

First author (Year)	Care settings (Country)	Study design	Study participants		Fall Prevalence	Data collection		
			Number	Age (Unit: Years)		Method	Dura-tion	Fall measures
Costa-Dias (2014)	Single acute hospital (Portugal)	- Retrospective - Observational - Cross-sectional	193 fallers	Range: 20 - 101 M(*SD*) = 75(13.1) 89% older than 60	214 fall cases (0.42/yr)	• Patient medical record review	42 mos	Number of fall incidence in the study period
Chari (2013)	Multiple hospitals (Australia)	- Retrospective - Observational - Cross-sectional	24,218 fall cases	Range: 18 or over M(*SD*) = 70.1(17.3) Median = 74.35	24,218 fall cases (57.7/yr)	• Patient medical record review • Clinical incident report review	35 mos	Number of fall incidence in the study period
Neumann (2013)	Single acute hospital (Germany)	- Retrospective - Observational - Cross-sectional	4,735 participants	Range: 65 - 101 Median = 82	7.8 falls during 1000 hospital days	• Patient medical record review • Clinical incident report review	36 mos	Fall number per 1000 hospit

								al days
Ferrari (2012)	Single acute hospital (USA)	- Retrospective - Observational - Cross-sectional	233 fallers	Range: 65 - 98 M(*SD*) = 78(7.9)	233 fall cases (1.62/yr)	• Patient medical record review	12 mos	Number of fall incidence in the study period
Mion (2012)	Single acute hospital (USA)	- Retrospective - Observational - Cross-sectional	784 fallers	Range: 20 - 90 M(*SD*) = 63.3(15.8) 47% older than 65	784 fall cases (5.4/yr)	• Patient medical record review • Clinical incident report review • Interviews with patients and nurses	26 mos	Number of fall incidence in the study period
Härlein (2011)	Multiple hospitals (Germany)	- Retrospective - Observational - Cross-sectional	9,246 participants	Range: 65 or over M(*SD*) = 77(7.6)	489 fall cases (1.13/yr)	• Patient medical record review • Clinical incident report review	36 mos	Number of fall incidence in the study period
Chen (2011)	Single acute care hospital (Australia)	- Retrospective - Observational - Case-control	408 (339 fallers & 69 non-fallers)	Range: 65 or over M(*SD*) = 80(10.1)	339 fall cases (0.94/yr)	• Patient medical record review • Clinical incident report review	30 mos	Number of fall incidence in the

								study period
Boelig (2011)	Single acute care hospital (USA)	- Retrospective - Observational - Cross-sectional	3,562 fall cases	Range: 20 - 80 M(*SD*) = 57.8(14.4)	• 3,562 falls (604 falls/yr) • 3.3 SCD-related falls/yr	• Patient medical record review • Clinical incident report review	59 mos	Number of fall incidence in the study period
Brand (2010)	Multiple acute care hospitals (Australia)	- Retrospective - Observational - Longitudinal	21,250 fall cases	Range: 18 - 90 50.9% over 80	0.41 - 0.88 falls/1000 bed days	• Hospital incident reporting system	120 mos	Fall number per 1000 hospital days
Chen (2010)	Single acute care hospital (Australia)	- Retrospective - Observational - Case-control	507 (438 fallers & 69 non-fallers)	Range: 65 or over M(*SD*) = 80(10.1)	438 fall cases (1.22/yr)	• Patient medical record review • Clinical incident report review	30 mos	Number of fall incidence in the study period
Schmid (2010)	Multiple acute care hospitals (USA)	- Retrospective - Observational - Cross-sectional	1,269 participants	Range: 65 or over M(*SD*) = 71.2(13.3)	65 fall cases (0.1/yr) (5%)	• Patient medical record review	60 mos	Number of fall incidence in the study period
Tzeng (2010)	Single acute care	- Retrospective - Observational	1,017 fall cases	Range: 17 - 103	1,017 fall cases	• Patient medical record review	46 mos	Number of fall

	hospital (USA)	- Cross-sectional		M(*SD*) = 72.8(16.2)	(1.84/yr)	• Clinical incident report review		incidence in the study period
Corsinovi (2009)	Single acute care hospital (Italy)	- Prospective - Observational - Longitudinal	620 participants	Range: 65 or over M(*SD*) = 79.3(8.9)	6 falls/1000 patient days	• Patient medical record review	17 mos	Fall number per 1000 hospital days
Rhalimi (2009)	Single acute care hospital (France)	- Retrospective - Observational - Case-control	260 (134 fallers & 126 non-fallers)	Range: 65 or over M(*SD*) = 84(7)	142 fall cases (0.5/yr)	• Patient medical record review • Fall incident forms review	24 mos	Number of fall incidence in the study period
Schwendimann (2008)	Single acute care hospital (Switzerland)	- Prospective - Observational - Cross-sectional	34,972 participants	Range: 18 - 80 M(*SD*) = 67.3(19.3) 91.3%. over 65	7 falls/1000 patient days	• Fall reporting hospital system	60 mos	Fall number per 1000 hospital days
Tommasini (2008)	Single acute care hospital (Italy)	- Retrospective - Observational - Cross-sectional	71 fallers	Range: 65 - 80 M(*SD*) = 79.8(12.2) 43.6% over 80	79 fall cases (0.55/yr)	• Patient medical record review • Clinical incident report review	12 mos	Number of fall incidence in

								the study period
Heinze (2007)	Multiple acute care hospitals (Germany)	- Retrospective - Observational - Cross-sectional	7,757 participants	Range: 65 or over M = 77	4.2 - 4.7 falls/1000 patient days	• Patient medical record review • Fall incident form review	24 mos	Fall number per 1000 hospital days
Dharmarajan (2006)	Single acute care hospital (USA)	- Prospective - Observational - Case-control	362 participants	Range: 59 - 104 M(*SD*) = 76.9(9.9) 73% over 70	198 fall cases (0.4/yr) (54.7%)	• Incident report review	42 mos	Number of fall incidence in the study period
Fischer (2005)	Single acute care hospital (USA)	- Retrospective - Observational - Cross-sectional	1,082 fallers	Range: 49 - 77 Median = 62	3.1falls/1000days	• Adverse event report review	18 mos	Fall number per 1000 patient days
Mecocci (2005)	Multiple acute care hospitals (Italy)	- Prospective - Observational - Cross-sectional	13,729 participants	Range: 65 or over M(*SD*) = 78.3(7.2) 69% over 75	279 fall cases (1.16/yr)	• Patient medical record review	20 mos	Number of fall incidence in the study

								period
Walker (2005)	Single acute care hospital (USA)	- Retrospective - Observational - Case-control	124 (62 fallers & 62 non-fallers)	Range: 65 or over M(*SD*) = 74(6)	62 fall cases (0.43/yr)	• Patient medical record • Clinical incident report review	12 mos	Number of fall incidence in the study period
Hitcho (2004)	Single acute care hospital (USA)	- Prospective - Observational - Cross-sectional	183 fallers	Range: 17 - 96 M(*SD*) = 63.4 (6) 53% over 65	3.38 falls/1000 patient days	• Patient medical record review • Clinical incident report review	4 mos	Fall number per 1000 patient days
Salgado (2004)	Single acute care hospital (Australia)	- Prospective - Observational - Cross-sectional	88 participants	Range: 80 - 89 M(*SD*) = 85.9 (4.2)	15 fall cases (17%)	• Patient medical record review • Fall assessment record review	Not reported	Number of fall incidence in the study period

*Notes***.** M = Mean; mos = Months; SD = Standard Deviation; USA = The United States of America; yr = year.

Risk Factors for Inpatient Falls

There were 28 risk factors found from 23 studies as well as non-relevant risk factors determined based on statistical significance (see Table 2-2).

Intrinsic risk factors for falls: patient level. Advanced age was a major significant factor for falls (9 times identified, 39%). Falls were prevalent among older adult inpatients in the selected studies. Costa-Dias et al. (2014) found that 89% of falls occurred in adult inpatients 60 years and older while over 40% of falls occurred among elderly from 80 to 89 years. Among the inpatients who fell, some studies found that about 40% to more than 50% were 65 years or older (Hitcho et al., 2004; Mion et al., 2012), while some studies found that almost half of patients experiencing an inpatient fall were 80 years or older (Brand & Sundararajan, 2010; Tommasini, Talamini, Bidoli, Sicolo, & Palese, 2008).

Table 2-2.

Prevalence and Risk Factors for Falls

First Author (Year)	Advanced age affects fall?	Other significant risk factors		Environmental/ Situational factors	Non-significant risk factors	Consequences after falls
		Intrinsic	Extrinsic			
Costa-Dias (2014)	Yes	- Central nervous system, psychotropic, antipsychotic, & antidepressant medications			- Cancer - Gender - Anticonvulsants, opioid analgesia, antihypertensive, & oral antidiabetic medications	
Chari (2014)	Yes	- Gender: Female	- Unscreened fall risk upon admission	- Time: Evening - Location: Bedroom & hallway - Patient activity: Walking & sitting	- Timing	- Fall-related fractures (0.94%)
Neumann (2013)	No	- Gender: Male - Fall history - Mental alteration - Insecure mobility - Psychotropics		- Patient activity: Frequent toileting	- Age - Visual impairment	
Ferrari (2012)	Unclear	- Cognitive impairment - Inattention			- Gender - UI	
Mion (2012)	Unclear	- Race: Caucasian - Antidepressants, antipsychotics, & diuretic		- Time: 7 - 11am - Location: Patient room - Patient activity: Toileting		- Injurious falls (29%): Minor (82%); moderate (7%); major (9%); death (2%) - Discharge to: Home (49%), postactue care (17%), long term care (6%) - Hospital death (8%)
Härlein (2011)	Yes	- Cognitive impairment - Greater care dependency - Impaired mobility	- Geriatric unit		- Gender - UI	
Chen (2011)	No	- Gender: Male - Low English literacy - Comorbidities: Visual impairment, dementia, hypertension, stroke, UI, & MS problems - 3 or more co-			- Hearing impairment - CHF - Atrial fibrillation	

		morbidities - 5 or more polypharmacy				
Boelig (2011)	Unclear			- Patient activity: Toileting	- SCD use	
Brand (2010)	Yes	- Comorbidities: HIV infection, liver disease, ataxia, PD, dementia, & delirium				- Fall-related fractures (21%) - Increased LOS and mortality rate
Chen (2010)	No	- Gender: Male - Hostel/Nursing home pre-admission - Low English literacy - Comorbidities: Visual impairment, dementia, hypertension, stroke, UI, & MS problems - 3 or more co-morbidities - 5 or more polypharmacy		- Time: 9 - 11am, 7 -8 pm, midnight - 1am - Location: Patient room, bathroom & hallway - Patient activity: Moving, toileting, transferring, & showering	- Hearing impairment - CHF - Atrial fibrillation	- Injurious falls (72%): Minor (53%); moderate (8%); major (0.5%)
Schmid (2010)	No	- Greater stoke severity - Anxiety history - Loss of functional status			- Gender - Sensory impairment - Gait abnormality	
Tzeng (2010)	Unclear	- Mental status deficits		- Patient activity: Toileting		- Injurious falls (30%): Minor (25%); moderate (2%); major (2%)
Corsinovi (2009)	Yes	- Balance impairment - Comorbidities: Delirium & endocrino-metabolic disease - Polypharmacy		- Location: Patient bed, bathroom, & corridors	- Gender - Visual impairment - UI - Sleep disturbances - Orthostatic hypotension	- Injurious falls: Minor (13%); major (12%) - Prolonged LOS - Nursing home placements
Rhalimi (2009)	No	- Prolonged LOS - Medications: Zolpidem, calcium channel antagonists, & meprobamate		- Location: Patient bed, bathroom, outside the unit, & corridor	- Gender - Number of medications - Hypertension - PD	- Injurious falls: Minor (64%); moderate (20%); major (18%)
Schwendi mann (2008)	Yes	- Gender: Female - Prolonged LOS	- Geriatric unit	- Time: Night shift - Location: Patient room, bathroom, & hallway - Patient activity: Walking, getting out of bed & transferring		-Injurious falls: Minor (30%); major (5%)

Tommasini (2008)	Yes	- Gender: Female - Prolonged LOS - Stroke - Hypertension		- Location: Patient room, bathroom, & bed	- Fall history - Mental confusion - UI	- Injurious falls: Minor (40%); moderate (17%); major (13%)
Heinze (2007)	No	- Care dependency	- Geriatric or medical unit		- Gender	- Injurious falls: Minor (67%); moderate/major (27%)
Dharmarajan (2006)	No	- Anemia - Prolonged LOS - Hispanic ethnicity			- Gender - Place of residence	
Fischer (2005)	Yes	- Sedated mental status	- Geriatric unit	- Patient activity: Toileting		- Injurious falls (34%): moderate (54%); major (29%); death (0.2%)
Mecocci (2005)	Yes	- Cognitive impairment - Fall history - Prolonged LOS - Severe comorbidity - Neuroleptics & benzodiazepines			- Gender - Disability	
Walker (2005)	Unclear	- Dementia - Aspirin			- Opioid analgesic, benzodiazepine, & antidepressant medication	
Hitcho (2004)	Unclear	- Gender: Female	- Medicine or neurology unit - Environmental obstacles or wet floor	- Time: Evening or night - Patient activity: Unassisted transferring & toileting	- Urinary problems - Diuretics	- Injurious falls (42%): Moderate/severe (8%)
Salgado (2004)	No	- Cognitive impairment - Confusion - Fall history - Stroke history - Psychoactive medications			- Impaired mobility	- Injurious falls (9%)

*Notes***.** CHF = Congestive heart failure; HIV = Human Immunodeficiency Virus; LOS = length of stay; MS = Musculoskeletal; PD = Parkinson's disease; SCD = Sequential Compression Device; UI = Urinary incontinence.

The other risk factors were categorized to (1) medical conditions, and (2) non-medical conditions.

1. Major medical conditions identified as important risk factors for increasing falls included: mental status deficits including cognitive impairment, confusion, dementia, and delirium (12 times identified, 52%), impaired mobility or musculoskeletal problems (6

times identified, 26.1%), stroke (4 times identified, 17.4%), hypertension (3 times identified, 13%), urinary incontinency (2 times identified, 8.7%), and visual impairment (2 times identified, 8.7%).

2. Common non-medical conditions found as risk factors increasing falls included: prolonged length of hospital stay (4 times identified, 17.4%), previous fall history (3 times identified, 13%), male gender (3 times identified, 13%), female gender (2 times identified, 8.7%), and care dependency (2 times identified, 8.7%). Taking certain medications such as psychotropics (3 times identified, 13%), antipsychotics (3 times identified, 13%), and antidepressants (2 times identified, 8.7%) was also identified as a significant risk factor for falls statistically.

Some factors were identified as protective factors which could decrease falls. For example, fall risk screening upon admission reduced inpatient falls (Chari, McRae, Varghese, Ferrar, & Haines, 2013). Hispanic patients were likely to have less falls in the hospital compared to African American, Caucasian, and Asian patients (Dharmarajan, Avula, & Norkus, 2006).

However, there were inconsistent reports regarding risk factors. First, few studies reported whether age was a statistically non-significant factor for general inpatient falls, impulsive falls, or injurious falls (Ferrari, Harrison, & Lewis, 2012; Mion et al., 2012). Second, gender was quite controversial. Male gender was identified as a statistically significant risk factor for falls in several studies (Chen, Liu, Chan, Shen, & van Nguyen, 2010; Chen, van Nguyen, Shen, & Chan, 2011; Neumann, Hoffmann, Golgert, Hasford, & von Renteln-Kruse, 2013), while others reported that female gender was a risk factor (Schwendimann, Bühler, de Geest, & Milisen, 2008; Tommasini et al., 2008). However, the rest nine studies (39%) reported that gender did not matter. Third, visual impairment was statistically significant in 2 studies

(Chen et al., 2010; Chen et al., 2011) but identified as non-significant in 2 other studies (Corsinovi et al., 2009; Neumann et al., 2013). Fourth, having certain medical problems such as urinary incontinence was identified as a statistically significant risk factor in some studies (Chen et al., 2010; Chen et al., 2011), but statistically non-significant in other studies (Corsinovi et al., 2009; Ferrari et al., 2012; Härlein, Halfens, Dassen, & Lahmann, 2011).

Extrinsic risk factors for falls: staff and care setting characteristics. There is limited information available to explain how staff and care settings relate to inpatient falls. First, fall incidence rates differed among diverse types of units. Compared to other units in the hospital, geriatric units had the highest fall incidence followed by internal medicine and neurological units (Fischer et al., 2005; Härlein et al., 2011; Heinze, Halfens, & Dassen, 2007; Hitcho et al., 2004; Schwendimann et al., 2008). Being an inpatient in a geriatric unit was identified as a statistically significant factor for inpatient falls (4 times identified, 17.4%). Second, falls were found to be associated with the time when falls occurred. Shift change periods were associated with increased inpatient falls (Chen et al., 2011). Findings from several studies suggested high incidence of falls during evening and night shifts (Chari et al., 2013; Hitcho et al., 2004; Schwendimann et al., 2008), while Mion and colleagues (2012) found more falls occurred from 7am to 11am in the morning.

Environmental/situational factors. There are environmental or situational factors for increasing inpatient falls in older adults. First, certain patient activities contributed to inpatient falls. Among patients who fell in the hospital, about 25 - 70.3% patients were walking or transferring (Chen et al., 2011; Tzeng, 2010; Schwendimman et al., 2008), and about 12 - 69% of falls were related to urinary and bowel elimination needs (Boelig et al., 2011; Chen et al., 2011; Hitcho et al., 2004; Mion et al., 2012; Tzeng, 2010). In addition, about 15.9 - 51% patients fell

out of the bed (Corsinovi et al., 2009; Schwendimman et al., 2008; Tommasini et al., 2008). Second, regarding the location of falls, the majority of falls occurred in patient rooms (62 - 77.1%) with 11.4 - 68% in the bathroom and 4.9 - 13% in the hallways (Chen et al., 2011; Corisnovi et al., 2009; Fischer et al., 2005; Mion et al., 2012; Rhalimi, Helou, & Jaecker, 2009; Schwendimann et al., 2008; Tommasini et al., 2008).

Consequences of Falls among Older Adult Patients

Inpatient falls had negative consequences in patients, particularly in older adult patients. In general, the incidence rates of fall-related injuries ranged from 6.8 to 72.1%. Fall-related injuries included 12 - 82% minor injuries such as abrasions, 2.2 - 53.6% moderate injuries such as lacerations, and 0.5 - 29% major injuries such as fractures and even death (0.2 - 2%) (Brand & Sundararajan, 2010; Chari et al., 2013; Chen et al, 2011; Corsinovi et al., 2009; Fischer et al., 2005; Mion et al., 2012; Neumann et al., 2013; Rhalimi et al., 2009; Schwendimann et al., 2009; Tommasini et al., 2008; Tzeng, 2010). After an injurious fall, 4% of patients had to have some surgical procedures to treat the injuries (Mion et al., 2012). Compared to younger adults, older adults were at higher risk for experiencing fall-related injuries. Older adult patients were more likely to experience major or serious injuries from inpatient falls than other age groups (Fischer et al., 2005; Hitcho et al., 2004; Schwendimann et al., 2008). For older adults who were 80 years and above, they were 1.5 times more likely to suffer from fractures resulting from inpatient falls compared to younger patients (Chari et al., 2013). Brand and Sundarrajan (2010) found that approximately 60% of fall-related fractures occurred in older adult patients over 80 years old. Mortality rate and length of stay were increased among older adult patients with injurious falls (Brand & Sundarrajan, 2010; Corsinovi et al., 2009). In addition, older adult patients were more

likely to be placed in nursing homes after experiencing falls in acute care hospitals (Corisnovi et al., 2009).

Discussion

To our best knowledge, this integrative review is the first synthesis on multidimensional risk factors for falls focusing on older adult inpatients in acute care hospitals. Although there are several literature reviews on risk factors for inpatient falls, those literature reviews do not examine factors specifically for the older adult population in hospital settings. Given the unique impact of inpatient falls on older adult patients, the present study provides important knowledge on risk factors for falls at different levels including intrinsic, extrinsic, and situational factors. Compared to the AHRQ (2013) toolkit for preventing falls in hospitals, our study findings center on identifying: (1) how fall assessment processes connect to outcomes; (2) important risk factors for falls in a specific setting; and (3) challenges in current practice.

In this study, we found that advanced age was a key risk factor to increased inpatient falls. More than one third of studies identified advanced age increased falls, specifically in those older than 65. In addition, being an inpatient in the geriatric unit as another risk factor may be correlated to advanced age as a risk factor. This finding is consistent with the result of a recent systematic review of studies on older people in nursing homes and hospitals, in which Deandrea and colleagues (2013) found that the odds ratio for inpatient falls for a 5-year increase in age was 1.1. Thus, 80-year old adults are 1.2 times more likely to have a fall, and 95-year old adults are 1.4 times more likely to have a fall compared to 65-year old adults.

We found certain medical conditions were highly associated with falls, such as altered mental status (confusion, cognitive impairment, or delirium), impaired mobility, stroke and hypertension. Negative effects secondary to confusion and cognitive impairment have been well

established in a previous review related to inpatient falls (Deandrea et al., 2013). In addition, we also found that increased falls were among those who had previous history of falls or took certain medications such as psychotropics, antipsychotics, or anti-depressants (Deandrea et al., 2013).

Environmental and situational factors also are important regarding inpatient falls. The findings of patient activities while falling suggest mobile patients were at a higher risk of falling than non-mobile patients. A prolonged length of hospital stay and insufficient physical assistance may negatively affect mobile older adults. However, we believe that a prolonged length of stay was not an independent risk factor because it was considered as a consequence of inpatient falls in some studies (Brand & Sundararajan, 2010; Corsinovi et al., 2009).

Methodological Issues

Major data collection methods were patient medical records and fall incident report reviews. The data collection duration ranged from 4 months to 120 months (Mean = 33.1 months, with one study not reporting data collection duration). There are study limitations and methodological concerns present in the 23 selected studies.

First, the definition and operationalization of falls differ among studies. In general, a fall was defined as an unintentional sudden change in body position coming to rest on the ground, floor or other lower level (Chen et al., 2010; Mion et al., 2012; Neumann et al., 2013; Salgado, Lord, Ehrlich, Janji, & Rahman, 2004). Some studies defined a fall similarly but more detailed: “sudden, unintentional loss of posture causing an individual to inadvertently rest at a lower level, without use of overwhelming external force” (Dharmarajan et al., 2006, p. 288) or “a sudden, unexpected descent from a standing, sitting, or horizontal position” (Fischer et al., 2005, p. 823; Hitcho et al., 2004, p. 733). The most frequent operationalization of falls was a count of falls per 1000 patient days or during study periods. Different usage of diverse types of definitions may

affect the wide range of fall prevalence, non-compatible rate across studies, or inconsistent significance of risk factors. Healthcare providers and researchers should be careful to use study findings from multiple studies. For example, we converted the fall prevalence to compare the prevalence across the studies (see Table 2-2).

Second, there is a concern about reliability of data collection. Most studies were secondary data analyses using the data extracted from patient medical records or clinical incident reports. The primary data record did not purpose to study fall prevalence and its risk factors; thus, there was no control for training healthcare providers to record fall incidence accurately. Moreover, the potential underreporting of falls in the incident report system may occur because most of reviewed studies depended on data reported by nurses or other healthcare providers for hospital incident report systems (Shorr et al., 2008). Moreover, although several common risk factors were identified in the review, the definitions and categorizations of the risk factors were inconsistent among the reviewed studies. For example, several different terms were used to indicate abnormal level of consciousness, including mental alteration (Neumann et al., 2013), cognitive impairment (Ferrairi et al., 2012; Harlein et al., 2011), dementia (Chen et al., 2011), mental status deficits (Tzeng, 2010), and confusion (Salgado et al., 2004).

Third, most studies did not control confounding effect from extraneous factors; thus, it is difficult to compare their findings across different study settings and countries. Since different countries have different regulations and policies for acute care hospitals, the risk factors identified among inpatients in European acute care hospitals may not be directly comparable with those in Australian or American acute care hospitals; therefore, generalizability of study findings in a specific country will be limited in other countries.

Fourth, the study design was another major methodological issue. Retrospective design was utilized in most of the studies (76%), while only several studies used prospective design (24%). With retrospective design, it is challenging to identify causal relationship since reverse causality could occur (Shadish, Cook, & Campbell, 2002). It is unclear that some factors such as impaired mobility, confusion or prolonged length of stay were either the cause of falls or the consequence of falls.

Implications for Clinical Practice and Research

Findings from this literature review have important implications for clinical practice. All healthcare providers need to acknowledge that older adult patients with advanced age are at increased risk for falls. In general, both single and multifactorial fall prevention interventions have been developed and implemented to prevent inpatient falls and fall-related injuries in hospitals. According to a recent Cochrane review on fall prevention interventions, single interventions include: exercise, Vitamin D with calcium supplements, environment adaptations, using assistive technology such as bed exit alarms for communication aids, staff training, service model change, and patient knowledge improvement through education, and multifactorial interventions that incorporate several single intervention components (Cameron et al., 2010).

When nurses combine multiple single interventions, the long-term and short-term effects should be considered to maximize the preventive effects. For example, taking vitamin D and calcium supplements generates long-term effect to prevent fractures secondary to falls for older adults from acute care hospitals to the community. However, it is difficult to expect short-term effect during the limited period of hospital stay. Thus, it is more appropriate to educate older adults about the importance of taking vitamin D and calcium supplements when they return to home. In contrast, since most falls are elimination-related, nursing and other staff should

provide assistance to patients using toilets, particularly to patients with urinary or bowel incontinence during hospital stays as short-term intervention.

Although some multifactorial interventions have shown positive effect in reducing inpatient falls, falls and fall-related injuries are still prevalent among older adults in hospitals. When healthcare providers in acute care hospitals care for older adult patients, they need to focus on identified risk factors of falls to maximize the preventative effect with limited time and resources. To prevent falls and fall-related injuries, nursing and other healthcare professionals should perform a thorough assessment on patients and implement appropriate fall prevention interventions from admission to discharge. Comorbid conditions, medications, mobility and cognition should be evaluated for determining comprehensive fall risk. In addition, comprehensive assessment including patient characteristics and situational factors is required continuously. Environmental modification in care settings focusing on patient room, bathroom, and hallway is also needed.

In addition, more organizational strategies should be designed and implemented considering the extrinsic and environmental risk factors of older adult inpatients identified in this review. Using the AHRQ toolkit to prevent inpatient falls in hospitals (AHRQ, 2013) as a framework, hospitals could incorporate the following strategies when developing fall prevention programs: (1) assessing the culture of safety, organizational attention to, and leadership support for fall prevention programs; (2) staff education for the best practices; and (3) collecting the right data to evaluate falls and fall-related injuries. Resource identification, utilization, and distribution should be emphasized specifically for older adult inpatients.

For future studies, prospective studies are needed to examine the associations between risk factors and inpatient falls in acute care settings. Prospective studies allow differentiating

risk factors for falls from potential consequences of falls (e.g., impaired mobility, prolonged length of stay). In addition, mixed methods design studies are needed to examine psychosocial factors and consequences of falls by interviewing patients to learn their lived experiences. Patient perspectives regarding falls will be beneficial to design patient-centered intervention and outcome measures. For example, fear of falling, a psychosocial risk factor, was not examined in any of the 23 studies. Fear of falling occurs in 35 to 55% of older adults and has been found to be predictive of future falls among community-dwelling older people (Fletcher et al., 2010). Future studies in acute care settings need to examine the association between patient-perceived fall risk factors and the consequences of falls so as to develop patient-centered interventions for older adult patients at high risk for falls.

Conclusions

Falls are prevalent among adult inpatients in acute care hospitals and have adverse impact on patients, particularly older adult patients. This integrative literature review identified several key risk factors including intrinsic and extrinsic factors, as well as environmental/situational factors. The findings from this literature review provide updated knowledge on risk factors for inpatient falls and implications for future research and clinical practice regarding fall prevention among patients, particularly older adult patients in acute care hospitals.

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Chapter 3

Multilevel Factors Associated with Injurious Falls in Acute Care Hospitals

This manuscript will be submitted to *Journal of Nursing Care Quality* and represents the overall report of the study including the findings, discussion, and implications for research and clinical practice. The authors for this manuscript include: Yunchuan Zhao, Marjorie Bott, Jianghua He, Heejung Kim, Shin Hye Park and Nancy Dunton.

Abstract

Background: Falls among patients in acute care settings are a serious concern for patient care and have a number of adverse consequences. Inpatient falls may cause injuries, reduce functional ability and quality of life, and create extra financial burden to patients, families and healthcare facilities. The purpose of this study was to examine the associations of injurious falls among all patient falls with multilevel factors in acute care hospitals including hospital- and unit-level organizational factors, unit-level nursing care process factors, and unit-level patient population characteristics.

Conceptual Framework: The modified Donabedian Structure–Process–Outcome (SPO) model (Coyle & Battles, 1999) served as the conceptual framework. Structure included hospital characteristics (i.e., hospital size, teaching status, and Magnet® status) and unit factors (i.e., nurse staffing and unit type); unit process consisted of nursing care factors (i.e., falls without employee assistance, fall risk assessment, implementation of fall prevention protocol, and physical restraint use); and the outcome variable was incidence of inpatient injurious falls. Unit-level patient population characteristics (i.e., gender and fall risk status) also were included.

Method: This cross-sectional, descriptive, and correlational study of unit-level injurious falls used National Database of Nursing Quality Indicators® (NDNQI®) data from July 2013 to June 2014. The sample included all falls recorded in adult medical, surgical, combined medical-surgical, and step-down units (N = 2,299) in NDNQI® participating hospitals (N = 488). The outcome variable was the number of injurious falls among all falls recorded on these units during the one-year study period. Besides descriptive analyses, hierarchical negative binominal regression analyses were performed to examine the risk factors of injurious falls.

Results: There were on average 78.9 reported falls (*range* = 1 to 864) and 5.2 injurious falls (*range* = 1 to 131) annually across the 2,299 units during 12 months. Falls that happened in teaching hospitals were 13% less likely to be injurious falls compared to those in non-teaching hospitals ($p = 0.001$). Falls on surgical units were 8% more likely to be injurious falls than those on other units ($p = 0.021$). RN hours per patient day (RNHPPD) demonstrated a non-linear relationship with injurious falls, presenting 5.08 RNHPPD as a turning point. Before RNHPPD reached 5.08, the relationship between RNHPPD and injurious falls was negative; while the relationship turned to be positive when RNHPPD was higher than 5.08. At the unit level, the injurious fall risk was expected to increase by 4% when the percent of falls without employee assistance increased by 10 percentage points ($p = 0.005$), while the risk of injurious fall was expected to decrease by 2.5% when the percent of patients at risk of falls increased by 10 percentage points ($p = 0.009$). The total number of patient days also was found to be associated with injurious falls: for every increase of 1000 patient days, the injurious fall risk was expected to decrease by 2% ($p < 0.001$). Hospital Magnet® status, bed size, unit non- RNHPPD, and RN turnover were not associated with injurious falls.

Conclusions: The study findings add new knowledge about organizational factors that contribute to inpatient injurious falls at unit levels. The findings can guide healthcare professionals and acute care hospital administrators in planning and implementing effective and cost-reducing preventions for inpatient falls and injurious falls in acute care settings.

***Key Words*:** injurious falls, organizational structure, nurse staffing, nursing care process, acute care setting

Introduction

Inpatient falls and injurious falls in acute care settings are prevalent and a serious concern for patient care. In the United States (U.S.), the overall prevalence of falls range from three to five falls per 1000 patient days with about one million inpatient falls annually (Oliver, Healey, & Haines, 2010). According to a literature review study, among inpatient falls, the incidence rates for fall-related injuries range from 6.8% to 72.1% with 0.7% to 30% for severe injuries such as fractures, cranial trauma, or death (Zhao & Kim, 2015). Injurious falls have a negative impact on patients, families, and the healthcare system. With injurious falls, patients may suffer from loss of independence, depression, and decreased quality of life (Oliver et al., 2010). Injurious falls can result in a prolonged length of stay (LOS) that further leads to increased direct patient care costs, and healthcare resource use (Oliver et al., 2010). When comparing severe injurious falls to patients without falls, the LOS increases on average, by six to twelve days with an additional cost of $13,316 for the patient (Wong et al., 2011). In addition, indirect costs associated with injurious falls may include but are not limited to loss of income, placement in a skilled nursing facility or nursing home, and litigation expenses (Oliver et al., 2010; Wong et al., 2011).

In the last decade, interventions aimed at fall prevention have been developed and implemented in hospitals (Cameron et al., 2012). Several national initiatives also have underscored the importance of preventing falls and their associated adverse consequences. The U.S. Department of Health and Human Services (USDHHS, 2010) selected reduction of falls and fall-related serious injuries and death as one major goal in the Healthy People 2020. Beginning in October 2008, the Centers for Medicare and Medicaid Services (CMS, 2008) no longer reimburse hospitals for treatment of preventable injuries, including fall-related injuries. Despite

the national efforts and initiatives on fall prevention, inpatients falls and fall-related injuries still are prevalent in hospitals. The results of a recent study show a total of 315,817 falls (3.56 falls per 1000 patient days) with 26.1% (82,332) of the falls having related injuries (0.93 injurious falls per 1000 patient days) in less than a two-year period in U.S. hospitals (Bouldin et al., 2013).

Given the prevalence and significant consequences of inpatient falls and associated injuries, it is important to prevent falls, especially injurious falls in acute care settings. To prevent falls and their associated injuries, it is critical to identify factors associated with injurious falls. Inpatient falls are a complicated phenomenon that involves multilevel factors, including patient-specific factors, environmental factors, organizational factors and patient-staff interaction factors in the hospital (Oliver et al., 2010). Research shows that patients identified at risk for falls are more likely to experience injurious falls (Chari, McRae, Varghese, Ferrar, & Haines, 2013). Evidence of the associations between gender and injurious falls is controversial. In some studies, being female is identified as a risk factor for injurious falls (Chari et al., 2013; Williams, Szekendi, & Thomas, 2014); while being male is found to be associated with increased risk of injurious falls in other studies (Krauss et al., 2007; Staggs, Mion, & Shorr, 2014).

Hospital characteristics such as hospital size, and Magnet® or teaching status, are associated with injurious falls. Small hospitals (<300 beds) tend to have more injurious falls (Dunton, Gajewski, Taunton, & Moore, 2004; Staggs et al., 2014) while Magnet® or teaching hospitals have less inpatient falls or injurious falls, respectively (Dunton, Gajewski, Klaus, & Pierson, 2007; Staggs et al., 2014). Unit factors (e.g., unit types and nurse staffing factors) also are found to be associated with injurious falls. Intensive care units have significantly lower fall and injurious fall rates than other units (Dunton et al., 2004; Williams et al., 2014). Among medical, surgical, and medical-surgical units, medical units have the highest prevalence of falls

and injurious falls (Bouldin et al., 2013; Staggs et al., 2014; Williams et al., 2014). Based on a systematic review and a meta-analysis (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Lake & Cheung, 2006, respectively), the evidence on the association between inpatient falls and nurse staffing is inclusive; although some studies suggest that lower inpatient fall rates are associated with higher nursing hours, higher registered nurse (RN) hours, and a higher proportion of RN hours (Dunton et al., 2004; Staggs and Dunton, 2014).

Nursing care process factors also contribute to inpatient falls and associated injuries. Studies show that fall risk assessment and fall protocol implementation help prevent or reduce injurious falls (Chari et al., 2013; Staggs et al., 2014). Falls without employee assistance are more likely to result in injuries (Chari et al., 2013; Krauss et al., 2007; Staggs et al., 2014). However, the use of physical restraints is positively associated with increased risk for falls, injuries and even death (Berzlanovich, Schöpfer, & Keil, 2012; Titler, Shever, Kanak, Picone, & Qin, 2011; Tzeng & Yin, 2013).

Given the controversial evidence on factors associated with injurious falls in the literature and the complicated nature of inpatients falls and associated injuries, further study integrating multilevel factors contributing to injurious falls is required. Using a modified Donabedian's Structure-Process-Outcome (SPO) model (Coyle and Battles, 1999; Donabedian, 1988) that added patient characteristics to the SPO model, this study aims to examine multilevel factors associated with injurious falls in acute care hospitals (see Figure 3-1). Structure factors include hospital characteristics (i.e. hospital size, Magnet®, and teaching status) and unit characteristics (i.e., unit types and nurse staffing). Process factors consist of services and patient interaction with healthcare professionals, including fall risk assessment, fall prevention protocol implementation, falls without employee assistance, and physical restraint use. Patient

characteristics include gender and fall risk status. To date, this study is the first attempt at investigating the complex phenomenon of injurious falls at multiple levels. The research question is: what organizational structure, unit structure, nursing care process and patient factors are associated with injurious falls in acute care hospitals?

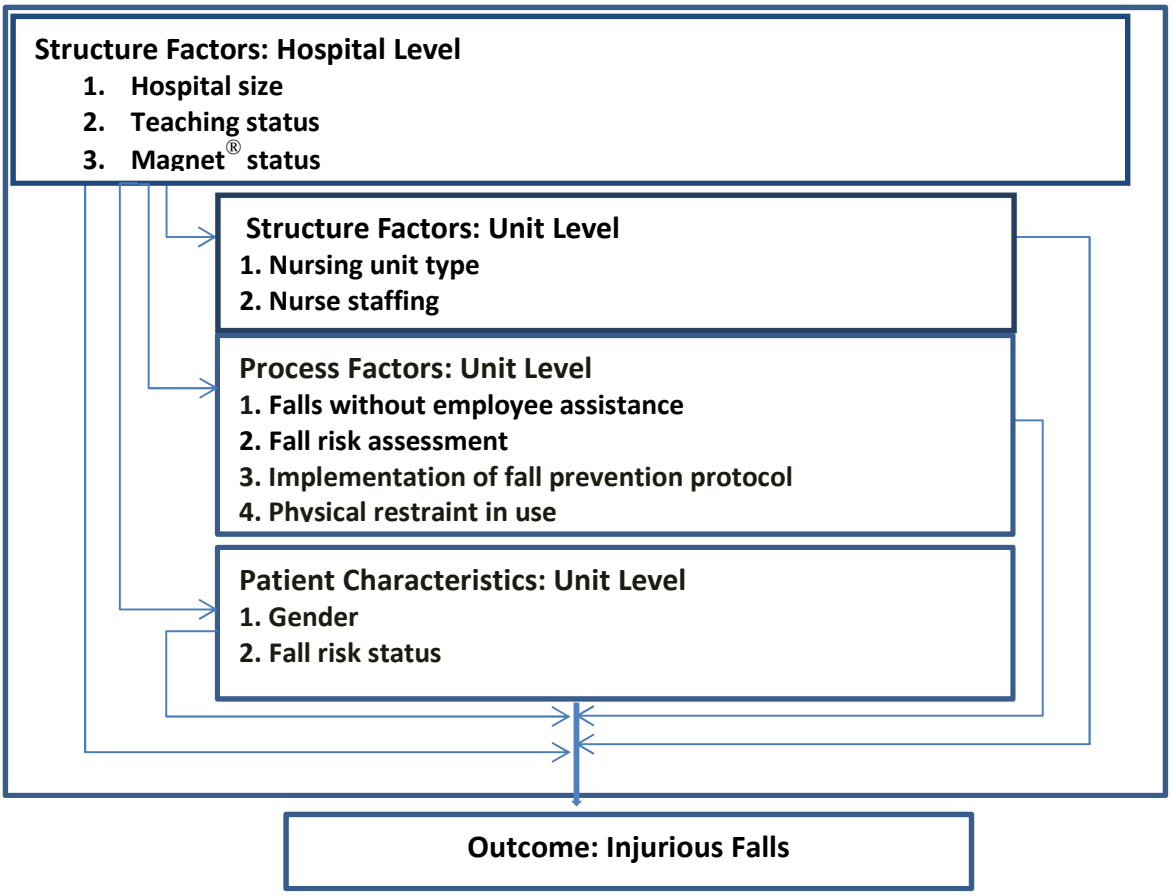

Figure 3-1. Conceptual framework of the modified Donabedian's SPO model to examine multilevel factors associated with inpatient injurious falls

Methods

Design and Data Source

The study is a cross-sectional, correlational design, using the National Database of Nursing Quality Indicators® (NDNQI®) data collected between July 2013 through June 2014. The NDNQI®, established in 1998 by the American Nurses Association (ANA), became a

proprietary database of the Press Ganey Associates, Inc. in 2014. As of 2014, over 2000 hospitals in the U.S. voluntarily participate in the NDNQI®. Following standard guidelines, hospitals collect monthly data on structure, process, and outcome indicators of inpatient falls and injurious falls and submit the data quarterly through a secure website (NDNQI®, 2014a). The nursing quality indicators such as falls and injurious falls in NDNQI® are National Quality Forum (NQF) endorsed measures that have demonstrated strong reliability and validity (Garrad, Boyle, Simon, Dunton & Gajewski; 2014; NQF, 2015).

Only adult (≥ 18 years) patients who had any fall event during the study period were selected for this study, and then patient-level fall data were aggregated to the unit level. This study was restricted to medical, surgical, medical-surgical, and step-down units in acute care hospitals, while excluding critical care, labor and delivery, and post-partum units. NDNQI® monthly data were aggregated into annual data at the unit level or hospital level. The final sample included 2,229 units (medical = 587, surgical = 412, medical-surgical = 795, and stepdown = 435) in 488 hospitals. This study was approved for non-human subject determination from the Human Subjects Committee at a Midwestern academic medical center.

Measures

Injurious falls. The annual total number of injurious falls among all inpatient falls at the unit level was the outcome variable. NDNQI® defines a fall as "sudden, unintentional descent, with or without injury to the patient, that results in the patient coming to rest on the floor, on or against some other surface (e.g., a counter), on another person, or on an object (e.g., a trash can) (NDNQI®, 2014b, p.2)". Injurious falls are falls with any injuries from minor to death (NDNQI®, 2014b).

Structure, process and patient factors. Independent variables included structure, process and patient factors. Structure factors had two levels: hospital and unit. Hospital characteristics were categorized into hospital bed size (small: <100 [coded as "0"], medium: ≥100 to <300 [coded as "1"], large: ≥300 [coded as "2"]), teaching status (teaching [coded as "1"] and non-teaching [coded as "0"]), Magnet® status (Magnet® [coded as "1"] and non-Magnet® [coded as "0"]). Unit structure factors included unit types (i.e., medical, surgical, medical-surgical, and stepdown) and nurse staffing factors. Nurse staffing on the unit consisted of five continuous variables: total nursing hours per patient day (TNHPPD), RN hours per patient day (RNHPPD), non-RNHPPD (calculated by subtracting RNHPPD from TNHPPD), RN skill mix, and RN turnover rate.

The following process and patient factors reported by NDNQI® for each inpatient fall were first coded into dichotomous variables from monthly data files and then aggregated and summered across months into annual data at the unit level that represent the proportions of certain characteristics among patients who fell in the units. Fall risk assessment was measured by whether a fall risk assessment was performed on the patient prior to the fall ("yes, assessed" coded as "0"; "not assessed or no documentation" coded as "1"). Implementing fall prevention protocol was measured by whether a documented fall prevention protocol had been implemented prior to the fall ("yes, implemented" coded as "0"; "not implemented" coded as "1"). Falls with employee assistance were defined as falls in which "any staff member (whether a nursing service employee or not) was with the patient and attempted to minimize the impact of the fall by slowing the patient's descent (NDNQI®, 2014b, p.3)". Falls with employee assistance were coded as "0" and falls without employee assistance were coded as "1". Physical restraint(s) use was measured with any physical restraints that were in use at the time of patient fall ("yes, used"

coded as “1”; “not used” coded as “0”) (NDNQI®, 2014b). Patient gender was reported as either male (coded as “1”) or female (coded as “0”). Patient fall risk status was determined based on the most recent risk assessment (“no risk” coded as “0” or “yes, at risk” coded as “1”). These proportional data were multiplied by 10 to get a 10 percentage points changes at the unit level to make the data more clinically meaningful.

Data Analyses

All statistical analyses were conducted with STATA® 14 (StataCorp, 2015). Both descriptive and regression analyses were performed. Prior to the regression analyses, correlation and interaction tests were carried out to examine the correlations and interactions among independent variables. Due to strong correlations between RNHPPD and TNHPPD (r = 0.81), RNHPPD and RN Skill Mix (r = 0.53), only RNHPPD, non-RNHPPD, and turnover rate among nursing staffing factors were included in the models for analyses due to concern of multicollinearity. A quadratic term of RNHPPD also was included in the models to test the potential nonlinear relationship between injurious fall rates and RNHPPD.

The hierarchical negative binominal regression model was used to account for the complex sample with multiple units within hospitals (Rabe-Hesketh & Skrondal, 2012). The hierarchical negative binominal regression model was chosen based on the characteristics of the outcome variable-the number of injurious falls among all falls. Because the rate of injurious falls is very low, we can approximate the distribution of injurious falls using a Poisson regression model with the total number of falls as the exposure. However, the descriptive analysis of the outcome variable showed that the variance of total count of injurious falls was much larger than the mean of total count of injurious falls, which indicates over-dispersion of the variable, for which negative-binomial models are preferred (Rabe-Hesketh & Skrondal, 2012). Considering

the multilevel data structure and the over-dispersion issue, the hierarchical negative binominal regression model was selected. In the regression model, the annual count of total injurious falls at the unit level was the outcome measure with the annual count of total falls at the unit level as the exposure variable. Falls with missing data on one or more variables were excluded. In addition to the fixed effects of independent variables, a random hospital intercept was included in the model to control for the correlation among units within a hospital. The STATA procedure *menbreg* for multilevel data was used for modeling with the significance level set at 0.05. The incidence rate ratios (*IRR*s) were estimated to show the associations of independent variables with the injurious fall rate. These *IRR*s also can be interpreted as odds ratios because of the low rates of injurious falls among falls.

For model selection, a teardown method was used. The initial model included all 17 predictor variables. Variables within a group (i.e., structure, process, nurse staffing, and unit type) with large *p* values were removed ($p > .05$) and the resulting reduced model was tested and compared to the previous model. Using the Akaike information criterion (AIC) value as a criterion, multiple models were tested and the final model included six significant predictor variables with the smallest AIC value.

Results

Descriptive Analysis

The frequencies and descriptive statistics are shown in Table 3-1. Hospitals with medium bed size or teaching status accounted for about one half of the sample while Magnet® hospitals were about 20% of the sample. Medical-surgical units (35.7%) accounted for the most units included in sample of 2,229 units. There were on average 78.9 reported falls (*range* = 1-864) and 5.2 injurious falls (*range* = 1-31) annually across the units during the study period. The

average patient days was 17.11 ranging from 0.357-110.24 (unit: 1000 patient days). RNHPPD on average was 6.28 with a range of 1.15 to 14.96.

Table 3-1.

Frequencies and Descriptive Statistics

Frequencies		
Variable	***n***	**%**
Hospitals (n= 488)		
Bed Size		
Small (<100beds)	134	27.5
Medium (≥100<300 beds)	256	52.5
Large (≥300beds)	98	20.0
Teaching Status		
Teaching	215	44.1
Non-teaching	273	55.9
Magnet® Status		
Magnet®	97	19.9
Non-Magnet®	391	80.1
Units (*n* = 2,229)		
Medical	587	26.3
Surgical	412	18.5
Medical-Surgical	795	35.7
Stepdown	435	19.5

Descriptive Statistics (*n* = 2,229 units)			
Variable	***M***	***SD***	**Range**
Annual Number of Unit Falls	78.91	90.03	1-864
Annual Number of Unit Injurious Falls	5.2	4.07	1-31
Patient Days (1000 days)	17.11	14.67	0.357-110.24
TNHPPD	9.12	1.99	1.46-18.95
RNHPPD	6.28	1.63	1.15-14.96
RN Skills Mix (%)	68.96	9.85	18.26-100
Annual RN/APRN Turn Over Rate (%)	3.85	5.21	0-90.05
Gender (male)*	0.52	0.19	0-1
At Fall Risk*	0.84	0.19	0-1
No Fall Risk Assessment*	0.02	0.06	0-0.59
No Fall Protocol in Place*	0.09	0.15	0-1
Restraints in Use*	0.02	0.07	0-1
Falls Without Employee Assistance*	0.86	0.13	0-1

Note. M = mean; *SD* = standard deviation; TNHPPD = total nursing hours per patient day; RN = Registered nurse; RNHPPD = RN hours per patient day; RN Skill Mix = percentage of total RN hours of total nursing hours. *Variable is a proportion.

Hierarchical Regression Analysis

Hierarchical regression modeling was used to estimate the associations between predicator variables and the injurious fall rate. Table 3-2 lists incident rate ratio (*IRR*) values with 95% confidential intervals (*CI*s) and *p* values for different variables included in the initial and final models.

Table 3-2.

Estimates from the Multilevel Negative Binominal Regressions

	Initial Model ***AIC*$^{+}$=9368.685**		**Final Model** ***AIC*=9351.538**	
Fixed Effects	***IRR* (95% *CI*s)**	***p***	***IRR* (95% *CI*s)**	***p***
Bed Size (large vs)				
Small	1.10 (0.95 -1.26)	0.205	-	-
Medium	1.04 (0.94-1.15)	0.412	-	-
Teaching	0.88 (0.81-0.96)	**0.004**	0.87 (0.80-0.94)	**0.001**
Magnet® ®	1.00 (0.91-1.11)	0.942	-	-
Unit Type (Medical vs)				
Surgical	1.07 (0.99 -1.16)	0.066	1.08 (1.01-1.16)[a]	**0.021**
Medical-Surgical	0.97 (0.91-1.04)	0.424	-	
Stepdown	0.98 (0.90-1.06)	0.576	-	-
RNHPPD	0.86 (0.78-0.95)	0.002	0.86 (0.78-0.95)	**0.002**
RNHPPD2	1.01 (1.01-1.02)	**<0.001**	1.01 (1.01-1.02)	**<0.001**
Non-RNHPPD	1.00 (0.97-1.04)	0.788	-	-
Turnover	0.99 (0.99-1.00)	0.211	-	-
Annual Patient Days (1000 days)	0.98 (0.99-1.00)	**<0.001**	0.98 (0.98-0.982)	**<0.001**
Male Gender[b]	1.00 (0.98-1.02)	0.905	-	-
At Fall Risk[b]	0.978 (0.96-0.99)	**0.033**	0.975 (0.96-0.99)	**0.009**
No Risk Assessment[b]	1.00 (0.95-1.06)	0.865	-	-
No Fall Protocol Implementation[b]	1.01 (0.98-1.03)	0.561	-	-
Restraint in Use[b]	1.02 (0.96-1.07)	0.525	-	-
Falls without Employee Assistance[b]	1.04 (1.01-1.07)	**0.005**	1.04 (1.01-1.07)	**0.005**
Random Effects	***SD* (95% CIs)**	**95% Range of Variation**	***SD* (95% *CI*s)**	**95% Range of Variation**
Hospital Level	0.11(0.087-0.139)	(0.81-1.24)	0.11(0.088-0.140)	(0.81-1.24)

Note. IRR = incidence rate ratio; *CI*= confidence interval; *SD* = standard deviation; 95% Range of Variation = [exp (-1.96SD), exp (1.96SD)]; TNHPPD = total nursing hours per patient day; RN = Registered nurse; RNHPPD = RN hours per patient day. [a] Surgical units versus all other units. [b] This variable is a proportion. The IRR is estimated for every10 percentage points increase in the variable for better interpretation. +AIC (Akaike information criterion) is a model selection criterion with a smaller value indicating a better model fit.

Hospital characteristics. Among hospital structure characteristics, teaching status was the only significant variable. Compared to falls in non-teaching hospitals, falls in teaching hospitals were 13% less likely to be injurious falls (p = .001). There was no difference between

Magnet® and non-Magnet® hospitals regarding injurious fall rates. There was no significant difference in injurious fall rates among hospitals with different bed sizes.

Unit characteristics. Falls on surgical units were 8% more likely to be injurious falls than those in other units ($p = .021$). RNHPPD was the only significant variable among nurse staffing factors. No significant differences were found in Non-RNHPPD and turnover rate on injurious fall rates. In the final hierarchical regression model, RNHPPD showed a significant nonlinear relationship with injurious falls. Further model analysis using a quadratic term of RNHPPD suggested a significant non-linear relationship between injurious fall rates and RNHPPD ($p < .001$) for the quadratic term of RNHPPD. Based on the estimated coefficients of linear and quadratic terms of RNHPPD, the injurious fall risk was estimated to be lowest at 5.08 RNHPPD. With all the other independent variables controlled, the injurious fall risk was expected to decrease with increasing RNHPPD till RNHPPD reached 5.08. After RNHPPD reached 5.08, the expected injurious fall risk increased with increased RNHPPD. Figure 3-2 shows the relationships between injurious fall risk and RNHPPD based on models estimated for the four different unit types, separately. This figure shows the consistent non-linear association across different unit types except for medical units. The variable, 1000 patient days, also was identified to be a significant factor: with every one thousand day increase in patient days, there likely was a 2% decrease in injurious fall risk ($p <0.001$).

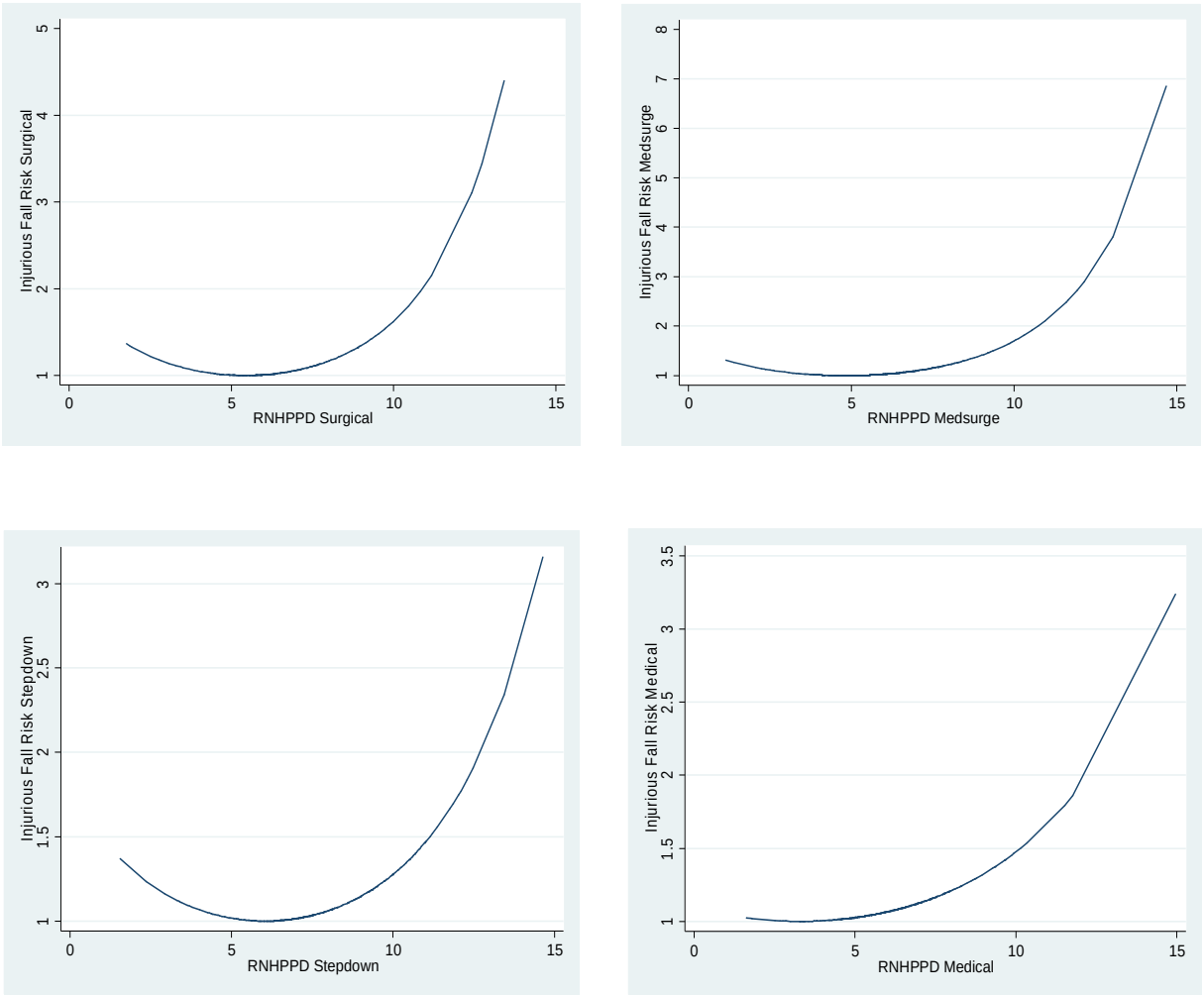

Figure 3-2. Relationships between Injurious Fall Risk and RNHPPD Based on Unit Types

Note: The risk level is incidence risk ratios (*IRRs*). These plots are rescaled so that *IRR*=1 at the nadir of each plot.

Nursing process factors. Among nursing process factors, falls without employee assistance was the only significant factor. At the unit level, the risk of injurious falls was expected to increase by 4% when the percent of falls without employee assistance increased by 10 percentage points ($p = 0.005$). In addition, the risk of injurious falls was expected to decrease by 2.5% when the percent of patients at fall risk increased by 10 percentage points on the units ($p = 0.009$).

In addition to fixed effects, the random effect of the model also was estimated for the hospital level. The injurious fall rates for an individual hospital might vary from 19% lower to 24% higher than the average injurious fall rate of all hospitals, assuming all other variables are fixed.

Discussion

The major contribution of the study is the examination of the associations between injurious falls and multilevel factors using the most recently available NDNQI® data (2013-2014). The multilevel factors included in this study were hospital and unit characteristics as well unit-level patient characteristics. One unique aspect is that the study focused on injurious fall rates among only those adult inpatients with falls while previous studies examined falls or injurious fall rates among all inpatients. Given this unique aspect of this study, the results may not be comparable to findings from previous studies although previous findings could provide some meaningful background information.

In this study, falls in teaching hospitals were 13% less likely to be injurious falls. Although no previous studies have focused on injurious falls among adult inpatient falls, the findings from a study examining injurious falls among adult inpatients suggested that patients tended to have less injurious falls in teaching hospitals (Staggs, et al., 2014). In teaching hospitals, quality of care and patient safety, often are institutional priorities. And the organizational culture emphasizes quality and safety (Pingleton, Davis, & Dickler, 2010). In addition, teaching hospitals often have positive work environments compared to non-teaching hospitals (Hall, Doran, Sidani, & Pink, 2006); this also contributes to better quality of patient care. Nurses in teaching hospitals report higher perceptions of the quality of work, quality of care, work environment, nursing leadership and job satisfaction than those in non-teaching

hospitals (Hall et al., 2006). Evidences show that hospitals with better work environments have better quality of care and patient outcomes (Aiken et al., 2011; Aiken et al., 2012). This was validated in this study with the low occurrence of injurious falls (*IRR*= 0.87, $p = 0.001$) in teaching hospitals. This finding has important clinical implication. To decrease injurious falls and increase patient care quality, hospital and nursing leadership can develop strategies to emphasize quality and safety, promote positive work environment, and increase nurse job satisfaction.

Interestingly, Magnet® status was not associated with injurious falls among inpatient falls in this study. In the literature (Bouldin et al., 2013), Magnet® hospitals were found to have less injurious falls among adult inpatients than non-Magnet® hospitals while findings of the associations between falls and Magnet® status were inconclusive. Some researchers found Magnet® hospitals have lower fall rates compared to non- Magnet® hospitals (Dunton et al., 2007; Lake, Shang, Klaus, & Dunton, 2010), while other researchers found no significant association between fall rates and Magnet® status (He, Dunton, & Staggs, 2012). Findings from previous studies reported a significant negative relationship between hospital size and injurious fall rates among all adult inpatients (Dunton et al., 2004; Staggs et al., 2014). However, in this study the association was non-significant between hospital size and injurious fall rates among inpatients with falls. Because the results from this study are not comparable to findings from other studies on injurious falls due to different samples (i.e., all adult inpatients versus inpatients with falls) and the inconclusive findings on the associations between hospital Magnet® status as well as bed size, more research is needed to explore the associations.

Several significant unit factors were associated with injurious inpatient falls. These factors included unit type and unit staffing rates (i.e., RNHPPD). In previous studies on injurious

falls among adult inpatients, medical units were found to have the highest injurious fall rates (Bouldin et al, 2013; Staggs et al., 2014). The findings from this study indicated that falls on surgical units were 8% more likely to be injurious falls compared to those on medical units. Although no similar findings could be identified in the literature, a longitudinal study of the trends in inpatient fall rates in acute care hospitals reported that surgical units had increased fall rates from 2004 to 2009 (He et al., 2012). The increased fall and injurious fall rates in surgical units might be associated with the outcomes of the Enhanced Recovery After Surgery (ERAS) programs implemented in acute care hospitals. During the last decades, the ERAS programs that aimed at an early patient recovery following surgery have been widely implemented in acute care hospitals (Feldman, Lee, & Flore, 2015). In the ERAS programs, patients usually start early post-operative mobilization and have a shorter length of stay than those in traditional operative programs (Feldman et al., 2015; Watson, 2015). Early post-operative mobilization can cause orthostatic intolerance (OI), which is common in surgical patients (Bundgaard-Nielsen et al., 2009; Jans, Bundgaard-Nielsen, Solgaard, Johansson, & Kehlet, 2013). OI further can lead to falls or fall-associated injuries (Jans et al., 2013). Further research on injurious falls should be conducted on surgical units through comparing injurious fall rates in units implementing ERAS programs with those without ERAS programs.

In our findings, unit RNHPPD was the only significant predictor among nurse staffing factors although the association between RNHPPD and injurious falls was non-linear. To date, this study was the second study that examined the association between injurious fall rates and RNHPPD although the focus of this study was different from the previous study: this study focused on the injurious fall rate of inpatient falls while the previous study examined injurious fall rate among all inpatients (Dunton et al., 2004). The association between RNHPPD and

injurious falls was non-linear regardless of unit types. Upon further examination, there were negative relationships between injurious fall rates and RNHPPD for up to five RNHPPD; the relationships became positive after RNHPPD reached five. Dunton and colleagues (2004) identified similar non-linear associations between injurious fall rates among inpatients and TNHPPD for medical units and RN skill mix for stepdown units with a changing point at 9. In other studies, researchers found negative associations between fall rates with TNHPPD and RN skill mix (He et al., 2012) or RNHPPD (Lake et al., 2010).

The different findings on the associations between nurse staffing and injurious fall rates and general fall rates might be due to the differences in the outcome variables of the studies. In this study, the primary outcome was injurious fall rates from those patients who had a general fall while other studies focused just on general falls. The non-linear relationship between injurious fall rates and RNHPPD also may be related indirectly to patient acuity levels. In last decades, many hospitals have implemented Acuity Adaptable Model (AAM) or Universal Bed Model (UBM) in delivering patient care (Emaminia et al., 2012; Hennon, Kothari, Maloney, & Weigel, 2011; Venditti, 2015). In the AAM, post-cardiac or pulmonary surgical patients are admitted from ICU or a stepdown level of care through discharge and nurse staffing levels are based on patient acuity levels. Upon admission, the patient stays in one single room for the entire hospital stay without being transferred to medical, surgical or medical-surgical units (Gallant & Lanning, 2001; Venditti, 2015). In general, these patients are at higher acuity level and require higher nurse staffing levels (Hennon et al., 2011). As discussed earlier, post-operative patients often start ambulation earlier, which can place them at a higher risk for falls. It is uncertain how many units in this study have implemented the AAM. Thus, the researchers

cannot draw the conclusion that the non-linear association between injurious fall rates and RNHPPD was due to different patient acuity levels.

The non-linear association between injurious falls and RNHPPD calls for appropriate RN staffing in acute care settings. Nurse managers need to ensure adequate RN staffing especially at the lower levels of RNHPPD (i.e. up to 5.08 hours) because RN understaffing can place patients at high risk for injurious falls. Nurse managers need to be cognizant of patient acuity levels to ensure adequate RN staffing. Further research is needed to include patient acuity levels in exploring the association between RNHPPD and injurious fall rates.

Among nursing process factors, falls without employee assistance was a significant factor contributing to injurious falls. This finding is consistent with the findings from previous studies (Krauss et al., 2007; Staggs et al, 2014). In a recent study of unassisted inpatient falls, Staggs and colleagues (2014) found that falls without employee assistance were 59% more likely to result in injuries than falls with employee assistance. Similarly, the findings from a study comparing inpatient falls and injurious falls between teaching and non-teaching hospitals suggested that unassisted falls were significantly associated with increased injuries resulting from falls in both teaching and non-teaching hospitals (Krauss et al., 2007). This finding has significant clinical implications. In patient care, nursing staff need to monitor patients closely and provide assistance as needed given the association between unassisted falls and injurious falls. More RN staff are needed to ensure patient safety.

One important finding from this study was that the risk of injurious falls was expected to decrease by 2.5% when the percent of patients at fall risk increases by 10 percentage points on the units. This finding indicates the importance of nurses conducting fall risk assessment for all inpatients and implementing fall protocols. Although the associations between injurious falls

and fall risk assessment and fall protocol implementation were not significant, falls without prior fall risk assessment or fall protocol implementation more likely tended to be injurious falls. Similarly, in a study of predicators of fracture from inpatient falls, Chari and colleagues (2013) found that patients were less likely to have fractures from falls if they were assessed for fall risk upon admission. When patients were identified at fall risk from the assessment, nurses become more aware of the patient's fall risk and implement a fall prevention protocol. A previous study also revealed that fall prevention protocol implementation was significantly associated with increased assisted falls (Staggs et al., 2014). This has significant clinical implication since unassisted falls are more likely to result in injuries.

Study Limitations

The limitations of the study are similar to the limitations of conducting secondary data analyses. The generalizability of the study findings may be limited because NDNQI® participating hospitals have characteristics different from those non-participating hospitals. NDNQI® hospitals are mainly not-for-profit hospitals with more, large Magnet® hospitals (Dunton et al., 2007) compared to non-participating hospitals. In addition, the intra-rater reliability might be impacted since the NDNQI® data are self-reported by participating hospitals.

Another limitation is that findings may be not be generalizable to all adult patients hospitalized because the study sample only included adult patients who had a fall while hospitalized. This could be a limitation because patients might have been identified at high risk for falls but did not necessarily fall. In addition, the study did not exclude repeat falls. One patient may have multiple falls during the hospital stay but the data obtained from NDNQI® did not contain information on repeat falls. Due to the large volume of missing data for age, it was not included in the analysis. Because previous studies have identified advanced age as a

significant risk factor for injurious falls (Chari et al., 2013; Krauss et al., 2007; Williams et al.,2014; Zhao & Kim, 2015), age should be included as a predictor factor in future research.

Conclusions

This study examined the associations between injurious falls and multilevel structure, process and patient factors in acute care hospitals. Several hospital (i.e., teaching status) and unit (i.e. surgical) organizational factors as well as nurse staffing (i.e., RNHPPD) and process factors (i.e., fall risk, unassisted falls) were identified as significant factors contributing to injurious falls. The study findings have important implications for clinical practice and future research. Researchers need to further examine the impact of multilevel factors on injurious falls. Hospital administrators and nurse managers should consider nurse staffing and process factors when planning and implementing fall prevention programs.

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Chapter 4

Are Hospital Falls and Injurious Falls Preventable?

This manuscript will be submitted to *Nurse Leader* and presents clinical and policy implications of the major study. The authors for this manuscript include: Yunchuan Zhao, Marjorie Bott, Jianghua He, Heejung Kim, Shin Hye Park and Nancy Dunton.

Abstract

Background: Falls and injurious falls are a major safety concern for patient care in acute care hospitals. Inpatient falls and injurious falls can cause extra financial burden to patients, families and healthcare facilities.

Factors Associated with Falls and Injurious Falls: Known factors associated with falls and injurious falls include intrinsic factors (i.e., patient age, gender and certain medical conditions) and extrinsic factors, such as hospital and unit organizational characteristics (i.e., hospital teaching status, unit type, and unit staffing) and nursing process factors (i.e., fall risk assessment, fall prevention protocol, and employee assistance).

Fall Prevention Interventions: Common fall prevention interventions can be categorized into environmental, educational, communicational and nursing process. The major challenges in fall prevention fall into three areas: fall risk assessment, fall prevention components, and fall intervention implementation and adherence.

Clinical Implications and Recommendations: Nurse administrators and managers need to provide strong leadership support, develop appropriate fall prevention programs based on effective fall prevention interventions with the consideration of risk factors for falls and injurious falls, and enhance intervention implementation and adherence. Staff education on fall prevention, staff engagement in fall prevention development and implementation strategies, and appropriate nurse staffing are essential for successful fall prevention implementation and adherence.

Key Words: falls, injurious falls, risk factors, fall prevention interventions, acute care hospitals, nursing leadership.

Introduction

The problem of inpatient falls and injurious falls in acute care hospitals has been a serious safety concern for patient care. In acute care hospitals, inpatient falls are the most common incidents reported by nurses and other healthcare team members (Anderson, Boshier, & Hanna, 2012; Cameron et al., 2012; National Patient Safety Agency [NPSA], 2007; Oliver, Healey, & Haines, 2010). In the United States (U.S.), the average fall rate is about three to five falls per 1000 patient days with approximately one million annual falls in hospitals. Falls during hospitalization can have numerous negative consequences to patients and families, including fear of falling, depression, injuries, reduced mobility and functional ability, and decreased independent living and quality of life (Chung et al., 2009, Oliver et al. 2010). Furthermore, nursing care quality and patient satisfaction also can be impacted negatively (Oliver et al., 2010).

Injuries resulting from inpatient falls can cause extra financial burden and decreased revenue to healthcare facilities. On average, injurious falls lead to an increased length of hospital stay by six to twelve days with an additional cost of $13,316 (Wong et al., 2011). Since the Centers for Medicare and Medicaid Services (CMS) no longer reimburse hospitals for treatment of preventable injuries, including fall-related injuries (CMS, 2008), not only will hospital pay the extra cost for these fall-related injuries, hospitals also will sustain a big loss in revenue.

Falls and falls-related injuries are listed as one of the major nursing-sensitive care outcome measures by the National Quality Forum (NQF) (2004). It is essential to prevent inpatient falls and related injuries so as to improve nursing care quality. To improve nursing care quality, nurse leaders in acute care hospitals need to have the knowledge of: (a) specific risk factors associated with inpatient falls and injurious falls, (b) common fall prevention interventions, and (c) potential strategies for effective fall and injurious fall prevention in acute

care hospitals. The information presented below will assist nurse leaders to develop organizational policies and programs that aim at effective fall and injurious fall prevention.

Factors Associated with Falls and Injurious Falls

Evidence shows that inpatient falls and injurious falls are a complicated phenomenon that involves multiple factors, including intrinsic and extrinsic factors (Oliver et al., 2010; Zhao & Kim, 2015; Zhao et al., 2016). Intrinsic factors are patient-specific factors such as age, gender, and medical conditions (Oliver et al., 2010; Zhao & Kim, 2015). Extrinsic factors include hospital organizational factors such as hospital teaching status, unit types, nurse staffing and nursing process factors such as fall risk assessment and fall prevention protocols (Oliver et al., 2010; Zhao et al., 2016).

Intrinsic Factors

Sufficient evidence demonstrates the association between advanced age and inpatient falls and injurious falls (Brand & Sundararajan, 2010; Chari, McRae, Varghese, Ferrar, & Haines, 2013; Krauss et al.; 2007; Mion et al., 2012; William, Szekendi, & Thomas, 2014). Among inpatient falls, about 50% occur in patients 60 years and older while patients over 80 years old are significantly at high risk for falls and injurious falls (Brand & Sundararajan, 2010; Mion et al., 2012; William et al., 2014). Interestingly, the evidence on the relationship between gender and falls is inclusive because both male and female are identified as a risk factor for falls or injurious falls in previous studies (Brand & Sundararaja, 2010; Chari et al., 2013; Krauss et al, 2007; Neumann, Hoffmann, Golgert, Hasford, & von Renteln-Kruse, 2013; William et al., 2014) or no association is identified at all (Zhao et al., 2016). Certain medical conditions such as cognitive impairment, impaired mobility, hypertension and stroke also are known risk factors for falls or injurious falls (Brand & Sundararajan, 2010; Neumann et al., 2013; Zhao & Kim, 2015).

Extrinsic Factors

Hospital and unit organizational characteristics also are found to be associated with patient falls and injurious falls. Teaching hospitals in general have less falls and injurious falls (Staggs, Mion, & Shorr, 2014; Zhao et al., 2016). According to recent studies, surgical units have an increasing rate of falls or injurious falls (He, Dunton, & Staggs, 2012; Zhao et al., 2016) although previous studies suggested that medical units had the highest rates of falls and injurious falls (Bouldin et al, 2013; Staggs et al., 2014). The association between nurse staffing levels (i.e., total nursing hours per patient day [TNHPPD], registered nurse hours per patient day [RNHPPD], and proportion of RN hours) and the rate of injurious falls is complicated. Before the nurse staffing reaches a certain level, the rate of falls or injurious falls is higher with lower staffing, and after that level is reached, the rate of falls or injurious falls is higher as the relationship becomes opposite (Dunton, Gajewski, Taunton, & Moore, 2004; Zhao et al., 2016).

Several nursing process factors significantly contributing to falls and injurious falls require attention from nurse administrators and managers. Studies indicate that falls without employee assistance are more likely to result in injuries than falls with employee assistance (Chari et al., 2013; Krauss et al., 2007; Staggs et al., 2014; Zhao et al., 2016). Fall risk assessment and fall prevention protocols are two important nursing process factors in preventing falls and injurious falls (Chari et al., 2013; Staggs et al., 2014). Patients who are identified at risk for falls through fall risk assessment are less likely to have injurious falls (Zhao et al., 2016). In clinical practice, nurses often initiate a fall prevention protocol to patients identified at fall risk. With a fall prevention protocol implemented, falls are more likely to be assisted by employees, which can reduce fall-related injuries (Staggs et al., 2014; Zhao et al., 2016).

Fall Prevention Interventions

Existing Fall Prevention Interventions

In last decades, many fall prevention interventions have been developed and implemented in acute care hospitals. Based on the characteristics of intervention components, fall prevention interventions can be categorized into: (a) environmental, (b) educational, (c) communicational or (d) nursing process interventions (Cameron et al., 2012; Hempel et al., 2013; Oliver et al., 2010).

Environmental interventions. Environmental interventions focus on the efforts to create a clutter-free, safe environment (Cameron et al., 2012; Oliver et al., 2010). Specifically, environmental interventions include modifying the hospital environment with vinyl flooring (Cameron et al., 2012; Donald, Pitt, Armstrong, & Shuttleworth, 2000) and ensuring the patient bed is in low position (Haines, Bell, & Varghese, 2010). Modifying the hospital environment with vinyl flooring helps prevent falls as hospital units with carpeted floors have increased fall rates compared to units with vinyl floors (Cameron et al., 2012; Donald et al., 2000). However, lowering hospital beds shows no significant effect in preventing inpatient falls (Haines et al., 2010; Oliver et al., 2010).

Educational interventions. Staff and patient education on fall prevention are two major components of educational interventions (Cameron et al., 2012; Hempel et al., 2013). Staff education often is used to raise staff awareness of fall prevention or provide training for fall risk assessment tools (Cameron et al., 2012; Oliver et al., 2010). Patient education programs aim to improve patient knowledge of: (a) fall prevalence and consequences, (b) causes of falls, and (c) hospital fall prevention strategies along with preventing patient falls through patient self-reflection of individual risk and a goal setting review (Ang, Mordiffi, & Wong, 2011; Haines et al., 2011). Evidence shows that staff or patient education as a single intervention strategy has

been effective in preventing inpatients falls and injurious falls (Cameron et al., 2012; Oliver et al., 2010).

Communicational interventions. Communicational interventions use visual alert signs, verbal communications, or electronic alarm systems to assist fall prevention. Visual signs—yellow wristband on high fall risk patients, fall risk signs on doors of patient rooms and patient medical records—alert staff to the patients at high risk for falling (Cameron et al., 2012; Hempel et al., 2013; Oliver et al., 2010). Electronic bed or chair exit alarm systems alert staff to the movement of high fall risk patients so that the staff can provide assistance to patients for their activities (Hempel et al., 2013; Oliver et al., 2010). Awareness posters (i.e., call don't fall, keep calm) remind the patient to call staff for help to prevent falls (Cameron et al., 2012; Hempel et al., 2013). These communicational interventions often are used in combination with other fall prevention strategies (Hempel et al., 2013; Miake-Lye, Hempel, Ganz, & Shekelle, 2013; Oliver et al., 2010). In recent years, a video monitoring system has been utilized in acute care hospitals to prevent patient falls and ensure patient safety, which has shown to be effective in reducing inpatient falls and improving patient safety (Burtson & Vento, 2015; Jeffers et al., 2013).

Nursing process interventions. Nursing process interventions aiming to prevent falls include: fall risk assessment; fall protocol implementation (i.e., care, safety and toileting rounds; and ambulation assistance); and postfall review/evaluations (Hempel et al., 2013; Miake-Lye et al., 2013; Oliver et al., 2010). Fall risk assessment is the most common nursing process intervention (Miake-Lye et al., 2013; Hempel et al., 2013). Fall risk assessment is performed through either a fall assessment tool or nursing judgement (Haines, Hill, Walshe, & Osborne, 2007; Meyer, Kopke, Haastert, & Muhlhauser, 2009).

Based on fall risk assessment, a fall prevention protocol often is implemented on patients identified at high risk for falls. A fall prevention protocol usually consists of patient education, visual alert signs, electronic alert systems, care, safety and toileting rounds and ambulation assistance (Hempel et al., 2013; Oliver et al., 2010). Care, safety and toileting rounds, often referred as hourly rounding, is a common practice in acute care hospitals during which the nursing staff purposely check on the patients at regular intervals to ensure patients receiving the care and assistance as needed (Mitchell, Lavenberg, Trotta, & Umscheid, 2014). As discussed earlier, fall risk assessment and fall prevention protocol implementation can effectively prevent inpatient falls and injurious falls (Chari et al., 2013; Staggs et al., 2014). When used as a single intervention, hourly rounding, a major component in most fall prevention protocols, has proved to be an effective strategy in preventing falls and improving patient satisfaction of nursing care (Hempel et al., 2013; Mitchell et al., 2014). Postfall review or evaluations that have shown some effectiveness in preventing future or recurrent inpatient falls (Gray-Miceli, Ratcliffe, & Johnson, 2010) are used in many hospitals (Hempel et al, 2013; Miake-Lye et al., 2013; Oliver et al., 2010).

Issues in Existing Fall Prevention Interventions

Falls and injurious falls still are prevalent in many U.S. hospitals (Bouldin et al., 2013). Although some fall prevention interventions have been developed and implemented in acute care hospitals, the effectiveness of these prevention interventions vary (Cameron et al., 2012; Hempel et al., 2013; Oliver et al., 2010). In the literature, several major issues that affect the success of hospital fall prevention interventions are identified (Hempel et al., 2013; Miake-Lye et al., 2013; Oliver et al., 2010).

Fall risk assessment. Most fall prevention intervention approaches include fall risk assessment (Miake-Lye et al., 2013; Hempel et al., 2013). Fall risk assessment often is done with an assessment tool or nursing judgement. However, a recent systematic review of hospital fall prevention programs revealed that more than half of the studies used an assessment tool that did not have reported validity and reliability testing (Hempel et al., 2013). Because fall risk assessment is still an important approach for fall prevention, using an assessment tool that does not have reported validity and reliability testing may threaten the accuracy of the assessment (Shadish, Cook, Campbell, 2002).

Fall prevention components. Most fall prevention interventions consist of multiple common components including fall risk assessment, patient and staff education, visual alert signs, and hourly rounding (Hempel et al., 2013; Miake-Lye et al., 2013; Oliver et al., 2010). However, an optimal bundle of intervention components cannot be identified because there has not been strong evidence on what components are most important for successful fall interventions (Miake-Lye et al., 2013). However, multicomponent interventions with different combinations of fall prevention strategies have been effective in hospitals with different sizes, locations, and teaching status (Hempel et al., 2013; Miake-Lye et al., 2013).

Intervention implementation and adherence. The implementation and adherence of fall prevention interventions has been a determining factor in successful fall prevention programs. Without appropriate implementation and adherence, the effectiveness of fall prevention interventions is negatively impacted (Hempel et al., 2013; Miake-Lye et al., 2013). Major challenges in the implementation and adherence of fall prevention interventions include poor organizational prioritization of fall prevention, nihilistic staff attitude toward fall prevention, and poor compliance with existing fall prevention protocols (Capan & Lynch, 2007;

Gutierrez & Smith, 2008; Kolin, Minnier, Hale, Martin, & Thompson, 2010; Weinberg et al., 2011).

Clinical Implications and Recommendations

Existing evidence suggests that inpatient falls and injurious falls are complicated. Therefore, preventing falls and injurious falls is challenging. Nurse administrators and nurse managers need to consider multilevel factors associated with inpatient falls and injurious falls. Based on the evidence on the effectiveness of and issues in the existing fall prevention interventions, the following strategies should be utilized in fall and injurious fall prevention interventions to improve the success of fall prevention interventions.

Provide Strong Leadership Support

Leadership support has been identified as an essential factor for successful fall and injurious falls prevention in acute care hospitals in several systematic reviews of inpatient fall prevention programs (Hempel et al., 2013; Miake-Lye et al., 2013). Strong leadership support of fall prevention is one common characteristic of successful fall prevention programs (Hempel et al., 2013; Miake-Lye et al., 2013). With leadership support, patient safety and fall prevention are established as organizational priorities. A culture of patient safety is emphasized and promoted throughout the hospitals and units (Hempel et al., 2013; Kolin et al., 2010; Miake-Lye et al., 2013; Weinberg et al., 2011). With strong leadership support, hospitals fall prevention interventions have been successful (Hempel et al., 2013; Kolin et al., 2010; Miake-Lye et al., 2013; Weinberg et al., 2011).

Previous studies show that teaching hospitals, in which patient safety and quality of care are institutional priorities (Pingleton, Davis, & Dickler, 2010), have less inpatient falls and injurious falls compared to non-teaching hospitals (Staggs et al., 2014; Zhao et al., 2016). To

prevent inpatient falls and injurious falls successfully, hospital administrators and nurse managers need to set patient safety and quality of care as the organizational priorities and provide strong leadership support to fall prevention interventions.

Develop Appropriate Prevention Programs

Fall risk assessment. Evidence suggests fall prevention interventions are important in preventing falls and injurious falls. Given the known risk factors for inpatient falls and injurious falls (Zhao & Kim, 2015) and the positive impact of fall assessment on fall prevention (Chari et al., 2013; Staggs et al., 2014), all fall prevention programs should begin with an appropriate fall risk assessment. However, when choosing the fall risk assessment tools, hospital administrators and nurse managers need to select fall assessment tools that have established and reported reliability and validity. Because the result of fall risk assessment determines the fall intervention components or the implementation of a fall protocol, it is critical to accurately assess fall risk level of the patient in order to implement appropriate fall prevention interventions (Hempel et al., 2013; Oliver et al., 2010). Without accurate assessment of the patient fall risk level, inappropriate fall prevention interventions can result in avoidable falls or related injuries.

Fall prevention components. Because there is not one identified optimal bundle of fall prevention intervention components (Miake-Lye et al., 2013), nursing leadership needs to consider different patient populations at different hospital units when selecting fall prevention intervention components. For example, research suggests that surgical units have more injurious falls among inpatient falls compared to medical, medical-surgical, and step-down units (Zhao et al., 2016). In acute care hospitals, many surgical units have implemented the Enhanced Recovery After Surgery (ERAS) programs, in which early post-operative mobilization is promoted (Feldman, Lee, & Flore, 2015; Watson, 2015). With early post-operative mobilization,

patients can develop orthostatic intolerance (OI) that further causes falls and injurious falls (Bundgaard-Nielsen et al., 2009; Jans, Bundgaard-Nielsen, Solgaard, Johansson, & Kehlet, 2013). Fall prevention interventions on surgical units need to be focused on providing ambulation assistance by employees given the association between early post-operative mobilization and falls. Hourly rounding to check on toileting needs and provide ambulation assistance also is important for surgical patients due to their high fall risk when ambulating following the surgical procedure. Research shows that falls with employee assistance result in significantly less injurious falls compared to falls without employee assistance (Chari et al., 2013; Krauss et al., 2007; Staggs et al., 2014; Zhao et al., 2016). Therefore, providing employee assistance to patients as needed is a critical method for injurious fall prevention.

Enhance Intervention Implementation and Adherence

To ensure successful fall prevention, nurse leaders must ensure successful fall prevention intervention implementation and adherence. Given the issues of nihilistic attitude and poor compliance with existing fall prevention protocols in intervention implementation and adherence (Capan & Lynch, 2007; Gutierrez & Smith, 2008; Kolin et al., 2010; Weinberg et al., 2011), staff education should be enhanced and staff should be engaged in fall prevention to change staff attitudes and improve intervention implementation and adherence. Staff education on the importance of patient safety and fall prevention has been an effective strategy in changing staff's nihilistic attitude towards fall prevention (Capan & Lynch, 2007; Gutierrez & Smith, 2008). Staff involvement also is a key factor in successful fall prevention interventions. In many successful fall prevention programs, frontline nursing staff are engaged in the intervention design and implementation either as members of the multidisciplinary falls prevention team or the unit champions for fall prevention enhancement (Capan & Lynch, 2007; Gutierrez & Smith, 2008;

Weinberg et al., 2011). The involvement of frontline nursing staff has improved the compliance with fall prevention protocols, enhanced intervention implementation, and increased intervention adherence (Capan & Lynch, 2007; Gutierrez & Smith, 2008; Weinberg et al., 2011). Nursing leadership should engage frontline nursing staff in fall prevention intervention development and implementation to ensure buy-in from staff and successful adoption of the prevention strategies.

In the implementation of fall prevention interventions, nurse staffing is an important factor that nursing leadership needs to consider. Evidence shows that nurse staffing (i.e., TNHPPD, RNHPPD, and proportion of RN hours) is associated with inpatient falls and/or injurious falls (Dunton et al., 2004; He et al., 2010; Lake, Shang, Klaus, & Dunton, 2010; Zhao et al., 2016). Previous studies suggest negative associations between inpatient fall rates with TNHPPD and proportion of RN hours (He et al., 2012; Lake et al., 2010). The relationship between injurious fall rates and TNHPPD, RNHPPD, and proportion of RN hours is complicated. The results of a recent study on injurious fall rates among inpatients who fell showed a non-linear relationship between injurious fall rates and RNHPPD (Zhao et al., 2016). Before RNHPPD reaches a certain level (approximately 5 RNHPPD), as RN hours increased injurious falls decreased. Conversely, after RNHPPD exceeded five as RN hours increased injurious falls also increased (Zhao et al., 2016). Similar non-linear association was identified between injurious fall rates among all patients and TNHPPD or proportion of RN hours (Dunton et al., 2004). Given the non-linear association between injurious fall rates and nurse staffing, nurse leaders need to ensure adequate staffing in patient care. Without adequate staffing, it is challenging for nursing staff to implement appropriate fall prevention interventions to prevent falls and injurious falls.

Conclusions

Inpatient falls and injurious falls in acute care hospitals are a complicated phenomenon that makes falls and injurious falls prevention a challenge for nurse administrators and managers. To ensure prevention interventions for falls and injurious falls are successful, strong leadership with a focus on safety and quality nursing care is needed. Additionally, involving frontline staff in the development and implementation of fall prevention interventions and fall risk assessment is important for buy-in and successful adherence. Other strategies for successful fall prevention intervention adherence are staff education and appropriate nurse staffing. In addition, nurse leaders need to develop fall prevention interventions based on effective intervention strategies with the consideration of known factors associated with inpatient falls and injurious falls.

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Chapter 5

This chapter will include a summary and discussion of the major findings for each of the three manuscripts presented in chapters two through four. Study strengths and limitations are presented along with implications for practice and future research.

Summary

This study examined multilevel factors associated with inpatient injurious falls in acute care hospitals. Using the modified Donabedian Structure–Process–Outcome (SPO) model, the study analyzed one year of the latest available NDNQI® data (2013-2014) through descriptive and hierarchical analyses. Three manuscripts have been developed to present and disseminate the work and findings of the dissertation study. The following summary will discuss the purpose and importance of each manuscript in improving prevention of inpatient falls and injurious falls and promoting better quality of care in acute care hospitals.

Manuscript One

This manuscript presents the findings from a comprehensive, integrated literature review of risk factors for falls among older adult inpatients. "Older Adult Inpatient Falls in Acute Care Hospitals: Intrinsic, Extrinsic, and Environmental Factors" has been published in the *Journal of Gerontological Nursing.* The publication summarizes intrinsic, extrinsic and environmental/situational factors identified in the literature that contribute to older adult inpatient falls. Major consequences of inpatient falls also are discussed in the article.

Inpatient falls are a serious safety concern for patient care. The National Quality Forum (NQF) (2004) has listed falls and injurious falls as the major nursing-sensitive care outcome measures. Fall and injurious fall prevention is a major goal of several national initiatives (Centers for Medicare and Medicaid Services [CMS], 2008; U.S. Department of Health and

Human Services [USDHHS], 2010). Understanding the risk factors for inpatient falls is essential for effective fall prevention program development and implementation. This publication provides solid background about risk factors for inpatient falls, identifies major gaps in the literature, and offers implications for future research in the field of inpatient fall prevention.

Manuscript Two

Findings from the dissertation study are presented in this manuscript. The study is a descriptive and hierarchical regression analyses that uses one year of latest available NDNQI® data (2013-2014) related to adult inpatient falls. Based on the gaps identified in the literature, the study aims to explore multilevel factors associated with injurious falls in acute care hospitals. The manuscript, "Multilevel Factors Associated with Injurious Falls in Acute Care Hospitals", will be submitted to the *Journal of Nursing Care Quality*, a prominent journal for nursing care quality. Multilevel factors that were associated with injurious falls among inpatient falls included hospital (i.e., teaching status) and unit organizational characteristics (i.e., nurse staffing and unit type), unit nursing process factors (i.e., falls without employee assistance) and unit patient population characteristics (i.e., fall risk status).

The findings of the study add an important contribution to the fall prevention literature. Among those inpatients who experienced a fall, these findings provide further understanding of factors related to injurious falls in acute care hospitals. The findings may assist frontline nursing staff and hospital nurse leaders in developing and implementing effective injurious fall prevention programs addressing specific factors associated with injurious falls. The findings also suggest further implication for future research in hospital falls, especially injurious falls prevention.

Manuscript Three

This manuscript presents clinical implications and recommendations to hospital administrators and nurse leaders regarding fall and injurious fall prevention interventions in acute care hospitals. "Are Hospital Falls and Injurious Falls Preventable?" will be submitted to *Nurse Leader*, a journal for nurses in leadership position. The purpose of this manuscript is to provide nursing leadership suggestions and recommendations for developing and implementing effective fall prevention interventions.

The manuscript first summarizes known risk factors for inpatient falls and injurious falls. In addition, the effectiveness of and issues in existing hospital fall prevention interventions are reviewed. Based on the findings from the study presented in manuscript two, the manuscript offers suggestions on how to improve fall prevention interventions through strong leadership support, appropriate fall prevention interventions, and enhanced intervention implementation and adherence. These suggestions are developed based on the known risk factors for inpatient falls and effectiveness of and issues in current fall prevention interventions. Thus, these suggestions may guide hospital administrators and nurse managers in planning and implementing effective and cost-reducing preventions for falls and injurious falls in acute care hospitals.

Discussion

Multilevel factors including hospital structure characteristics, unit structure and process factors, and patient characteristics are found to be associated with inpatient falls and injurious falls in acute care hospitals. The integrative literature review identified intrinsic, extrinsic and environmental/situational risk factors for inpatient falls and injurious falls. Among patient level intrinsic factors, advanced age was a major significant risk factor for inpatient falls and injurious falls. Some medical conditions (i.e., cognitive impairment, impaired mobility or stroke) and

non-medical conditions (i.e., prolonged length of hospital stay, previous fall history) also were significant factors. Extrinsic factors included geriatric units and shift change periods. Environment/situational factors also contributed to inpatient falls. The majority of falls occurred while patients were ambulating in their rooms, toileting in bathrooms or transferring between beds and wheelchairs/chairs (Zhao & Kim, 2015). Identification of risk factors from this review guided selection of variables for the dissertation study to the extent they were available in the NDNQI® database.

The hierarchical regression analyses of NDNQI® data from July 2013 to June 2104 further revealed that multilevel factors (i.e., hospital and unit organizational characteristics and unit nursing process factors) were associated with inpatient injurious falls among inpatient falls. Hospital teaching status and unit type were significantly associated with injurious falls. Falls occurred in teaching hospitals were 13% less likely to be injurious falls compared to those in non-teaching hospitals. Compared to falls on medical, medical-surgical and stepdown units, falls on surgical units were 8% more likely to be injurious. Among nurse staffing factors, RN hours per patient day (HPPD) was the only significant factor, which demonstrated a non-linear relationship with injurious falls with RNHPPD: before RNHPPD reached 5.08, the relationship between RNHPPD and injurious falls was negative; after RNHPPD reached 5.08, the relationship became positive. Falls without employee assistance was a significant factor for injurious falls, and were more likely to be injurious falls.

Strengths of the Study

A primary strength of the study was the exploration of the associations between multilevel factors and inpatient injurious falls from inpatients who experienced a fall. Inpatient

injurious falls is a complicated phenomenon that involved multilevel factors, including hospital, unit, and patient specific factors (Oliver, Healey, & Haines, 2010). Using the modified Donabedian Structure–Process–Outcome (SPO) model (Coyle & Battles, 1999; Donabedian, 1988) as the conceptual framework, the study included hospital structure characteristics, unit structure factors, unit process factors and patient population characteristics. Therefore, from measures that were available in the NDNIQ® database, the study presents a complete picture that includes variables that represent the hospital, unit and patient population characteristics contributed to inpatient injurious falls. The study findings add further knowledge of factors related to injurious falls in acute care hospitals and may guide hospital administrators and nurse leaders in developing effective fall prevention programs by considering those multilevel factors.

The analysis method used in the study is the second strength. The hierarchical regression model was used given the characteristics of the outcome and independent variables. Because injurious falls are associated with hierarchical clusters, including unit patient population characteristics, unit structure and nursing process factors and hospital organizational characteristics, the analysis model must consider the correlation within these clusters. Hierarchical regression model acknowledged the correlation within these hierarchical clusters and estimated the correlational relationships between the dependent variable and the independent variables more meaningfully.

The third strength of the study is that the study examined factors associated with injurious falls among inpatient falls. Previous studies mainly focused on injurious falls or falls among all adult inpatients who may or may not have experienced a fall. Although general falls have negative consequences on patients, injurious falls have more severe impact on patients and

hospitals. Injurious falls can cause prolonged length of hospital stay and extra financial burden to patients, family, and hospitals. Injurious falls also may result in loss of independence, depression, and decreased quality of life for patients (Oliver et al., 2010). Given the consequences of injurious falls, it is essential to understand the factors contributing to injurious falls among general falls and prevent injurious falls. The findings from this study present a better understanding of factors specifically associated with injurious falls, which can provide guidance in injurious fall prevention interventions.

Limitations of the Study

One major limitation of the study is the lack of inclusion of variables that could impact injurious falls. The study did not include some known risk factors due to missing or unavailable data. Age and certain medical conditions are identified major significant risk factors for falls and injurious falls. Patient activities (i.e., ambulating, transferring, or toileting) and shift changing periods also contribute to inpatient falls and injurious falls (Zhao & Kim, 2015). However, age was not included in the study due to large volume of missing data. Since NDNQI® does not collect data related to patient activities and shift changing periods, these data were not included in the study.

Another limitation of the study results from the sampling method. The sample of the study included NDNQI® participating hospitals and units within those hospitals. Because NDNQI® participating hospitals have characteristics (i.e., not-for-profit, large, Magnet ® designation) different from those non-participating hospitals (Dunton et al., 2007), the findings from the study may not be generalized to non- NDNQI® participating hospitals. Additionally, since NDNQI® data are all self-reported by participating hospitals, the intra-rater reliability might be impacted if hospitals do not follow NDNQI® data collection guidelines closely.

Implications for Practice and Research

Practice implications. Findings from the study have important implications for clinical practice. One major finding was that teaching hospitals had less injurious falls among inpatient falls compared to non-teaching hospitals. Because teaching hospitals emphasize a culture of patient safety and set patient safety as one of organizational priorities, these characteristics may contribute to less injurious falls and better quality of care (Pingleton, Davis, & Dickler, 2010). This finding has specific implications for nursing leadership in acute care hospitals. Hospital administrators and nurse managers need to promote a culture of patient safety at the hospital and unit levels. Because evidence shows that strong leadership support of fall prevention is one common characteristic of successful fall prevention programs, strong leadership support to fall prevention interventions is a key factor for successful fall and injurious fall prevention (Hempel et al., 2013; Miake-Lye, Hempel, Ganz, & Shekelle, 2013).

When developing fall prevention programs, nursing leadership needs to consider multiple factors related to injurious falls by paying close attention to unit structure, unit nurse staffing and patient population characteristics. One study finding indicated that falls on surgical units were more likely to be injurious falls compare to those on medical, medical-surgical, and stepdown units. This finding has important implications for nurse managers and nursing staff on surgical units. Considering the characteristics of clinical practice and patient population on surgical units (i.e., early post-operative ambulation, short length of hospital stay) (Feldman, Lee, & Flore, 2015; Watson, 2015), fall prevention interventions on surgical units should focus on assisting post-operative patients with ambulation.

Nurse staffing is another important factor that nursing leadership needs to consider for effective injurious fall prevention. Given the non-linear relationship between injurious falls and

RNHPPD, it is essential to ensure appropriate RN staffing level to ensure patient safety. Nurse managers should assign adequate RNs at lower level of RNHPPD because patients are at high risk for injurious falls without adequate RN staffing. Nurse managers also should be cognizant of patient acuity levels and patient needs to ensure adequate RN staffing on different units.

To prevent injurious falls, it is critical to accurately assess and identify patients for fall risk. Nurse leadership needs to select a validated fall risk assessment tool for frontline nurses to use. Nurses need to perform a thorough assessment on patients with focus on significant risk factors for injurious falls. For patients identified at fall risk, nurses need to implement an appropriate fall prevention protocol accordingly. Given the association between unassisted falls and injurious falls, nurses also need to monitor patients closely and provide assistance as needed.

Future research implications. The study also revealed several implications for future research. This study focused on injurious falls among inpatient falls while previous studies mainly examined falls or injurious falls among adult inpatients. Therefore, findings from this study may not comparable to findings from previous studies. More research on injurious falls among inpatient falls is needed. For future studies, other variables such as patient age, major medical conditions, and situational conditions related to injurious falls should also be included in order to obtain a thorough understanding of injurious falls.

Considering the increased rate of injurious falls on surgical units and recent clinical practice in care for post-operative patients, further research on injurious falls should be conducted to compare injurious fall rates on surgical units that have implemented Enhanced Recovery After Surgery (ERAS) programs with those without ERAS programs implementation. Further research also is needed to include patient acuity level in exploring the relationship

between nurse staffing (i.e., RNHPPD) and injurious falls because the patient acuity level may be associated with injurious falls and RNHPPD.

For future studies, prospective studies are needed to examine the associations between risk factors and injurious falls in acute care hospitals. This study was a retrospective study using July 2013 to June 2014 NDNQI® data. For retrospective studies, it is challenging to identify causal relationship because reverse causality may occur (Shadish, Cook, & Campbell, 2002). Prospective studies can avoid reverse causality and may identify causal relationship between risk factors and injurious falls. Therefore, prospective studies are needed for future research.

Conclusions

In conclusion, this study identifies multilevel structure, process and patient population factors associated with inpatient injurious falls. The results of this study will provide guidance for nurse leaders and frontline nurses in developing, implementing, and improving cost-effective fall prevention interventions to reduce injurious falls, improve patient safety and care quality in acute care hospitals.

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