Evaluation Of Hospital-Based Fall Prevention Program

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THESIS

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This dissertation is dedicated to my parents, Dr. Barbara Ringquist and Dr. Delbert Ringquist, without whom it would never have been accomplished.

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LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
CMS	Centers for Medicare and Medicaid Services
DV	Dependent Variable
FPP	Fall Prevention Program
IV	Independent Variable
MFS	Morse Fall Scale
MIDAS	Maximum Integrated Data Acquisition System
SEIPS	Systems Engineering Initiative for Patient Safety
SPSS	Statistical Package for the Social Sciences
UHC	University HealthSystem Consortium
UIMCC	University of Illinois Medical Center at Chicago (currently known as University of Illinois Hospital and Health Sciences System)

SUMMARY

In response to The Joint Commission's *National Patient Safety Goals* (The Joint Commission, 2005), developed to prevent falls in hospitalized patients, the University of Illinois Medical Center at Chicago (UIMCC) implemented a fall reduction task force in spring 2006.

The fall reduction task force examined best practices and literature and developed a fall prevention program (FPP) using an input-transformation-output model as well as a logic model. The program was implemented in fall 2007. To determine the success of the program, an analysis was performed. Data related to patient falls were collected 1 year prior to and 1 year after implementation of the FPP to analyze whether there had been any change in the fall rate, the severity of falls, and the types of falls that patients experience while in the hospital.

The results indicated a significant change in the fall rate from preintervention to postintervention of the FPP. No statistically significant change was observed in patients from the preintervention period to the postintervention period in terms of either severity of falls or the types of falls reported.

The study was limited by its being a historical comparison instead of a randomized control trial. A randomized control trial had not been feasible to conduct due to federal regulations that

were required to be implemented throughout the Medical Center. This study suggests that the implementation of the FPP devised by UIMCC was effective at reducing the fall rate of hospitalized patients.

I. INTRODUCTION

This chapter reviews background information related to hospitalized patient falls and related initiatives that impact the development of this study. It then states the problem and purpose of this study. Lastly, the chapter examines the significance of a study related to hospitalized patient falls.

A. Background

Falls in hospitalized patients constitute an enormous health-care problem in the United States. Falls that occur while a patient is in a weakened health condition can, in addition to the immediate fall, contribute to further illness and prolonged hospitalization. Health-care facilities that work to prevent adverse events such as falls offer better quality patient care and help to decrease hospitalization costs. With respect to health insurance companies, prevention of patient falls can potentially reduce hospital bills. However, the system of insurance payouts for preventable adverse events ended in October 2008 and thus shifted such costs to the hospitals.

According to a 2003 University HealthSystem Consortium (UHC) study that covered an 18-month period, patient falls comprised 13% of the documented adverse events in hospitals. Of those who experienced falls, 21% sustained injury. Secondary consequences of patient falls include longer hospital stays, greater hospital costs due to increased testing, and greater costs associated with malpractice damages (University Health System Consortium, 2003). The Agency for Healthcare Research and Quality (AHRQ) (2001) found that the incidence of falls among hospitalized patients was between 0.6 and 2.9 per hospital bed per year. Successful prevention strategies could improve care and decrease costs to patients, hospitals, and the health insurance companies that still cover preventable adverse events.

The implementation by the Centers for Medicare and Medicaid Services (CMS) of a "never events" (i.e., serious reportable events or occurrences that should never happen in a hospital and can be prevented) policy took place in October 2008. A CMS (2006) review of 18 types of medical events concluded that medical errors, including falls, accounted for 2.4 million extra hospital days, $9.3 billion in excess charges (for all payers), and 32,600 deaths. The review data from CMS (2006) were aggregate and did not define individual errors such as falls, but if UHC's study is applicable, falls may contribute 13%—or 320,000—of those extra hospital days (CMS, 2006). Medicare intends to shift those costs to the providing hospitals with the hope that doing so will also improve care.

The issue of medical errors is significant. The Institute of Medicine (2006) estimated that in 2000, 44,000–98,000 deaths in the United States occurred as a result of medical errors. The financial costs of such errors have a great impact on the U.S. health-care system. All insurances, including government insurance programs such as Medicare and Medicaid, must attempt to control costs to remain competitive or sustainable over time.

The CMS's never-events policy is designed to decrease expenditures and simultaneously improve hospital care. Medicare's determination of the quality measures it will not pay for if adverse events occur during hospitalization is based on information derived from large health-care databases. In 2006, the National Quality Forum (2007) identified 28 adverse events that are largely preventable. The CMS later incorporated this list of 28 events into its never-events policy (Appendix A). The list was developed to capture events that are not only of concern but also identifiable and measurable. The CMS's rationale is that the risk of occurrence can be influenced (i.e., decreased) by adherence to policies and procedures. Patient falls during hospitalization is one of the items included on the CMS list. This quality-measure policy has the potential to influence both the quality and the cost of health care.

Given the fact that hospitals must incur costs that Medicare previously covered, the never-events policy has had a significant impact on medical facilities. At the time the policy was developed, CMS advised hospitals to prepare to assume responsibility for medical errors by October 2008, the date on which Medicare implemented the policy. The CMS recommendations for preparing for the never events implementation included utilizing existing safety committees or developing multidisciplinary task forces and/or committees. Such groups would need to assess current hospital practice, gather and analyze current data pertaining to the 28 never events, review the CMS guidelines and standards, and develop appropriate interventions and programs based on analysis of the causes of the never events and motivated by the anticipated effects of such events on hospital function. Hospital administrators across the country needed to ensure that they fully understood the rules for nonpayment for never events that occurred during hospitalization and disseminate this information to appropriate staff members. After hospital-acquired conditions specific to a particular facility were identified, guidelines for addressing those conditions needed to be developed and staff education needed to be implemented. It was assumed that institutions that had task forces or committees in place may have had an easier transition to the CMS policy and therefore would have been ready to initiate a continuous feedback loop, in which findings from analysis could be reviewed and lead to the development of improvements.

B. Statement of Problem

Patient safety during hospitalization is an important health-care issue. Hospital administrators have established health policies to improve safety during hospitalization. In addition, falls entail significant costs, an important issue for hospitals to address. According to Stevens et al. (2006), direct medical costs for fatal falls totaled $0.2 billion, and for nonfatal injuries related to falls, the costs totaled $19 billion. Of the nonfatal injury costs, $12 billion were for hospitalizations. A better understanding of what causes such falls and the interventions that can prevent them is needed to adequately deal with the problem.

Patient safety as it relates to falls sustained during hospitalization is a multifactorial concept. Two major components include (a) the identification of factors that place patients at risk for falls and (b) the implementation of appropriate preventive measures. With respect to the first of these two components, identifying fall risk has been studied, and there are a number of measures that have been validated to assess patient risk. The overall problem is that the evidence for the best strategies for prevention of patient falls in the hospital setting is inconclusive.

A program for hospital-based fall prevention is needed. If effective, a fall prevention program (FPP) should improve patient safety. The overall goal of a FPP is a decrease in the fall rate, the severity of falls, and costs associated with falls. Determining whether a FPP has an impact on the type of falls is also important, so that appropriate changes in interventions can be made.

C. Purposes of Study

The first purpose of this study is to evaluate the effectiveness of a FPP in an urban medical center by assessing patient fall rates before and after implementation of the FPP. The effectiveness of the FPP will be determined by assessing whether the number of patients who sustain a fall during hospitalization decreases after program implementation compared with the period before implementation.

The specific aim inherent in the study's first purpose is to compare the rate of falls in patients during a 1-year period before and a 1-year period after implementation of a FPP. The hypothesis is that the number of falls sustained during hospitalization among patients who receive the FPP will decrease.

The second purpose of this study is to determine the severity of injury from falls. The specific aim inherent in the study's second purpose is to determine whether a fall prevention program can affect the severity of injury that patients sustain from a fall during hospitalization. This aim will be achieved by comparing the severity of falls of patients during a 1-year period before and a 1-year period after implementation of a FPP using a Fall Severity Rating Tool (Joint Commission International, 2010). The hypothesis is that the severity of injury sustained from a fall during hospitalization among patients in the FPP will decrease.

The third purpose of this study is to determine whether the implementation of a FPP will change the types of falls that occur during a 1-year period before and a 1-year period after the program's implementation. The specific aim inherent in this purpose is to compare the types of falls patients experience 1 year before and 1 year after implementation of a fall prevention program.

An anticipated additional benefit of the success of the facility's FPP is that the decrease in severity would be accompanied by a decrease in costs. Another anticipated secondary benefit is that a decrease in fall rates, accompanied by a correlated change in the types of falls, could result in the creation of more successful specific interventions that address the types of falls observed through the facility's FPP.

D. <u>Significance of Study</u>

There is a paucity of literature on the best methods of preventing falls in patients during hospitalization. According to the AHRQ (2001), there have been few hospital-based, randomized control trials of standardized fall interventions, despite the obvious need for them. Given the lack of published research into the effectiveness of hospital-based fall prevention programs, determining how to prevent hospitalized patients from experiencing falls is challenging. This is an important implication not only for improved quality of care but also for reimbursement issues.

This study is intended to examine the extent to which the implementation of a fall reduction program in an urban medical center affects the rate of patient falls. The FPP may improve patient safety during a hospital stay and decrease costs associated with adverse events. This study will also analyze the impact of the FPP on the severity of falls sustained by hospitalized patients. In addition, the pre- and postintervention groups will be evaluated to determine whether there is any change in the types of falls that might have an effect on the intervention program. It is hoped that if the FPP is found to be effective in reducing patient injury, it can then be made available to other large urban medical centers throughout the country.

To summarize, this study is intended to evaluate the effectiveness of the fall prevention program at UIMCC. If this program is found to be effective, it will reflect the improvement of patient care at this medical facility and could be useful for other medical facilities.

II. CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

This chapter reviews the conceptual framework and related literature on falls, fall prevention, and health-care policy. It begins with a review of the conceptual framework, including the systems approach models and input-transformation-output model of health care. This is followed by a review of a logic model for program evaluation related to a fall prevention program. The chapter concludes with a review of related literature.

A. <u>Conceptual Framework</u>

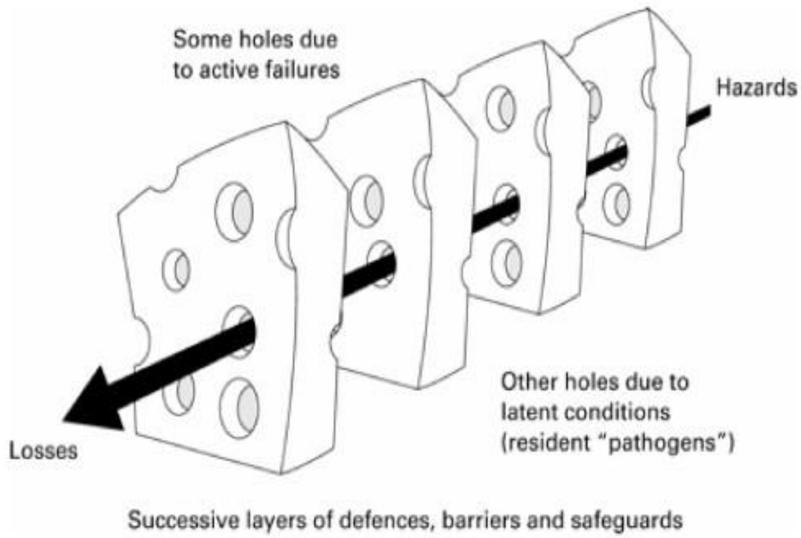
Conceptual framework is important in research, as it outlines the approach that will be utilized to study a research question. The conceptual framework for this study examines systems approaches that incorporate human factors into the system and how one transforms systems via inputs and transformations within the system.

1. <u>Systems Approach Models</u>

With the identification of medical errors reported by the Institute of Medicine, improving patient safety has become a focus in health-care delivery. The Institute of Medicine reports have prompted a shift from blaming an individual to developing a systems approach to patient safety (Institute of Medicine, 1999, 2001, 2004, 2006). Development of a systems model for health-care delivery can help to more effectively implement the changes needed to improve patient safety.

A systems approach recognizes that human error occurs and examines methods for decreasing unwanted variability in human behavior in the context of the organization in which it occurs (Reason, 2000). A systems approach is based on the assumption that although a human element is involved that cannot be changed, the structured and unstructured environment and conditions within which humans operate can be changed. By applying a systems approach when an adverse event occurs, focus is maintained on the structural-functional and institutional processes rather than on any individual’s error. The systems approach can delineate how and why institutional defenses failed (Reason, 2000). The “Swiss cheese” model of system failures describes multiple layers of safeguards, so that if a hole in one system allows an error to occur, another layer is in place that prevents the error from emerging and affecting a patient (Reason, 2000) (Figure 1).

Figure 1. "Swiss Cheese" Model of Patient Safety.



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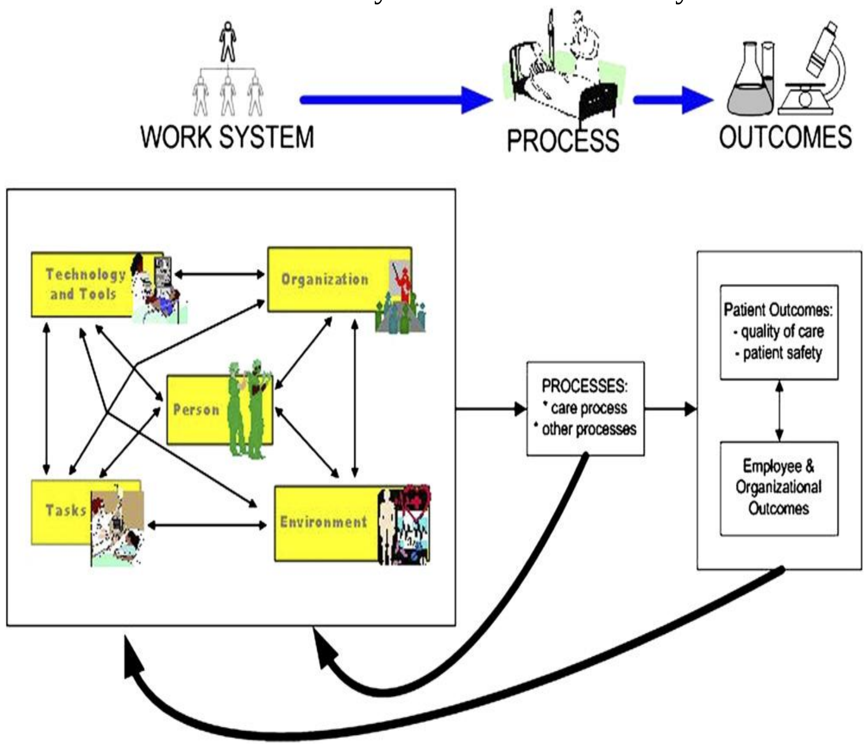
2. Systems Engineering Initiative for Patient Safety

The AHRQ funded the systems engineering initiative for patient safety (SEIPS) to help develop a work system and patient safety model. The SEIPS model integrates Donabedian's structure-process-outcome framework into the work system model (Carayon et al., 2006) (Figure 2). In the SEIPS model, the work system in which patient care is provided affects both the work and the clinical processes, which in turn affect outcomes of care.

Changes in the work system have an impact on the work and clinical processes and consequently on patients, employees, and organizational outcomes (Carayon et al., 2006). Compared with the structure-process-outcomes model, the SEIPS model places more emphasis on the system in which practitioners work than on the individual practitioner. The SEIPS model can be utilized proactively to design systems and reactively to evaluate breaks in systems (Carayon et al., 2006). The conceptual framework of the SEIPS model is targeted at those interested in applying systems engineering concepts to patient safety goals (Rivera and Karsh, 2008).

Figure 2. Systems Engineering Initiative for the Patient Safety Model of Work System and Patient Safety.



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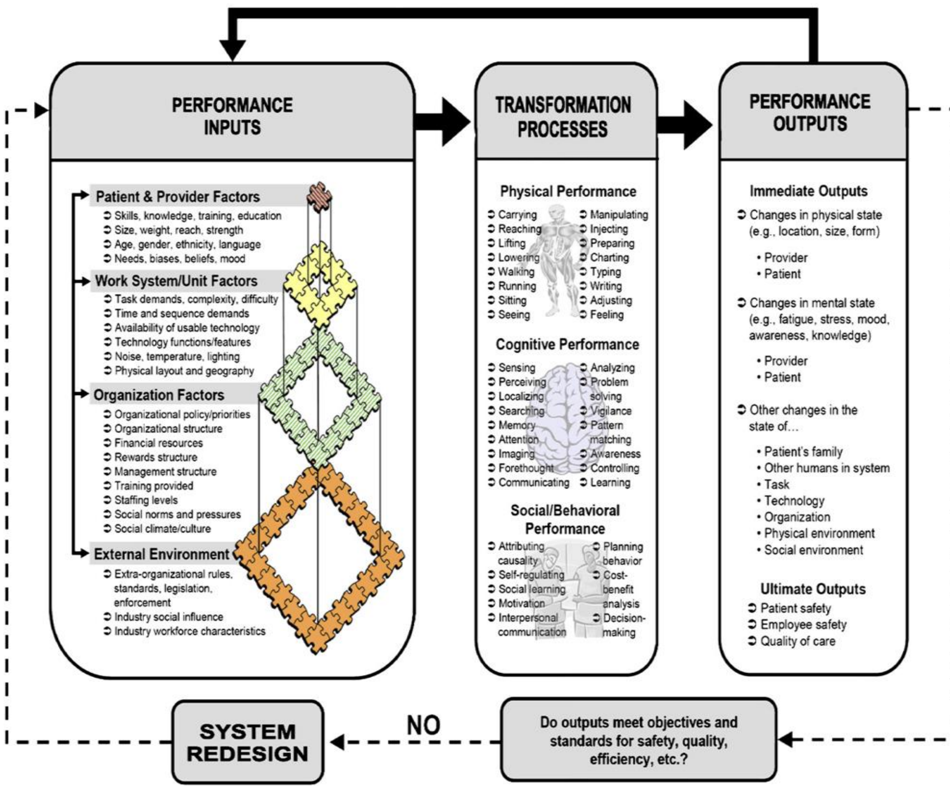
3. Input-Transformation-Output Model

Systems engineering refers to the design of an overall system (Rivera and Karsh, 2008). A design that incorporates human factors into the system better fits the people in that system. This fit is achieved when the components of the system are such that the people in the system can perform with a low probability of error and a high probability of quality (Rivera and Karsh, 2008). An input-transformation-output model for health-care professional performance provides a hierarchy of inputs that affects human performance. This, in turn, produces system transformations that generate system performance outputs (Karsh et al., 2006) (Figure 3). The input-transformation-output model derives from the open systems theory, the work system model for health care, and the SEIPS model (Karsh et al., 2006). It provides a framework for understanding how the elements, or inputs, of a system can interact to influence the performance of the health-care professional, and, ultimately, patient safety (Karsh et al., 2006).

Figure 3. Input-Transformation-Output Model of Health-care Professional Performance**.**



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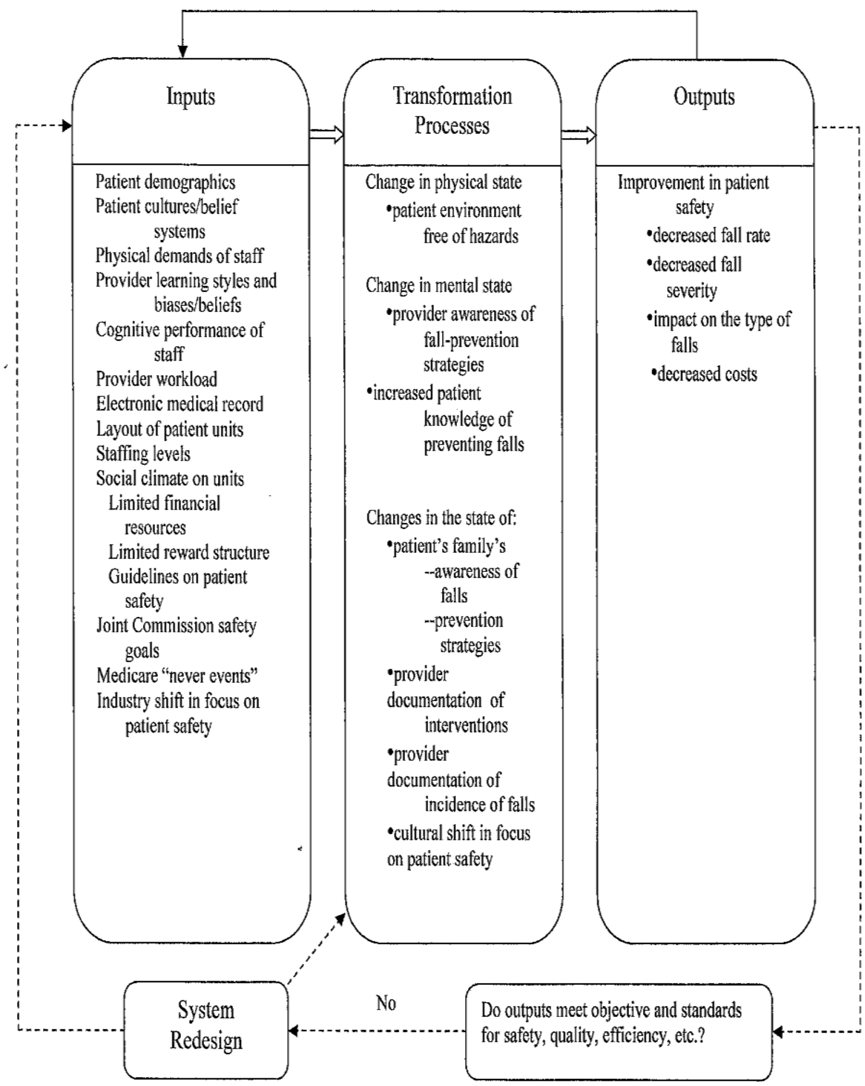
Although this framework was derived from the SEIPS model, its focus is to demonstrate how the structure of the health-care system can influence performance, and, subsequently, outcomes (Rivera and Karsh, 2008). The central component of the input-transformation-output model is that a significant amount of patient safety depends on the health-care professional; therefore, systems for supporting the providers must be in place (Rivera and Karsh, 2008). The performance inputs illustrated in Figure 3 (Karsh et al., 2006) represent the work system in which health-care professionals perform their jobs. The elements in the work system include patient and health-care provider factors, task factors, technological and tool factors, environmental factors, organizational factors, and external environmental factors. The inputs demonstrate that any given system exists within hierarchies of other systems and are pieced together necessary to fit the system. The transformation processes are the acts of transforming the inputs into outputs. The performance outputs include the new state of the system.

The input-transformation-output model for health-care professional performance is the conceptual framework for the development of the UIMCC fall prevention program (Figure 4). This construct was developed based on the work of the Fall Prevention Task Force at UIMCC. In this fall prevention program, development of the factor performance inputs for patient and providers include patient demographics, patient culture and belief systems, provider learning styles, cognitive performance, and biases/beliefs, as well as physical performance and demands

Figure 4. Input-Transformation-Output Model of Healthcare Professional Performance for the Fall Prevention Program.



on staff. The work system inputs include provider workload

pressures, the electronic medical record system, and the layout of the patient units. The organizational factor performance inputs for the UIMCC fall prevention program include staffing levels, social climate on the patient units, limitations on financial resources and reward structures, and guidelines related to patient safety. The external environmental performance inputs include The Joint Commission's National Patient Safety Goals, outlined in 2005; Medicare's never events policy, instituted in 2008; and a general industry shift to a focus on patient safety after the release of the Institute of Medicine's 1999 report on medical errors.

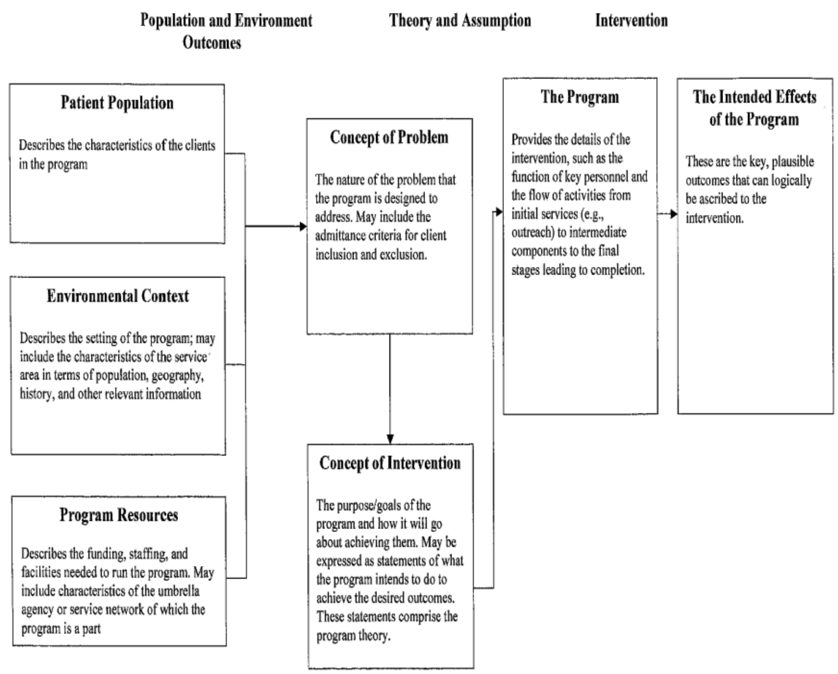
The transformation process for the FPP includes a change in the physical state of the patient environment that eliminates known hazards; a change in the awareness of the provider, patient, and patient's family that leads to greater knowledge of fall-prevention strategies; improved provider documentation of interventions for and incidence of falls; and a cultural change that produces a greater focus on patient safety.

The anticipated performance output that follows the transformation process of the FPP is a decrease in the medical center's fall rate, in the severity of falls, and in costs associated with falls as well as a change in the type of falls. The input-transformation-output model of health-care professional performance can guide the development and implementation of the FPP.

B. Logic Model for Program Evaluation

A logic model is commonly developed during the course of program evaluation. A logic model is a graphic representation of a program that describes (a) the context, (b) the theory and assumptions underlying the program's intervention, (c) the intervention, and (d) the outcomes (Conrad et al., 1999) (Figure 5).

Figure 5. A Logic Model Template.



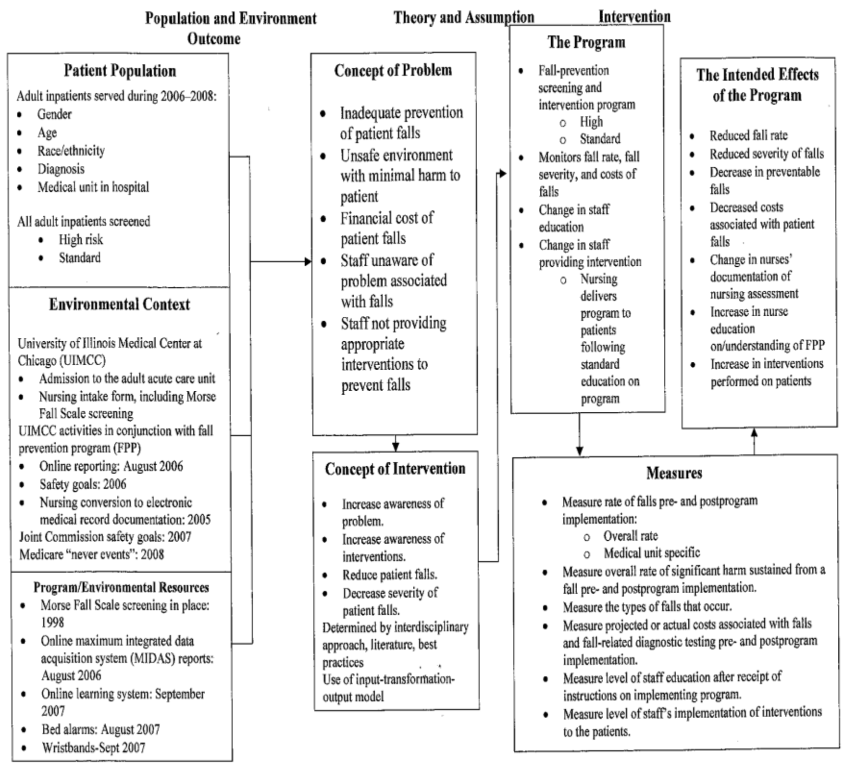
Reprinted from *Creating and using logic models: Four perspectives,* by K.J. Conrad, F.L. Randolph, M.W. Kirby, and R.R. Bedout, 1999, Philadelphia, PA: The Haworth Press, p. 19.

The context includes the population and environment as well as the program's resources. The underlying theory and assumptions focus on both the concept of the problem and the concept of the intervention. The intervention portion of the model provides details of the intervention. The outcomes section focuses on the intended effects of the program.

A logic model allows for a systematic and visual way to show the relationships among the resources available for operating a program, the activities planned, and the anticipated results of and changes produced by implementation of the program (W.K. Kellogg Foundation, 2004). Logic models commonly are used in program development and evaluation to provide a road map for connecting the need for the program with the program's desired results. Logic models allow for shared understanding of and focus on program goals and methodologies, and they relate activities to projected outcomes (W.K. Kellogg Foundation, 2004).

The logic model for the UIMCC fall prevention program was developed to provide information on and understanding of the program and its expected outcomes (Figure 6). The context for the program includes the demographics of the patients served, the type of facility in which the program is performed, changes in the mix of diagnoses and specialties performed at the medical center, and other patient-safety-related activities within the medical center, as well as outside environmental factors, including the development of The Joint Commission's safety goals and Medicare's never events. The context also includes resources such as the Morse Fall Scale screening tool, the Learning Management System, the bed alarms, the wristband identifiers, and online reports of occurrences.

Figure 6. A Logic Model for the Fall-Prevention Program.



Created based on the Fall Prevention Task Force work at UIMCC. Reproduced with permission from the University of Illinois Medical Center at Chicago.

The theory and assumptions of the FPP include the context of the problem as well as the concepts of the intervention and are related to the input-transformation-output model previously discussed. The context of the problem includes an inadequate prevention of patient falls, an unsafe environment for patients, the costs to the medical center resulting from falls, a lack of provider awareness of the problem associated with falls, and the failure of providers to provide appropriate interventions to prevent falls. The concepts of the intervention were determined by an interdisciplinary approach that used literature and best practices to develop the interventions via the input-transformation-output model. These concepts include increased awareness of the problem of patient falls and interventions to prevent them, decreased rate of patient falls, decreased severity of falls, and decreased preventable falls.

The interventions identified in the logic model for the FPP include fall-prevention screening, standard interventions for all patients with a targeted intervention program for those identified as high risk, staff education, and change in provider practice that includes the provision of the intervention. The measures for assessment will include pre- and postprogram implementation comparison of the fall rate, the severity of injury sustained in falls before and after implementation of the program, and an evaluation of the types of falls that are sustained.

The expected effects of the outcomes portion of the logic model include a reduced fall rate and a reduction in injury sustained in falls, with a concomitant decrease in costs associated with falls and greater ability to characterize the types of falls that occur.

Among the secondary outcomes of the FPP are a change in nursing documentation of fall assessments, an increase in provider education and understanding of the FPP, and an increase in interventions performed on patients. In addition, measures of staff education levels and provider implementation of the interventions given to patients will take place. Measuring levels of staff education and intervention implementation will indicate whether the intervention was implemented and effective, respectively.

C. Review of Related Literature

This section presents a review of the literature related to the risk factors for and interventions to prevent falls, including those that pertain to fall prevention in population-based settings, nursing home settings, and inpatient rehabilitation settings. Also reviewed are the gaps that exist in the literature on hospitalized patient falls.

1. <u>Literature on Risk Factors Related to Falls</u>

Health-care organizations and hospital accrediting organizations are increasingly aware that patient falls in the hospital setting are an issue of concern for hospitals. Risk factors for falls have been studied, and intrinsic and extrinsic factors have been identified in the literature (Beers and Berkow, 2000). Intrinsic factors include impairments in balance and in the vestibular system; impaired proprioception in the lower extremities; decreased visual acuity; impaired muscle activation, particularly in the lower limbs; use of medications; and chronic medical disorders of various systems of the body. Extrinsic factors include environmental and situational factors such as poor lighting, wet floors, and patients rushing or moving too quickly (e.g., to answer a phone call)—circumstances that can interact with impaired intrinsic factors and cause a fall (Beers and Berkow, 2000).

According to the Rand Corporation (Skekelle et al., 2006), the main finding in an analysis of fall-prevention interventions in the Medicare population was that the use of the multifactorial components in a prevention program was the most beneficial for reducing falls. The study did not find any significant difference in one-component interventions; rather, it noted a trend toward multifactorial fall-risk assessment and management programs.

2. <u>Literature on Population-Based and Nursing-Home Falls</u>

There is an abundance of literature in both the general community and the nursing home setting that describes who tends to fall and why falls occur in elderly patients. The factors contributing to falls in these settings, as well as interventions for preventing them, have been well studied (Colon-Emeric et al., 2006; Ganz et al., 2007; Horn, 2000; Lord et al., 2005; Ray et al., 1998; Vu et al., 2005). Some of these risk factors include advanced age, multiple medical problems, muscle weakness, gait problems, environmental hazards, use of sedative and antianxiety medication, activities related to transitioning back to the home, and poor foot care and shoe fit.

Fall-prevention strategies in the nursing home setting have been studied. Some of the general findings point toward a combination of medical treatment, rehabilitation, and environmental changes (Cooper, 1994, 1997; Nowalk et al., 2001; Ray et al., 1997; Rubenstein, 1994, 2006; Vu et al., 2005). It has been found that identifying residents at risk for falls, treating any underlying medical conditions they may have, reviewing their medications, making the environment safe for moving within it, developing exercise programs, and providing increased monitoring of residents at risk can help prevent falls. According to Beers and Berkow (2000), some general fall-prevention strategies include physical-therapist-designed exercise and balance programs, particularly for those who have experienced a fall. In addition, Beers and Berkow (2000) recommended use of an assistive device for ambulation, review of medications, evaluation and treatment of vision, and correction of environmental hazards. A Cochrane review (McClure et al., 2005) of population-based intervention programs revealed a decline in fall rates and fall-related injuries. In a meta-analysis of randomized clinical trials (Chang et al., 2004), an evaluation of 40 trials showed that multifactorial fall-risk assessment and intervention programs, as well as exercise programs, were the most effective fall-prevention strategies.

3. Literature on Inpatient Rehabilitation Unit Falls

Common characteristics of persons who fall in a rehabilitation ward include a history of falls, impaired gait, and confusion (Vassallo et al., 2003). In a tertiary hospital setting, characteristics associated with falls among elderly persons in elderly-care wards included mobility impairments, cognitive impairments, stroke, incontinence, and arthritis/osteoporosis (Chen et al., 2010). A Cochrane review (Cameron et al., 2010) on interventions for preventing falls in elderly persons in nursing care facilities and hospitals indicated that a multifactorial approach is needed. One limitation of this study is that of the 41 articles reviewed, only 4 were hospital based.

4. Gaps in Literature on Falls

Although the broad range of literature is helpful for identifying risk and providing interventions in nursing homes and rehabilitation units, it is not necessarily directly applicable to patients who experience falls in an acute-care/hospital setting. Hospitalized patients can have acute illnesses that increase their risk of falling; such illnesses are not necessarily the same as chronic problems that can cause falls in people in the community or nursing-home setting.

It is important to evaluate patient falls in the hospital setting and the various methods of preventing them. Tzeng and Yin (2008) found discrepancies between The Joint Commission’s recommendations and clinical nurses’ recommendations for eliminating falls. Achieving consensus on useful and cost-effective fall-prevention strategies and interventions is critical to successfully reducing patient falls (Tzeng and Yin, 2008). Further analysis of fall-prevention programs may yield information on the most effective way to reduce patient falls in the hospital. This paper addresses gaps in the literature in three ways: (a) by quantifying the types of falls that occur in an acute-care setting, (b) by determining whether a fall-prevention program is effective in reducing falls in hospitalized acute-care patients, and (c) by examining both the impact of a fall-prevention program on the severity of harm a patient sustains from a fall and the overall cost of falls. In a meta-analysis by the Rand Corporation (Shekelle et al., 2006), the evidence was inconclusive about the cost-effectiveness of a fall-prevention program. It was found that formal intervention programs provided to people who had a high risk of falling were the ones with the most potential to be cost-effective.

In light of the importance of optimal patient safety, hospitals have established health policies to help ensure safety during hospitalization. The identification of factors related to patients at risk for falls during hospitalization and the implementation of appropriate interventions are critical components of fall prevention. Evidence on the effectiveness of hospital fall-prevention programs is inconclusive. This study will determine whether implementation of a FPP in an urban medical center can decrease the fall rate of patients, the severity of injury associated with patient falls, and the incidence of preventable types of falls, with a resultant decrease in costs.

III. METHODS

This chapter presents hypotheses; elements of research design; information on participants, sample size, and outcomes measures used; and data analysis. It also examines the limitations of the research design and ways to control plausible threats to validity.

A. <u>Hypotheses</u>

Three hypotheses were derived from theory and fielded to determine whether participation in the FPP will significantly affect the number of patient falls, the severity of patient falls related to injuries, and the types of falls that occur. These hypotheses are as follows: (a) H_1: Participation in the FPP will result in a significant decrease in the number of patient falls during hospitalization among adult patients 18 years and older who receive the intervention, (b) H_2: Participation in the FPP will result in a significant decrease in the severity of injuries resulting from patient falls during hospitalization among patients who receive the intervention, and (c) H_3: Participation in the FPP will affect the types of falls during hospitalization among patients who receive the intervention.

TABLE I provides a summary of each hypothesis with its associated dependent variable (DV), independent variable (IV), level of measurement, and statistics used. The table displays that a different DV is used for each hypothesis. The DV for hypothesis 1 is fall rates. The DV for hypothesis 2 is severity of injury (i.e., 1 = no apparent injury, 2 = minimal harm, 3 = moderate harm, 4 = major harm, 5 = death, and 6 = unable to determine). The DV for hypothesis 3 is type of fall (i.e., 1 = from bed, 2 = ambulating with permission, 3 = ambulating without permission). The IV for all three hypotheses is the fall-prevention program. The levels of measurement for the three DVs are frequency, interval, and nominal, respectively. The level of measurement for the IV is nominal, meaning that there are two distinct levels (i.e., the September 2006–August 2007 group and the December 2007–November 2008 group). A proportions test, Kruskal-Wallis, and chi-square, respectively, will be used to determine differences between the groups.

TABLE I

DESCRIPTIVE STATISTICS ASSOCIATED WITH EACH HYPOTHESIS

Hypothesis	DV	IV	Level of Measurement (DV/IV)	Statistic
H_1	Fall rates	FPP	Frequency/ Nominal	Proportions
H_2	Severity of injury	FPP	Interval/ Nominal	Kruskal-Wallis
H_3	Type of fall	FPP	Nominal/ Nominal	Chi-square

Note. DV = dependent variable; IV = independent variable; FPP = fall prevention program.

B. <u>Research Design</u>

According to Johnson and Onwuegbuzie (2004), deduction, confirmation, theory/hypothesis testing, explanation, prediction, standardized data collection, and statistical analysis are the major elements of traditional quantitative research. As such, the basic design of this quasi-experimental study will incorporate the elements of traditional quantitative research in identifying the effects of the FPP on patient fall rates in an urban medical center, the severity of injury related to falls, the costs of falls, and the type of falls that occur.

Furthermore, this study will have a nonequivalent design that will use a pre- and postintervention comparison. A matching cohort will be used. According to Shadish et al. (2002), cohorts are particularly useful as control groups when the cohorts differ in only minor ways from their contiguous cohorts. Additionally, treatment needs to be given to all members of the groups. The comparison group will be a historical group within the same medical center prior to implementation of the FPP. The rationale for using a 1-year, pre- and postintervention comparison is to go beyond the periods within which natural changes in the setting could affect results. A comparison of fall rates, severity of injury related to falls, and the types of falls (with and without a fall reduction program) will be made between the two periods. The study design is displayed in Figure 7.

Figure 7. Study Design.

N_1 $O_1O_2O_3O_4O_5O_6O_7O_8O_9O_{10}O_{11}O_{12}$

N_2 $X \rightarrow O_{13}O_{14}O_{15}O_{16}O_{17}O_{18}O_{19}O_{20}O_{21}O_{22}O_{23}O_{24}$

N_1 = comparison group; O = observations measured monthly 1 year prior to and 1 year after intervention; N_2 = intervention group; X = fall-prevention program initiated; $\rightarrow$ = program is continuous over time.

1. <u>Appropriateness of Design</u>

A quasi-experimental research design was determined to be appropriate for this study, because it enables the collection of data from a large number of participants who fit a specific demographic profile. A large number of participants (i.e., more than 50) will be necessary to ensure that differences and commonalities are appropriately represented within a sample. Specific to this study, this research design gives a single researcher with limited resources the ability to collect and analyze data from a sample within a comparatively short period. Furthermore, data are collected at the ratio, interval, and nominal levels, which means that inferential statistics can be used to test the research question (Trochim and Donnelly, 2008). Another reason for the quasi-experimental design pertains to the Medicare mandates (CMS, 2006), which state that any program implemented by a set date does not allow a randomized control-group design to be used at the same time. With respect to these mandates, a historical comparison group will be used instead to compare the effects of the intervention.

2. <u>Variables</u>

Three measured dependent variables were used in the study: (a) patient fall rates, (b) severity of injury, and (c) types of falls. The data were collected from archival information. All three variables are discussed in detail herein.

3. Patient Fall Rates

Patient fall rates will be collected from archival data in aggregate form, which means that a single fall rate will represent the percentage of falls for each respective, designated period. Specifically, a fall rate will be collected for both the preintervention and postintervention periods. Fall rate is operationalized as the number of participants that have fallen divided by the total number of participants. The level of measurement is ratio.

The overall pre- and postfall rates will be determined by the overall number of falls. The equation for the fall rate is:

$$\frac{\text{Number of patient falls}}{\text{Number of patient days}} \times 1{,}000 = \text{fall rate per 1,000 patient days} \qquad (1)$$

This is a standard measurement of the fall rate and will be analyzed for the preintervention (September 2006–August 2007), intervention (September 2007–November 2007), and postintervention (December 2007–November 2008) periods.

4. Severity of Injury

Data on severity of injury will be collected from archival data obtained from the Maximum Integrated Data

Acquisition System (MIDAS) and chart audits for the preintervention, intervention, and postintervention periods. The severity of injury will be operationalized as the rating given on a scale of 1 to 6, where 1 means no harm; 2 means minor harm (e.g., a bruise or abrasion requiring application of dressing or ice, wound cleaning, limb elevation, or topical medication); 3 means moderate harm (e.g., injury that requires suturing, application of steristrips/skin glue, or splinting, or muscle or joint strain); 4 means major harm (e.g., injury requiring surgery, casting, or traction, or fracture that requires splinting); 5 means death; and 6 means unable to determine. The scale was evaluated as 1–4, because there were neither death cases nor cases for which the harm level could not be determined.

5. **Types of Falls**

Data on the types of falls will also be collected from MIDAS and chart audits used for the preintervention, intervention, and postintervention periods. The types of falls will be operationalized as the category assigned to the type of fall of each patient during hospitalization. The categories for types of falls include from bed, ambulating with permission, ambulating without permission, during transfers, from table/chair, around shower/tub/toilet while attended, and around shower/tub/toilet while unattended. The level of measurement for this variable is nominal.

C. Sampling

It was initially anticipated that sampling would occur from all patient falls data from September 2006 through November 2008. When calculating a sample size, several factors are considered—power of the study, the effect of size of the phenomena under study, and the level of significance (i.e., alpha) that is used in rejecting the null hypotheses. As a matter of convention, the power that would be adequate to reject a false null hypothesis is .80 (Keuhl, 2000).

The expected effect is an estimate measurement of the strength of the relationship between the independent and dependent variables (Cohen, 1988). The level of confidence, also referred to as alpha, is the probability that the results can be reliably replicated and is usually set at .05. In an effort to validate sample size for more advanced analyses, a formal power analysis was conducted to statistically determine the number of participants needed to conduct the study. To assess the a priori sample size, power was set at .80, and the expected effect size was set at .25. Accordingly, for research questions 2 and 3, the sample size necessary to likely determine a statistical difference is 128 participants, where alpha = .05 and degrees of freedom = 1. This means that there is an 80%

probability that 128 participants will be sufficient to find a statistical relationship (i.e., an effect size of .25) between variables where alpha = .05 (Faul et al., 2007).

However, once data collection was initiated, the researcher was able to collect information on all participants who sustained a fall from September 2006 through November 2008. Since it was reasonable to collect all data, the population of patients from the adult patient population at UIMCC who fell became the census.

In comparison with patient falls from large, urban medical centers across the United States, examination of patients who fell from one hospital, UIMCC, resulted in a convenient sample. This sample was convenient to use, in that UIMCC can be assumed to represent large, urban medical centers across the country with respect to patient fall rates, injuries, and types of falls. Merriam (1998) asserted that the two basic types of sampling are probability and nonprobability. Probability sampling is described as a statistically representative sample derived from the population under study. Nonprobability, or purposeful sampling, does not deal with generalization, and according to Honigmann (1982), it attempts to logically solve quantitative problems that describe the relationship of linked occurrences.

The several different types of purposeful sampling include typical, unique, maximum variation, convenience, snowball, chain, and network. This study will use convenience sampling, because it encompasses a person (or persons) readily available to be studied. Convenience sampling is regularly used in exploratory research to collect data that are generally representative of the population under study. According to StatPac (2007), convenience sampling "is often used during preliminary research efforts to get a gross estimate of results, without incurring the cost or time required to select a random sample" (p. 1).

Convenience sampling enables the researcher to act within a certain period and under conditions that facilitate data collection. By its nature, convenience sampling sacrifices generalizability and therefore may not provide sufficient representation of the target population. This means that those selected for the study might only partially represent the population under investigation. As such, replication may be necessary to fully validate study results (Keppel and Zedeck, 2001).

Despite its deficiencies, convenience sampling may be the best method for obtaining a sample when time and conditions prohibit random sampling (Neuman, 2003). The sampling methodology enables the researcher to achieve an approximation of the truth whenever obtaining a random sampling is conditionally prohibitive.

Similarly, study validity can be degraded as well. Conceptually, validity is concerned with how successfully the study measures what it intends to measure. Although the study's results may be valid within the same selected population, they may not necessarily be valid for the entire population. This study will attempt to measure the effects of the FPP on patient fall rates, injuries from falls, and types of falls. As such, it could successfully measure what needs to be measured, but the outcomes may not necessarily generalize to the greater target population outside UIMCC. However, given the lack of data and research available on the topics of fall prevention and fall rates, this project, even within its design limitations, will contribute to a much-needed area of patient safety.

D. Reliability of the Measures and Validity of Inferences

In research, reliability "means repeatability and consistency" (Trochim and Donnelly, 2008, p. 84). For this study, test-retest reliability was utilized to determine the reliability of the study. According to Trochim and Donnelly, test-retest reliability was used to assess the consistency of a measure from one time to another. The researcher performed 20 test audits of pulling data from patient charts. These were compared to the chart audits for those same patients when all charts were used for the study data.

According to Trochim and Donnelly (2008, p. 20), validity is "the best available approximation to truth of a given proposition, inference, or conclusion." Because validity is a property of inferences, the design of a study can impact various aspects of validity" (Shadish et al., 2002, p. 34). Plausible threats to validity, specific to this study, are reviewed later in this chapter.

Generally, studies that employ randomization in selecting participants from the study population have more external validity than those that do not. However, because random sampling is outside the scope of the researcher's resources, the convenience sampling strategy will be used for this study. Consequently, its external validity may not be strong. Given the fact that only patients who are immediately available will be studied, results may not necessarily reflect the study population's attitudes. In this case, repeating the test to compare results may be desirable.

E. <u>Instrumentation</u>

The Morse Fall Scale (Morse, 1995) will be used to identify all adult patients who entered UIMCC during the study period of September 2006 through November 2008. The independent variable of the FPP will be applied to the postintervention group. The fall rate for patients will be measured by a standardized equation. Patients' injuries from falls and types of falls will be measured by the MIDAS Occurrence Report and chart audits. Descriptive statistics on patient demographics will be collected to help define the sample collected. This approach will allow for comparison of the demographics of the pre- and postintervention groups, thereby ensuring that the two groups are similar. Moreover, it will provide information on the characteristics of patients who fall into both groups that will help determine whether those characteristics have changed after implementation of the fall-prevention program.

1. Morse Fall Scale

The Morse Fall Scale (MFS) (Morse, 1997) was developed to identify patients at risk for falls during hospitalization. It was developed by identifying significant variables that differentiated patients who fell compared with those who did not fall. This was accomplished by establishing a database of 100 patients who fell and 100 randomly selected patients who did not fall (Morse, 1997). Discriminate analysis was used to examine the variables, and 6 variables met the significant criterion of $F > .001$ as the minimum tolerance level (Morse, 1997). Identification of at-risk patients is based on a history of falls, a secondary diagnosis, use of an ambulatory aid, use of intravenous therapy, gait stability, and mental status. The 6-question scale has a total point value of 150, and the questions’ point values vary depending on responses. TABLE II (Morse Fall Scale Items and

Scores) outlines the Morse Fall Scale items and response options for scoring. Computer scoring of the scale was performed to calculate the weights of each scale item's responses (Morse, 1997). Morse (1997) then determined the level of risk for the Fall Scale by using computer testing of the scale. This testing determined a sensitivity of 78% and a specificity of 83%. Reliability of the MFS was then established with 21 nurses rating 6 patients at an r = .96 (Morse, 1997). The validity of the Morse Fall Scale was established with a prospective testing of the scale in acute-care hospitals, long-term care centers, and rehabilitation hospitals, resulting in findings that demonstrated that the scale was sensitive to changes in the patients' conditions (Morse, 1997).

TABLE II

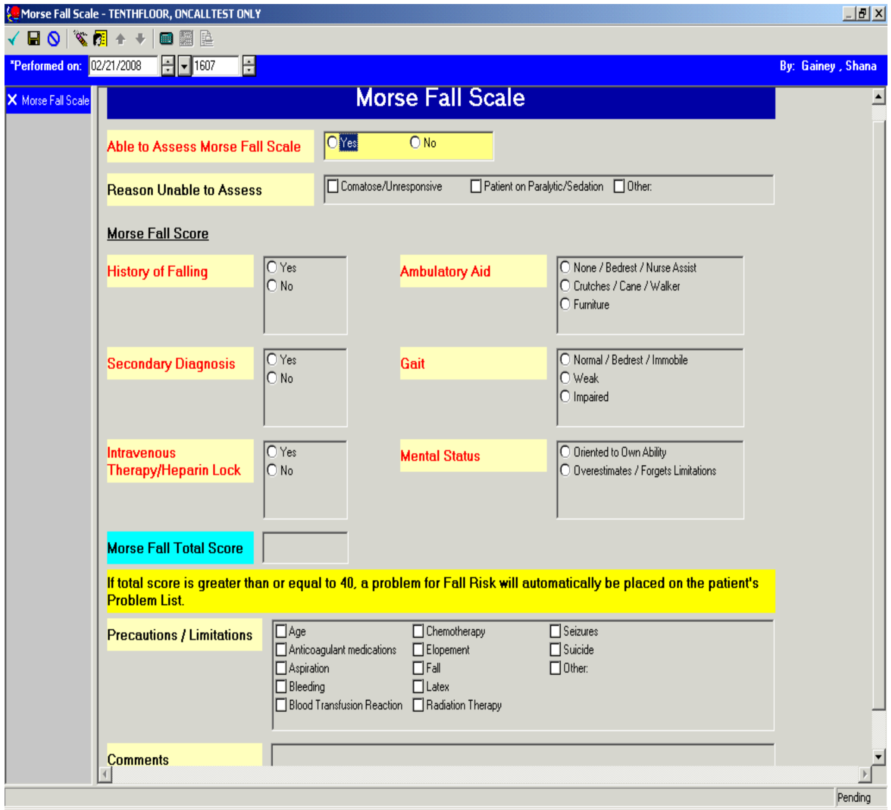
MORSE FALL SCALE ITEMS AND SCORES

Morse Fall Scale Items	Scoring
1. History of falling; immediate or within the last 3 months	No - 0 Yes - 25
2. Secondary Diagnosis	No - 0 Yes - 15
3. Ambulatory Aid	Bedrest/nursing assist - 0 Crutches/cane/walker - 15 Furniture - 30
4. IV/Heparin Lock	No - 0 Yes - 20
5. Gait/Transferring	Normal/bedrest/immobile - 0 Weak - 10 Impaired - 20
6. Mental Status	Oriented to own ability - 0 Forgets limitations - 15

A more recent study by Schwendimann et al. (2006) evaluated the effectiveness of the Morse Fall Scale tool via a prospective cohort group over a 4-month fall intervention study. This study was performed on adult patients with a wide range of medical conditions in a 300-bed, urban public hospital in Switzerland (Schwendimann et al., 2006). Schwendimann et al. (2006) found a sensitivity range of 91.5% to 38.3% and a specificity range of 81.7% to 10.9% for cutoff points 20 and 70, respectively. This study that examined the Morse Fall Scale in hospitalized patients found an optimal cutoff score of 55 to have sensitivity of 74.5% and specificity of 65.8%.

An internal review at UIMCC revealed that a cutoff of 40 captured >95% of patients at risk for falling and remains the current cutoff score for UIMCC. This was completed when the Morse Fall Scale was introduced to UIMCC in 1998 and based on an evaluation of patients who fell. The MFS will be used to determine the level of the FPP that will be implemented in the postimplementation group (standard versus high-risk interventions). Figure 8 contains a screen shot of the MFS used at UIMCC.

Figure 8. Screen Shot of the Morse Fall Scale.



This screen shot shows the Morse Fall Scale portion of the electronic medical record used at The University of Illinois Medical Center. The Morse Fall Scale is used as a screening tool for fall prevention. Reproduced with permission from the University of Illinois Medical Center at Chicago.

2. Fall-Rate Equation

The overall pre- and postfall rates will be determined by the overall number of falls. The equation for the fall rate is:

$$\frac{\text{Number of patient falls}}{\text{Number of patient days}} \times 1{,}000 = \text{fall rate per 1,000 patient days} \qquad (2)$$

This equation is a standard measurement of the fall rate and will be analyzed for the 1-year preintervention and the 1-year postintervention.

3. MIDAS Data Collection System

The MIDAS+ Care Management system is a national company that developed standard risk-reporting forms and systems. In 1998, MIDAS became an online occurrence reporting system. This system allows uniform data to be collected and compared and is widely accepted in the health-care industry as a means of increasing hospital operational efficiency (MIDAS+ Care Management System, 2010).

When the MIDAS instrument is used to analyze a patient fall, it collects a variety of data on the patient. The data are gathered either by hospital personnel who witnessed the fall, or , in the case of unwitnessed falls, the hospital worker who recognized that a fall had occurred. The MIDAS Occurrence Report for falls includes a collection of information about the incident surrounding the patient fall. Furthermore, the data collected in this report allow for internal evaluation as well as external comparison with national standards. Figure 9 contains a screen shot of the MIDAS Occurrence Report for falls.

Figure 9. MIDAS Fall Occurrence Report Form.

MIDAS Fall Occurrence Report Page 1 of 2

ATTENTION - This form is designed for NDNQI-- falls occurring on inpatient nursing units only

Facility * UNIVERSITY OF ILLINOIS HOSP

Incident Date * 12/2/2009

Incident No. * 09-5456

Incident Type *

Location *

Attributible Departments * Del

Time of fall *

Incident Possible Causes * Del

MD Evaluation Notified * No

Witnesses w/ ext Add Del

HARM SCORE *

NDNQI - Fall Assisted by Employee * --Select One--

NDNQI - Risk Assessment Prior to Fall? * --Select One--

NDNQI - Risk Assessment Scale Score? *

NDNQI - Time Since Last Risk Assessment? * --Select One--

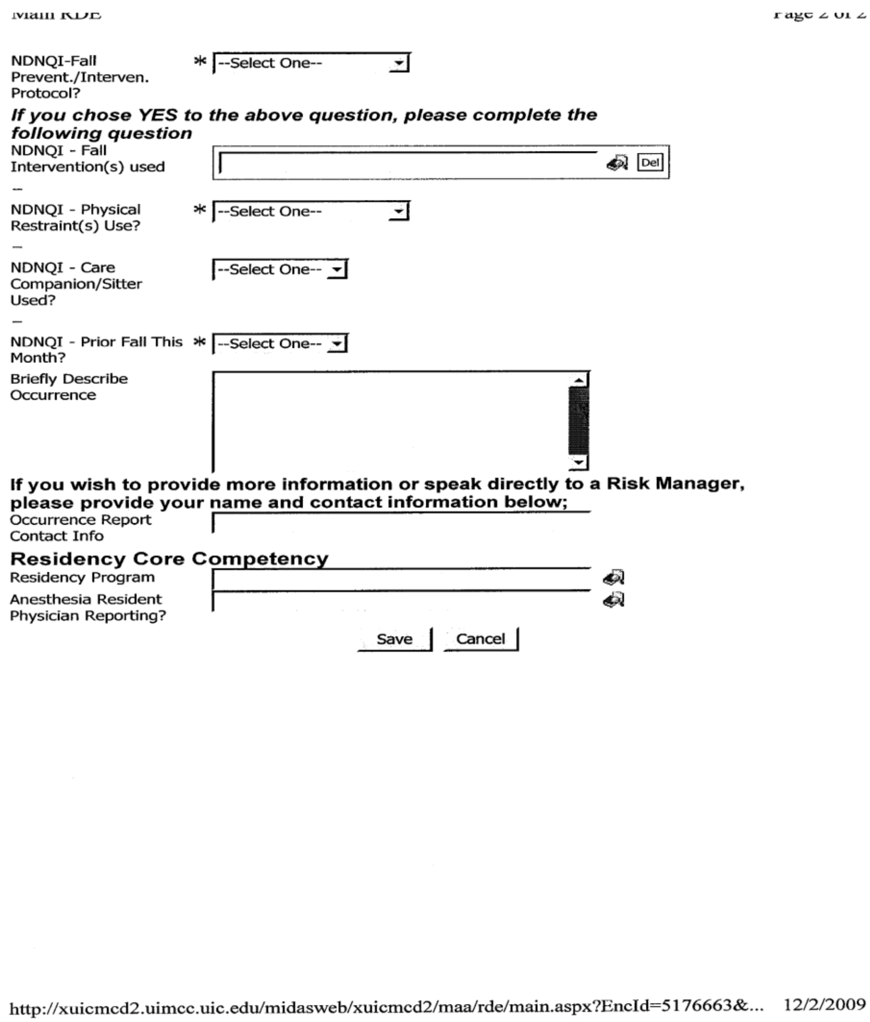
NDNQI - Patient at Fall Risk? * --Select One--

HARM SCORE

Name
HARM- Preventable
HARM-Unpreventable
NO HARM
NO HARM-Did not reach the patient (NEAR MISS)
UNDETERMINED-Cannot assess patient harm at this time

http://xuicmcd2.uimcc.uic.edu/midasweb/xuicmcd2/maa/rde/main.aspx?EncId=5176663&... 12/2/2009

Figure 9. (continued)


Main RDE Page 2 of 2

NDNQI-Fall Prevent./Interven. Protocol? * --Select One--

If you chose YES to the above question, please complete the following question

NDNQI - Fall Intervention(s) used [Del]

NDNQI - Physical Restraint(s) Use? * --Select One--

NDNQI - Care Companion/Sitter Used? --Select One--

NDNQI - Prior Fall This Month? * --Select One--

Briefly Describe Occurrence

If you wish to provide more information or speak directly to a Risk Manager, please provide your name and contact information below;

Occurrence Report Contact Info

Residency Core Competency

Residency Program

Anesthesia Resident Physician Reporting?

Save Cancel

http://xuicmcd2.uimcc.uic.edu/midasweb/xuicmcd2/maa/rde/main.aspx?EncId=5176663&... 12/2/2009

Screen shot of the MIDAS Fall Occurrence Report form. The form is part of the MIDAS occurrence system at the University of Illinois Medical Center. Reprinted with permission from the University of Illinois Medical Center at Chicago.

The MIDAS Fall Occurrence Report contains a mandatory reporting category pertaining to the harm the patient sustained from the fall. “Harm” is considered to be any physical injury that occurred as a result of the fall. Harm sustained from a fall is measured by assessing the online reporting form that medical staff completes whenever a patient falls. This electronic form provides detailed information pertaining to the patient's fall. One of the fields on this form pertains to the severity of the patient's fall. The options in this field are as follows:

- No harm—near miss
- No harm
- Unpreventable harm
- Preventable harm
- Unable to determine if harm occurred; further workup necessary

The above-mentioned fields do not provide much of a scale regarding the levels of severity of falls. They appear to provide information on whether a fall caused harm, which is more of a dichotomous variable than a scale. This data from the MIDAS report will be utilized along with chart audits to determine a harm score.

The MIDAS Occurrence Report also contains fields for indicating the type of fall and provides a comments section to describe the circumstances surrounding the fall. These will be analyzed to determine the types of falls that occurred both before and after implementation of the fall-prevention intervention. The type of falls measured in the MIDAS report are as follows:

- From bed
- Ambulating with permission

- Ambulating without permission
- During transfer
- Table/chair
- Shower/tub/toilet attended
- Shower/tub/toilet unattended
- Fainting/seizure
- Other

4. <u>Chart Audits</u>

Chart audits will be performed to generate additional analysis for H_2 and H_3 of this study. A standardized data collection form will be used to extrapolate the data from the chart audits (see TABLE III). Twenty charts will be reviewed initially to ensure that the appropriate categories are in place. These 20 charts will also be compared during the data collection phase to determine the accuracy of the audit.

TABLE III

SAMPLE DATA COLLECTION SHEET

Patient Number	Principle Payor	Incident Date	Incident Time	Incident Type	Incident Parameters	Incident Location	Significance - HARM (MIDAS)	LOS at time of incident	Total LOS	M/F Gender	Age	Admit Dx	# Comorbidities	Type of Fall (Chart Audit)	Harm Score/Severity of Fall (Joint Commission Scale)	MFS at time ofincident	Y/N Interventions documented at incident	Y/N Fall related to environment	Y/N Fall related to physiological response	Y/N Fall related to toileting	Y/N Altered mental status	Y/N Altered mobility status	Y/N Restraints Used at time of Incident	Y/N Sitter present at time of Incident	Additional Costs Related to Fall	Additional Days in Hospital Related to Fall	Total Additional Costs - Extrapolated	MFS Wrong	Near Miss - Lowered to ground
1																													
2																													
3																													
4																													
5																													

Note. MIDAS = Maximum Integrated Data Acquisition System; LOS = loss of consciousness; Dx = diagnosis; MFS = Morse Fall Scale.

The chart will be reviewed and a harm score determined based on the definitions of harm found in the Joint Commission International's *Nursing Sensitive Care Measures* (Joint

Commission International, 2010). The measures for harm (see Figure 10) range from no harm to death. The severity of the falls and whether the falls were preventable will be determined based on both the standardized chart audits and the MIDAS Occurrence Report.

Figure 10. Harm Definitions.

1. **None**—patient had no injuries
2. **Minor—**resulted in application of a dressing, ice, cleaning of a wound, limb elevation, topical medication, bruise or abrasion
3. **Moderate—**resulted in suturing, application of steristrips/skin glue, splinting, or muscle or joint strain
4. **Major**—resulted in surgery, casting, traction, fracture, or required consultation for neurological or internal injury
5. **Death—**the patient died as a result of injuries sustained from the fall
6. **UTD—**Unable to Determine from the documentation

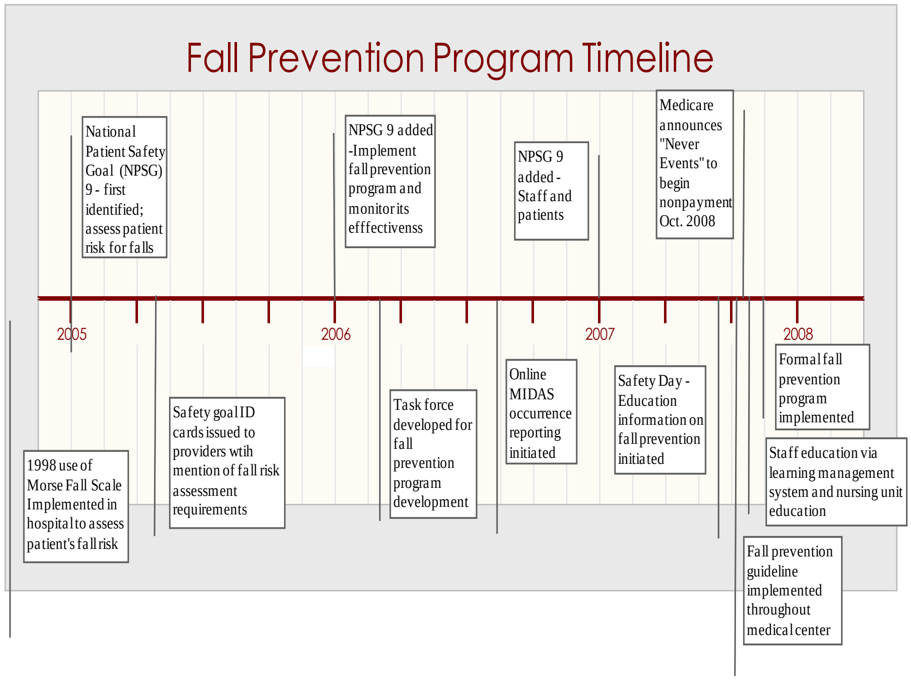
Reprinted with permission from *Joint Commission International.*

In addition to analyzing the severity of injury after a fall occurred, determining whether a change took place in the types of falls that occurred after intervention will be done by examining both the “type of fall” category in the MIDAS Occurrence Report and the chart audits. Knowing whether the type of falls changed after implementation of the program would indicate that the program had an effect on patient falls, because a change in the type of falls that occurred after the intervention can provide information on the interventions and potentially lead to further changes in the program that can decrease both the rate of patient falls and the severity of injury resulting from those falls.

F. Intervention Plan

The FPP was developed by the fall reduction task force, an interdisciplinary health-care group formed in 2006. The program is based on best practice guidelines and the literature on fall prevention. An overall time line for the FPP’s development and implementation is presented in Figure 11 and includes the external and internal patient safety measures that were taken during the period 1998–2008. The FPP provides standard interventions performed for all patients. The FPP includes information on assessing whether a patient is at risk for falling. After the level of risk is determined, specific interventions for the patients who are identified as high risk for falling are implemented.

Figure 11. Fall Prevention Program Time Line.



The time line represents events that occurred during the implementation period of the fall prevention program at the University of Illinois Medical Center at Chicago.

Education on the FPP was provided for staff in multiple ways. Clinical staff was provided an online learning module on prevention of patient falls and the key components of the intervention program (see Appendix B for a copy of the learning module). Clinical staff consists of staff members who have direct contact with patients. Nursing staff, who are the primary health-care team members involved in FPP implementation, received additional training that focused specifically on the fall-risk assessment tool (i.e., the Morse Fall Scale) and implementing the interventions. The training sessions were developed by the interdisciplinary health-care task force and provided in small-group form to all nursing staff. Both educational components were rolled out at the same time.

The Morse Fall Scale was part of the electronic medical record and was a required field for nurses to complete at admission and during reassessments. Education for patients concerning precautions to take against falling, as well as education on intervention, is listed in the nursing documentation in the electronic medical record. Incorporating these parts of the FPP into the electronic medical record permits the intervention implementation to be assessed.

This study will measure treatment implementation in a variety of ways. Treatment delivery is measured by means of the standardization of the education provided to the clinicians. The educational materials for the online learning module, as well as a standardized nursing educational in-service, were developed based on best practices. Treatment receipt was measured by the percentage of staff that received the standardized educational materials. Treatment adherence will be measured by monitoring the percentage of patient charts that indicate that fall precautions and preventions were undertaken.

To determine the fidelity and intensity of the intervention, the percentage of staff that receives the education will be tracked. Education of patients on fall prevention, provided by nursing staff, is also documented and will be monitored to determine the amount of fall precautions and interventions that patients are receiving. These are not direct measures of the program, but are available for examination.

G. Data Collection Procedures

Archival data from UIMCC will be collected for the period September 2006–August 2007. During this period, the UIMCC did not have a fall-prevention program, so these data will represent the preintervention group.

The fall-prevention program was implemented during the period September 2007–November 2007. Data will be collected for this phase of the intervention—the period during which the program was rolled out to staff throughout the Medical Center.

The FPP was developed by the fall-reduction task force and was based on best practice guidelines and the literature on prevention of falls. Archival data from the UIMCC will be collected for the period December 2007–November 2008, when the FPP was being implemented. These data will be used to analyze the postintervention group.

Patient data will be collected from the MIDAS Data Collection System and chart reviews from UIMCC. Preintervention data will be collected for the period September 2006–August 2007. The intervention phase spanned the period September 2007–November 2007. The postintervention data will be collected for the period December 2007–November 2008. Data will be analyzed for possible seasonal variation. All data are archival in nature, meaning that the intervention has been conducted and data have been collected.

H. Data Analysis

The analysis procedure will be conducted using the software program Statistical Package for the Social Sciences (SPSS), Student Version 19.0. The results are presented in Chapter IV. The demographics section will include a profile of participants in the data set. The summary of analysis will include a summary of the three hypotheses tested and is presented in both the text and in a table. The detail of analysis section will include a complete breakdown of the analysis conducted by hypothesis, including evaluation of appropriate assumptions and final inferential results.

The data analysis will include descriptive statistics, means, and standard deviations; frequency where applicable; and *z*-scores and plots to support assumptions of normality. A results table representing the proportions, the Kruskal-Wallis and chi-square tests, and other supporting figures will be displayed provided an effect is found. For these analyses, alpha will be set at $p = .05$, provided assumptions of normality are met. If these assumptions are violated, the appropriate next steps will be determined. For example, should assumptions be slightly violated, the researcher may choose to transform variables to normalize an offending distribution.

1. Profile of Sample

Variables of the pre- and postintervention groups will be used to profile participants. Each variable will be discussed using descriptive statistics in text and displayed within accompanying tables and figures. The information reported will include frequency count by group level (if appropriate), mean, standard deviation, skewness, kurtosis, and total number of participants (*N*). The programs SPSS/EXPLORE and SPSS/DESCRIPTIVE will be used to derive the aforementioned information.

2. Outliers

A test for univariate outliers will be conducted to determine whether any cases are not statistically part of the sample collected. To detect outliers, case scores will be converted into *z*-scores and compared with the critical value of +/- 3.29, $p < .001$ (Tabachnick and Fidell, 2007). Cases that exceed this value will be removed if warranted.

3. Missing Data

Cases with missing data will be detected by running frequency counts in SPSS 19.0. Any cases with missing data on more than 5% of the items will be summarily removed from further analysis. Cases with missing data on less than 5% of the items will be retained by inputting field means into empty cells.

4. Order of Analyses

Demographic data will be presented first to construct a profile of both the sample population and the patients in the pre- and postintervention groups who fell. Next, missing data and outliers will be evaluated and dealt with according to the prescription presented. Then, a *Z* test for proportions will be used to analyze H_1, Kruskal-Wallis will be used to test H_2, and a chi-square will be used to test H_3. Lastly, unintended consequences and program implementation will be examined.

5. *Z*-test for Proportions

The *Z*-test for two proportions will be used to test hypothesis 1. This test determines whether the proportions from two different groups differ significantly from each other. Data needed to conduct this test will consist of total sample size from both the pre- and postintervention groups, along with the fall rates from each group. Sample size for each group does not have to be equal for this analysis. The statistical equation for the test is written as:

$$Z = (p1 - p2)/SE \quad (3)$$

The proportion, or fall rate, of the preintervention group is represented by p1, and the proportion (or fall rate) of the postintervention group is represented by p2. *SE* is the standard error of the sampling distribution.

6. <u>Kruskal-Wallis</u>

The Kruskal-Wallis test will be used to test H_2. Originally, an analysis of variance was to have been used to test for significant differences in fall severity, depending on the period (i.e., preintervention, intervention, or postintervention). However, the severity variable was significantly positively skewed at all three time points (the majority of the scores were low, indicating no injury); thus, a parametric technique was not appropriate. A Kruskal-Wallis analysis, the nonparametric alternative to analysis of variance, was therefore the appropriate test to utilize for hypothesis 2. Nonparametric techniques do not require distributional assumptions (i.e., normality, homogeneity of variance). Kruskal-Wallis tests for significant differences in median scores, depending on the group.

7. Chi-Square

A chi-square (X^2) test will be used to analyze H_3. This statistic is used to test whether the distributions of categorical variables significantly differ from one another. Actual frequencies, rather than percentages, ratios, and means, will be used for this analysis. Specifically, the analysis for this study will use categorical variables—variables that place individuals into categories (e.g., those who fall while ambulating without assistance, fall from bed, or fall during transfer) and cannot be quantified in a meaningful way. Other examples of categorical variables include gender, eye color, or race.

I. Ethical Considerations

Archival data from hospital records will be used only to further the cause of science. No sensitive data will be collected or disclosed. An institutional review board exemption has been approved by the University of Illinois at Chicago. The researcher will not allow personal bias to affect results. In other words, results will be analyzed in accordance with standard research methods to ensure accuracy and comprehensiveness.

1. Confidentiality

No individually identifiable information will be disclosed or published, and all results will be presented as aggregate, summary data. The information will be kept confidential and secure by design. All aggregate data will be stored in a secured file for a minimum of 3 years and then permanently destroyed. If any content is published, it will be only for scientific purposes.

2. Risks and Benefits

There are no physical or mental risks involved in the study. However, there are direct benefits that may result from this research. This study may help to prompt further research on the topic and improve medical practices pertaining to decreasing patient falls and fall-related injuries, as well as possibly effect a shift in the types of falls that occur.

J. Product

The intended product of this study is an effective fall-prevention program that can decrease fall rates in hospitalized patients, decrease the severity of their falls, and decrease costs associated with such falls. It is hoped that this program can be continued at UIMCC. It is also hoped that an effective FPP can be made available to other large, urban medical centers throughout the country.

K. Plausible Threats to Validity of Study Inferences

There can be multiple threats to validity. Plausible threats to validity, including threats to internal validity, external validity, construct validity, and statistical conclusion validity, have been evaluated for this study. Internal validity examines the causal relationship of the study (Trochim and Donnelly, 2008). External validity examines the generalizability of the study to other populations, settings, treatment variables, and measurement variables (Shadish et al., 2002). Construct validity evaluates the degree to which the operationalized program reflects the theorized program (Trochim and Donnelly, 2008). Statistical conclusion validity examines the degree to which the conclusions drawn about relationships based on the data are reasonable (Trochim and Donnelly, 2008). Threats to validity provide reasons why a study can be partly or completely wrong when inferences are made about covariance, causation, or constructs, or about whether the causal relationship holds across variations in persons, setting, treatments, and outcomes (Shadish et al., 2002). Potential threats to a study's validity need to be evaluated, and when possible, controlled.

Appropriate measures will be taken to account for these plausible threats to validity.

1. <u>Internal Validity</u>

In this study, the main potential threat to validity is an internal validity threat that pertains to history. A history threat is when coincidental happenings occur simultaneously with the study (Shadish et. al, 2002). The FPP and the pre- and postprogram implementation were rolled out in a large medical center that may have other initiatives that could directly or indirectly affect the FPP. Although the constraints of the mandate to develop a hospitalwide program cannot be controlled for in the design of the study, they can be identified and explained. The graphic in Figure 11 was designed to identify a time line of initiatives related to fall prevention.

However, Joint Commission National Patient Safety Goals were established in 2002 with the mandate that they be implemented in 2003, with revisions made each year based on a review by a panel of experts. As a result, other safety initiatives have been implemented in the hospital since 2003. These additional safety initiatives could have impacted the 2006 goal of implementing a fall prevention program to reduce patient falls (The Joint Commission, 2009). Given that awareness of safety initiatives and patient safety goals had begun several years prior to this program's initiation, the initial impact of the rollout of safety initiatives should have stabilized by the time the fall prevention program was implemented in 2007. These other Joint Commission safety goals did not have a direct link to patient falls (e.g., use of two patient identifiers when providing care, report critical results in a timely manner, medication labeling, and hand hygiene). Additionally, the researcher has spoken with several key personnel involved with patient safety at UIMCC who were at the Medical Center during this period, and none could recall other initiatives that would have been related to or impacted the FPP implementation.

Another internal validity threat present in this design is treatment fidelity. Because of the large number of clinicians and nurses who will receive education on the FPP and implement the program, it will be challenging to control for successful implementation of appropriate treatment. The solution, in terms of this study, is to standardize the training provided to those who implement the program. In addition, treatment fidelity in the design and implementation of the FPP can be controlled for by mandating that clinicians and nurses complete compliance forms before implementing the program.

2. External Validity

The ability to generalize the findings of this study will depend on the ability to demonstrate that the persons served in UIMCC are similar to patients in other medical facilities and that their characteristics have remained relatively constant over time. This will be done by gathering a variety of categories of demographics that pertain to the intervention and comparison groups. This will help to generalize the two groups to patients with similar demographics in other facilities. It will also hold true for the demographics of UIMCC and the ability to compare this medical center with other medical centers with similar characteristics. The demographics of the persons served at this facility will be measured over time, so if the demographic findings remain constant, generalizability will be enhanced for future program implementation. In addition, UHC does comparisons of like hospitals. Therefore, hospitals that match with UIMCC in the UHC database could extrapolate that an FPP that is effective at UIMCC could be effective in their own facilities.

A potential external validity threat involves interaction of the causal relationship with settings. If there is any change in the setting, there could also be a change in the causal relationship. This can be controlled for by comparing the demographic data of the setting with those of other settings and documenting a time line of events that could affect the study's outcomes.

Another potential external validity threat is context-dependent mediation, whereby mediators may be present in one setting but not in another. This threat can be evaluated by identifying possible mediators and comparing them across settings, outcomes, and units. For example, while this program might work in other large, urban medical centers settings, it might not work in a small rural hospital that has different mediators, such as the types of patients who receive services.

3. Construct Validity

The FPP is a well-defined program, and this study will use a logic model to decrease the threat to construct validity by clarifying the program and intended results. The major potential threat to construct validity in this study is mono-method bias. The method of measurement of the severity of a fall is part of a single occurrence report. In this study, the use of dual measurement methods—both chart audits and review of the MIDAS Occurrence Report—will improve validity. The potential mono-operational bias of the treatment is controlled for in the design by the multiple educational methods that are in place for the program's implementation.

Experimenter expectations could be a threat to construct validity and will be controlled for by utilizing standard measurement tools for both the pre- and postcomparison groups. Participant novelty and disruption effect are other construct validity threats. These will be controlled for by using multiple measures over time to verify that any novelty effects do not dissipate and by adhering to a 3-month intervention time frame.

4. <u>Statistical Conclusion Validity</u>

In this study, the main threat to statistical conclusion validity is the unreliability of treatment implementation. The study's design will control for this by implementing the program in a standardized manner, with specific educational components distributed across the entire medical center. This threat will also be controlled for by measuring other components of the program, such as the percentage of staff who received the standardized education on the FPP and the percentage of patients who received the program.

Another threat to statistical conclusion validity is unreliability of measures. The predeveloped Morse Fall Scale and MIDAS reports are standardized in their use but may not accurately cover the construct that is measured. While it is outside the context of this study, if concern should emerge from within the profession regarding the Morse Fall Scale or the MIDAS reporting system, future studies could be performed to reanalyze these measurement scales with use of the Rasch model for person and item fit. These measures are the current accepted industry standard. Chart audits will be used to verify the accuracy of the measurement tools that are used.

An additional threat to statistical conclusion validity is heterogeneity of units, with the unit being the sample. This could occur if the patient demographics in the pre- and postintervention groups are not the same. The demographics of UIMCC patients historically have remained relatively constant. The demographics of the pre- and postcomparison groups will be verified throughout implementation of the FPP by analyzing the admitting diagnoses at pre- and postcomparison. If a difference is identified, blocking or matching will be performed to decrease the effect of any changes in experimental setting on the pre- and postcomparison groups.

L. Monitoring Unintended Consequences

When focusing on preventing falls, there is the potential for unintended consequences to occur. To ensure that they did not, the number of times that restraints were used for those patients who sustained a fall will be evaluated as will the number of pressure sores and cases of pneumonia.

M. **Summary**

This quantitative research study was designed to evaluate the effects of the FPP on rates of falls, severity of falls, and types of falls. This chapter described the research methodology that will be used to accomplish that purpose. In addition, it described the participants, instrumentation, study validity, data collection procedures, and data interpretation/analysis. Ethical considerations to ensure confidentiality and protection of patient data also were addressed.

Chapter IV includes a description of the demographic profile of the participants, the data analysis procedures, and the results of the study as they pertain to the hypotheses and research questions. Chapter V provides an overview of the study, interpretation of the findings, implications of the findings, limitations of the study, and suggestions for future research.

II. RESULTS

This chapter provides the analysis of the data pertaining to whether a fall prevention program in a hospital can have an impact on the rate of patient falls, the severity of those falls, and the types of falls that occur. The findings of the analysis, described in the previous chapter, will be reported. This chapter begins with a review of the demographics of the hospital across the preintervention, intervention, and postintervention periods. The presentation of the results then follows, in order of the research questions posed in Chapter III. Finally, the results related to unintended consequences and program implementation are presented.

A. Demographics Among the Groups

Two different demographics were reviewed. First, analysis of the entire population at UIMCC was performed over the 3 fiscal years that encompassed the study time frame. Second, analysis of demographics of the patients in the pre- and postintervention groups who fell was performed.

1. Demographics of Medical Center Population

A review of the types of patients admitted to UIMCC during the 3 fiscal years in which this study was performed was conducted. Although the information does not align to the exact months of the study, the time frames of the 3 fiscal years does provide additional data on the patient populations served at the hospital before and after the study’s time frame.

Assessment of the 3 fiscal years provides additional data on the type of patients the Medical Center served beyond the study’s time frame. TABLE IV displays the available data related to admitting diagnosis for the patients admitted to the medical units at UIMCC during the 3 fiscal years the study was conducted.

TABLE IV

DEMOGRAPHICS OF UIMCC BY MEDICAL UNIT FOR 3 FISCAL YEARS

Program Title	FY07	%FY07	FY08	%FY08	FY09	%FY09
Hospital West Medical Surgery/Oncology	8,633	8.77%	I,984	8.93%	8,456	8.60%
Hospital Bone Marrow Transplant Unit	3,165	3.21%	3,199	3.18%	3,075	3.31%
Hospital Neurosurgery Intensive Care Unit	7,040	7.15%	6,522	6.48%	6,655	6.77%
Hospital Nurisng-Neurosurgery-6-E	8,259	8.39%	8,489	8.44%	8,076	8.21%
Hospital Ctu/Ccu 645 West	2,834	2.88%	2,880	2.86%	2,771	2.82%
Hospital Nursing Medical Step Down Unit	7,676	7.80%	7,954	7.90%	7,561	7.69%
Hospital Psychiatry 855 East	9,259	9.40%	10,845	10.78%	10,452	10.63%
Hospital Adolescent Unit	3,239	3.29%	3,261	3.24%	3,253	3.31%
Hospital Orthopaedics Nursing	1,654	1.68%	1,792	1.78%	3,370	3.43%
Hospital Observation	2,774	2.82%	3,266	3.25%	3,940	4.01%
Hospital Medicine Intensive Care Unit	2,741	2.78%	2,637	2.62%	2,452	2.49%
Hospital Women's Family Health Care Services Total	9,604	9.75%	9,684	9.62%	9,610	9.77%
Hospital 7 East Medicine	13,387	13.60%	13,797	13.71%	11,830	12.03%
Hospital 7 West GI/Surgery	9,834	9.99%	8,794	8.74%	7,803	7.93%
Hospital Rehabilitation Unit	4,273	4.34%	4,038	4.01%	4,171	4.24%
Hospital Nursing Organ Tr & Kidney Dnr 7-W	4,094	4.16%	4,495	4.47%	4,867	4.95%
Total Paitent Days without Newborns	98,465		100,646		98,342	

Note. Ctu = cardiothoracic unit; Ccu = cardiac care unit; GI= gastrointestinal; Tr = transplant; Dnr = donor.

TABLE V displays the frequency count of patients by program title for 3 years. A one-sample test of independence was conducted to determine whether counts by category across years were significantly different. Test results indicated that for 13 of the

17 categories, frequency counts across years differed significantly where $p < .01$. The patient populations over the 3 fiscal years is discussed in more detail in Chapter V.

TABLE V

FREQUENCY COUNT OF PARTICIPANTS BY YEAR AND CATEGORY

Program Title	FY07	FY08	FY09	P value
Hospital West Medical Surgery/Oncology	8,633	8,984	8,456	***0.001
Hospital Bone Marrow Transplant Unit	3,165	3,199	3,075	0.271
Hospital Neurosurgery Intensive Care Unit	7,040	6,522	6,655	***0.001
Hospital Nurisng-Neurosurgery-6-E	8,259	8,489	8,076	***0.001
Hospital Ctu/Ccu 645 West	2,834	2,880	2,771	0.347
Hospital Nursing Medical Step Down Unit	7,676	7,954	7,561	**0.005
Hospital Psychiatry 855 East	9,259	10,845	10,452	***0.001
Hospital Adolescent Unit	3,239	3,261	3,253	0.963
Hospital Orthopaedics Nursing	1,654	1,792	3,370	***0.001
Hospital Observation	2,774	3,266	3,940	***0.001
Hospital Medicine Intensive Care Unit	2,741	2,637	2,452	***0.001
Hospital Women's Family Health Care Services Total	9,604	9,684	9,610	0.814
Hospital 7 East Medicine	13,387	13,797	11,830	***0.001
Hospital 7 West GI/Surgery	9,834	8,794	7,803	***0.001
Hospital Rehabilitation Unit	4,273	4,038	4,171	**0.030
Hospital Nursing Organ Tr & Kidney Dnr 7-W	4,094	4,495	4,867	***0.001
Total Paitent Days without Newborns	98,465	100,646	98,342	***0.001

Note. *** = significant at less than .001; ** = significant at less than .01; Ctu = cardiothoracic unit; Ccu = cardiac care unit; GI = gastrointestinal; Tr = transplant; Dnr = donor.

Additional information pertaining to age and gender for adult patients admitted to UIMCC was gathered during the preintervention, intervention, and postintervention periods.

TABLE VI shows the total number of patients served, average patient age, and gender percentages of the adult patients at UIMCC.

TABLE VI

AGE AND GENDER OF PATIENTS OVER TIME

Time Period	Total Number of Patients Served at UIMCC	Average Patient Age	Percentage Female	Percentage Male
Preintervention (1 year)	16,680	46.90	63.36%	36.64%
Intervention (3 months)	4,381	47.56	61.86%	38.14%
Postintervention (1 year)	17,477	47.53	63.72%	36.28%
2 Years Postintervention	16,233	47.65	62.48%	37.52%

In addition, information related to ethnicity was gathered during these three time periods. TABLE VII shows the ethnicity of the adult patients at UIMCC.

TABLE VII

PATIENT ETHNICITY OVER TIME

Time Period	African American	American Indian/ Alaskan	Decline/ Unknown/ Other	Hispanic	Caucasian	Asian/ Pacific Islancer
Preintervention (1 year)	50.00%	0.002%	4.23%	22.71%	21.40%	1.49%
Intervention (3 months)	51.08%	0.003%	3.70%	22.92%	20.05%	1.53%
Postintervention (1 year)	50.93%	0.002%	4.85%	21.54%	20.86%	1.68%
2 Years Postintervention	50.62%	0.003%	16.65%	10.36%	19.95%	2.13%

The last area of information that was gathered on the patients during the study period to help determine that no other major changes co-occurred with the intervention was the payer mix of the adult patients at UIMCC. TABLE VIII reveals the payer mix for the three time periods of the study.

TABLE VIII

PAYER MIX OVER TIME

Time Period	Missing Ins Info	BCBS	Illinois Corrections	HMO/PPO/ Managed Care	Campus Care	Medicaid	Medicare	VA	Worker's Comp	Charity Care	Medicaid Pending	Unknown
Preintervention (1 year)	2.19%	8.58%	1.64%	20.21%	0.90%	34.88%	28.83%	0.30%	0.25%	0.64%	1.11%	0.46%
Intervention (3 months)	2.17%	8.40%	1.96%	20.22%	0.79%	35.52%	29.31%	0.16%	0.14%	0.57%	0.34%	0.43%
Postintervention (1 year)	2.33%	8.87%	1.20%	20.38%	0.89%	35.64%	28.23%	0.33%	0.14%	0.78%	0.79%	0.42%
2 Years Postintervention	2.16%	10.07%	1.22%	19.50%	0.89%	33.67%	29.12%	0.57%	0.20%	0.87%	1.40%	0.31%

Staffing can also have an impact on the effectiveness of a new program. Nursing staff are the primary personnel who implement fall-prevention strategies for patients. It is therefore important to review staffing patterns to make sure that there was no significant change that could impact the results beyond the intervention itself. TABLE IX shows the turnover rate of nursing staff over the years of the intervention period.

TABLE IX

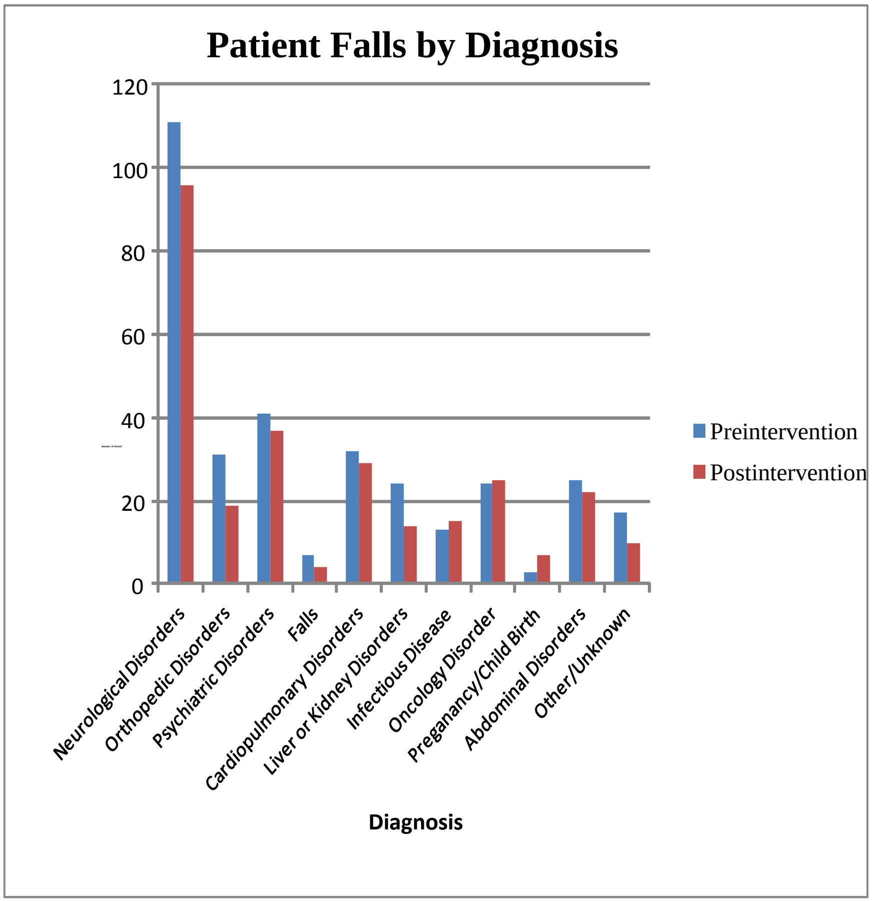
NURSING STAFF TURNOVER

	# of RN Separations (Only)	# RN Employees (Only)	Turnover Rate (By Year)
2006	44	956	4.60%
2007	64	976	6.56%
2008	59	995	5.93%
2009	47	950	4.95%
2010	42	942	4.46%
2011	73	885	8.25%

2. <u>Demographics of Patient Falls Pre- and Postintervention</u>

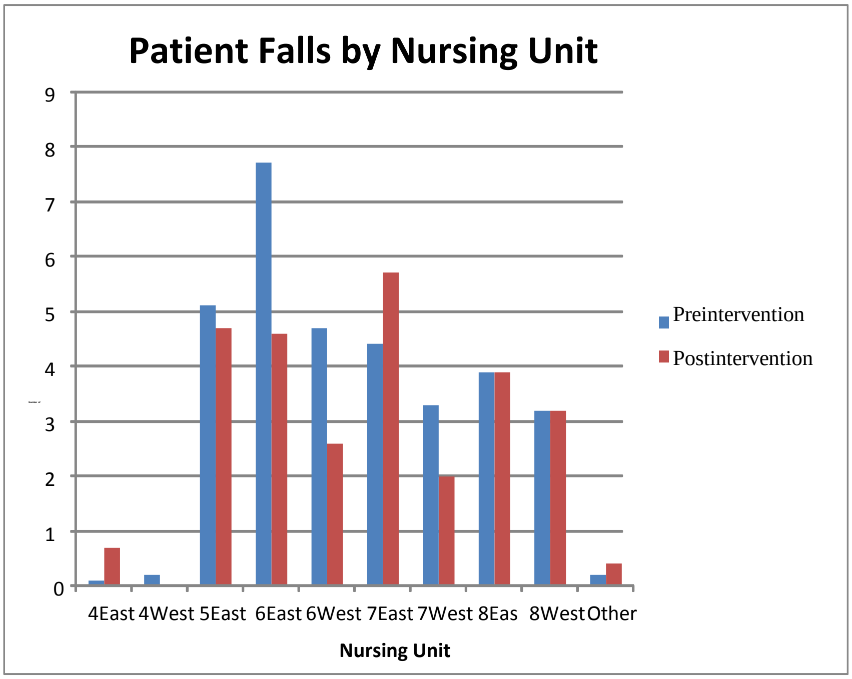
Demographics of the patients who fell during the preintervention compared with patients who fell during the postintervention were examined. Patient falls by diagnosis was examined. In Figure 12, the number of patient falls is displayed by primary admitting diagnoses for the pre- and postintervention groups.

Figure 12. Patient Falls by Diagnosis.



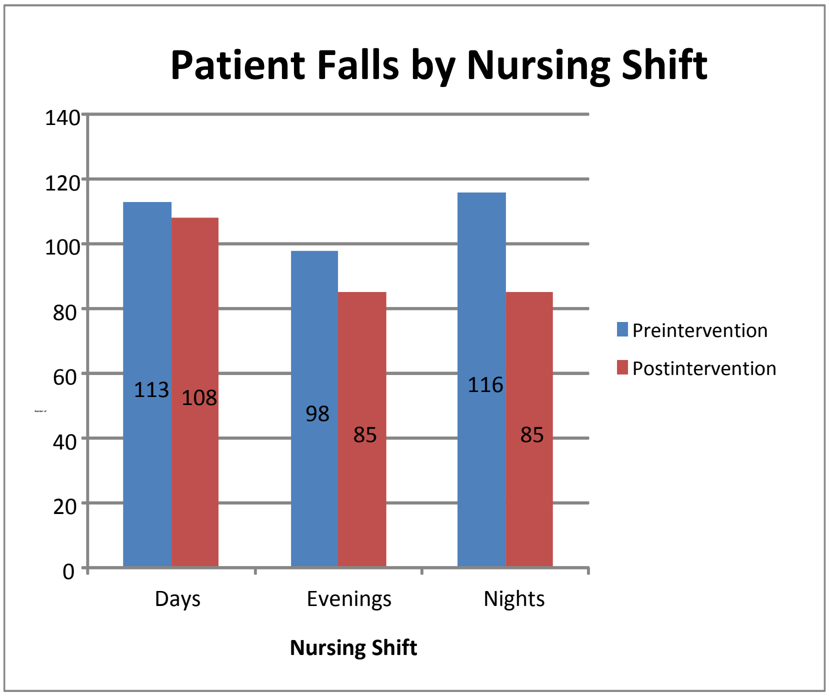
The number of patient falls by nursing unit was examined. As shown in Figure 13, the nursing unit fall numbers in the pre- and postintervention groups are examined.

Figure 13. Patient Falls by Nursing Unit.



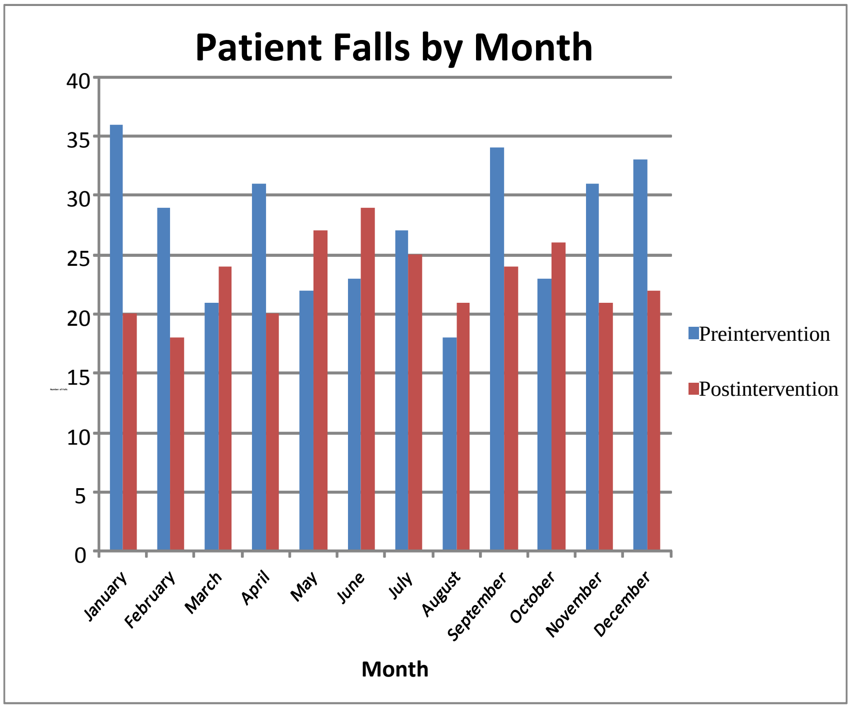
Data related to nursing shifts and shift changes were examined. Nursing shifts were defined as day, evening, and night shifts. The day shift was from 7 A.M. until 2:59 P.M., the evening shift was from 3 P.M. to 10:59 P.M., and the night shift was from 11:00 P.M. to 6:59 A.M. The number of patient falls by nursing shift is depicted in Figure 14.

Figure 14. Patient Falls by Nursing Shift.



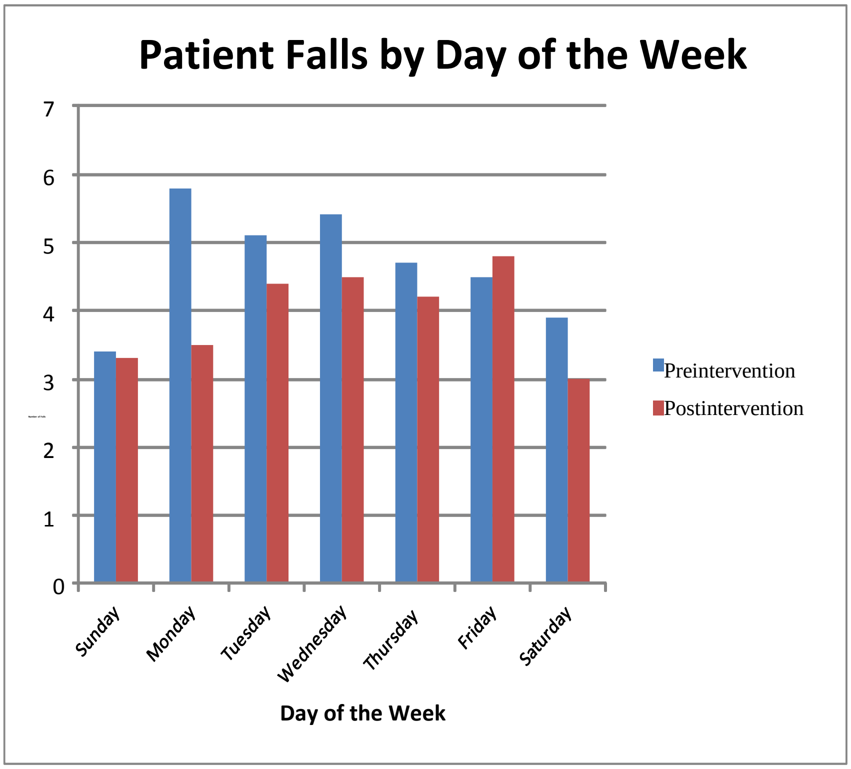
A review for any similarities, such as seasonal effects, that were present in both groups was performed. Data for potential seasonal effects also were examined. Given that both groups were examined over a period of a year, the opportunity existed to determine whether falls in general have a seasonal or cyclical pattern. Figure 15 shows the patient falls by month for the pre- and postintervention groups.

Figure 15. Patient Falls by Month.



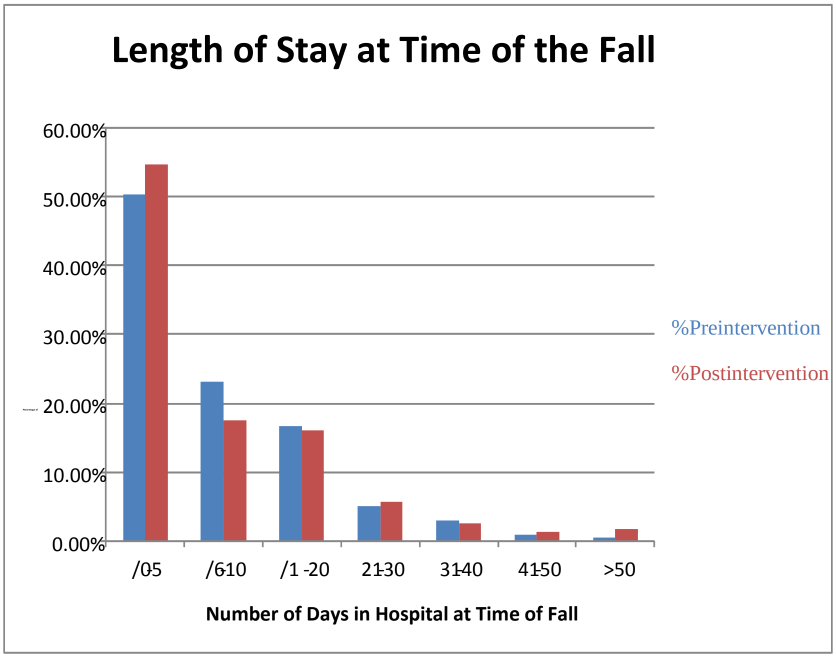
In addition, a cyclical pattern for day of the week was examined in the pre- and postintervention groups. Figure 16 displays the pre- and postintervention data by day of the week.

Figure 16. Patient Falls by Day of the Week.



Examination of the length of stay at time of the fall was performed. Figure 17 reveals that the majority of falls occurred within the first 5 days of admission.

Figure 17. Patient Falls by Length of Stay at Time of the Fall.



B. **<u>Research Questions and Hypotheses</u>**

The research questions were developed based on the existing literature on preventing patient falls during hospitalization by using program evaluation. The program was developed using a transformation-process-output model as the construct of the intervention.

The hypotheses are restated below. Each research question is described in terms of the variables and the technique used to test the hypothesis (TABLE X).

a. Participation in the FPP will result in a significant decrease in the number of falls that occur during hospitalization among adult patients 18 years and older who receive the intervention.

b. Participation in the FPP will result in a significant decrease in the severity of injuries resulting from falls that occur during hospitalization among patients who receive the intervention.

c. Participation in the FPP will affect the types of falls that occur during hospitalization among patients who receive the intervention.

TABLE X

VARIABLES, LEVELS OF MEASUREMENT, AND STATISTICAL TECHNIQUES FOR HYPOTHESES

Hypothesis	DV	IV	Level of Measurement (DV/IV)	Statistic
H_1	Fall rates	FPP	Frequency/ Nominal	Proportions
H_2	Severity of injury	FPP	Interval/ Nominal	Kruskal-Wallis
H_3	Type of fall	FPP	Nominal/ Nominal	Chi-square

Note. DV = dependent variable; IV = independent variable; FPP = fall prevention program.

1. <u>Data Analysis Procedure</u>

Inferential statistics were used to draw conclusions from the sample tested. The Statistical Package for the Social Sciences (SPSS), Version 19 (the most recent version), was used to code and tabulate scores and provide summarized values where applicable. The *Z*-test for two proportions, the Kruskal-Wallis test, and the chi-square test were used to test the respective hypotheses. The assumptions of all tests were evaluated prior to the analysis. The alpha level was set at .05.

2. <u>Hypothesis 1 Findings</u>

Hypothesis 1 stated: Participation in the FPP will result in a significant decrease in the number of falls during hospitalization among adult patients 18 years and older who receive the intervention. The average fall rate during the preintervention period was 2.66, indicating that approximately 3 falls occurred every 1,000 days. During the intervention period, the fall rate was approximately 2.5 falls per 1,000 days (2.47). The fall rate during the postintervention period was 2.22. The number of patient days, number of falls, and average rate of falls for the three periods (i.e., preintervention, intervention, and postintervention) are displayed in TABLE XI.

TABLE XI

NUMBER OF PATIENT DAYS, NUMBER OF PATIENT FALLS, AND FALL RATE PER 1,000 DAYS FOR THE THREE PERIODS

Statistic	Preintervention	Intervention	Postintervention
# Patient days	123,060	31,535	124,438
# Falls	328	78	278
Fall rate	2.66	2.47	2.22
Proportion (p; #falls/#patient days)	0.0027	0.0025	0.0022

To test whether the difference in proportions (i.e., number of falls per number of patient days) was statistically significant, a *Z*-proportions test for two independent samples was conducted for all three comparisons (i.e., preintervention vs. intervention, preintervention vs. postintervention, and intervention vs. postintervention). One of the *Z*-proportion tests was significant, indicating that the fall rate from preintervention to postintervention decreased from 2.66 to 2.22, a change large enough to be statistically significant at the $p < .05$ level. The results of the *Z*-proportion tests are provided in TABLE XII.

TABLE XII

SUMMARY FOR Z-PROPORTION TESTS

Comparison	p_a-p_b	Z	p
Preintervention vs. intervention	0.0002	0.594	0.276
Preintervention vs. postintervention	0.0004	2.171	*0.015
Intervention vs postintervention	0.0002	0.796	0.213

Note. One-tailed *p* values reported. Asterisk (*) indicates that difference was significant at $p < .05$.

3. Hypothesis 2 Findings

Hypothesis 2 stated: Participation in the FPP will result in a significant decrease in the severity of injuries resulting from falls during hospitalization among patients who receive the intervention. A Kruskal-Wallis analysis, the nonparametric alternative to analysis of variance, was used. Nonparametric techniques do not require distributional assumptions (i.e., normality, homogeneity of variance). Kruskal-Wallis tests for significant differences in median scores, depending on group. Frequency statistics for fall severity, by time point, are provided in TABLE XIII.

TABLE XIII

COUNT AND PERCENTAGE STATISTICS FOR FALL SEVERITY, BY GROUP

Time Point	Severity	Frequency	Percent
Preintervention	None	259	79
	Minor	54	16.5
	Moderate	7	2.1
	Major	8	2.4
	Total	328	100
Intervention	None	67	85.9
	Minor	9	11.5
	Moderate	1	1.3
	Major	1	1.3
	Total	78	100
Postintervention	None	211	76.2
	Minor	55	19.9
	Moderate	6	2.2
	Major	5	1.8
	Total	277	100

Note. The Kruskal-Wallis test was not significant (χ^2 (2) = 3.333, p = .189). There was not a significant difference in median scores depending on time point. The median score for each time point was 1, indicating that the patients had no injuries.

4. Hypothesis 3 Findings

Hypothesis 3 stated: Participation in the FPP will affect the types of falls during hospitalization among patients who receive the intervention. A chi-square test for independence was conducted to determine whether there was an association between time point (i.e., preintervention, intervention, and postintervention) and fall type (i.e., from bed, table/chair, during transfer, ambulating with permission, ambulating without permission, shower/tub/toilet attended, shower/tub/toilet unattended, fainting/seizure, or other). Frequency statistics for fall type, by time point, are provided in TABLE XIV. The values are sorted from highest to lowest, by percentage.

TABLE XIV

COUNT AND PERCENTAGE STATISTICS FOR FALL TYPE BY GROUP

Time Point	Fall Type	Frequency	Percent
Preintervention	From bed	80	24.4
	Ambulating without permission	66	20.1
	Other	54	16.5
	Ambulating with permission	40	12.2
	Shower/tub/toilet unattended	31	9.5
	Table/chair	23	7
	Shower/tub/toilet attended	18	5.5
	During transfer	12	3.7
	Fainting/seizure	4	1.2
	Total	328	100
Intervention	From bed	14	17.9
	Ambulating without permission	13	16.7
	Shower/tub/toilet unattended	12	15.4
	Other	12	15.4
	Ambulating with permission	10	12.8
	Table/chair	8	10.3
	During transfer	8	10.3
	Fainting/seizure	1	1.3
	Shower/tub/toilet attended	0	0
	Total	78	100
Postintervention	Ambulating without permission	76	27.4
	From bed	48	17.3
	Ambulating with permission	41	14.8
	Other	41	14.8
	Shower/tub/toilet unattended	23	8.3
	Table/chair	22	7.9
	During transfer	14	5.1
	Shower/tub/toilet attended	8	2.9
	Fainting/seizure	4	1.4
	Total	277	100

The chi-square test for independence was not significant (χ^2 (16) = 25.601, p = .060). There was no association between time point and fall type.

C. **Unintended Consequences and Program Implementation**

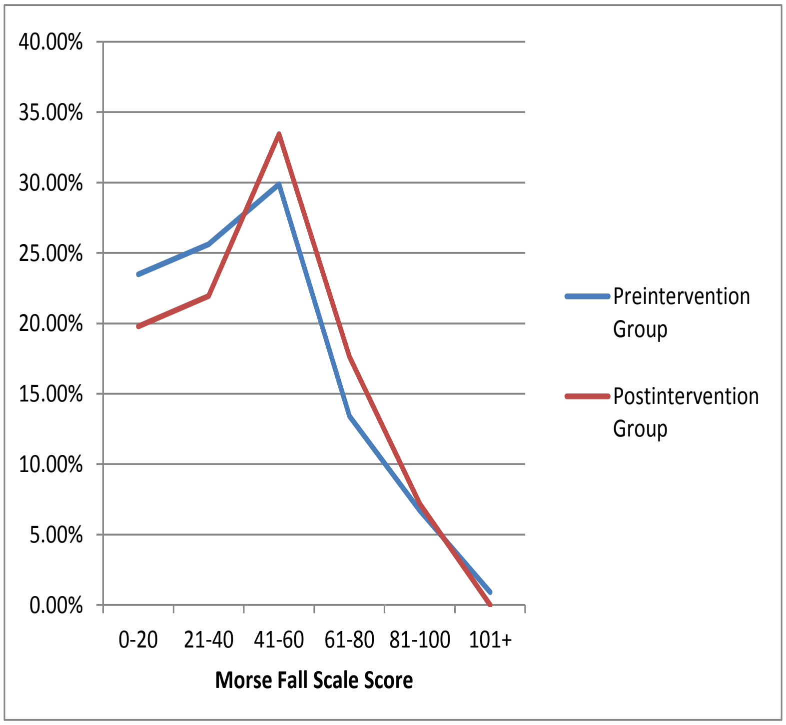
Data from UIMCC on restraints, skin breakdown, or pneumonia did not become available until after 2008, so it cannot be formally evaluated at this time. Of the patients who fell, the number of patients in the pre- and postintervention groups who were given restraints was 3 each. Sitters were utilized in 10 cases in the preintervention group and in 7 cases in the postintervention group. During chart reviews, there were no reports of noticeable skin breakdown or pneumonias in either group.

When the program was first rolled out, an online learning module (Appendix B) was delivered as a required educational course to all staff who interacted with patients. They were given the time frame of September through November to complete the module. There was a >96% completion rate for staff.

The percentage of patients in the preintervention group who fell and were scored incorrectly was 11.89%, compared with the postintervention group, in which only 5.75% of the patients were scored incorrectly. In the preintervention group, the percentage of patients who had a MFS score of ≥40, which would put them into the high-risk group, was 54.46%, compared with the postintervention group, in which 61.15% of the patients were identified as being at high risk for falling. The percentage of patients in the preintervention group for whom intervention implementation was documented was 49.08%, compared with the postintervention group, in which 57.91% of the patients received documentation of intervention implementation.

The distribution of MFS scores for patients in the pre- and postintervention groups was reviewed. For both groups, the majority of patients who fell were scored between 41-60 on the MFS. Figure 18 reveals a slight shift in MFS scores between the pre- and postintervention groups. A slight shift in score was observed in the postintervention group, who had a higher MFS score at the time of the fall. This correlates with the abovementioned findings that more accuracy existed in the scoring of the MFS and that there was a slight increase in the postintervention group scores in comparison with the UIMCC cutoff score of $\geq$40.

Figure 18. Pre- and Postinterventions MFS Scores.



Twenty charts were initially audited to ensure the correct data were being collected. These 20 charts were compared for reliability of data collection with the charts after all data were collected, and no differences in various data points were noted for these 20 charts.

D. <u>Summary</u>

This research study was designed to evaluate the effectiveness of the FPP. This chapter described the analysis of the three hypotheses—the effect of the FPP on (a) rates of falls, (b) severity of falls, and (c) types of falls. It also examined the demographic profile of the participants of the two groups. Chapter V provides an overview of the study, interpretation, and implications of the findings for the three hypotheses and related demographics; limitations of the study; and conclusions, including suggestions for future research.

V. DISCUSSION

This chapter summarizes and discusses the key findings obtained from the study. Demographics among the groups are discussed, as are the findings related to the three hypotheses. The purpose of this study was to examine whether a fall prevention program implemented in a hospital setting was effective at reducing patient falls. Another purpose of the study was to evaluate whether the FPP decreased the severity of injury that patients sustained during a fall. This study also was intended to determine whether the types of falls patients experienced changed with the implementation of a fall prevention program. In addition, unintended consequences and program implementation are examined. Lastly, this chapter reviews the limitations of the study and conclusions.

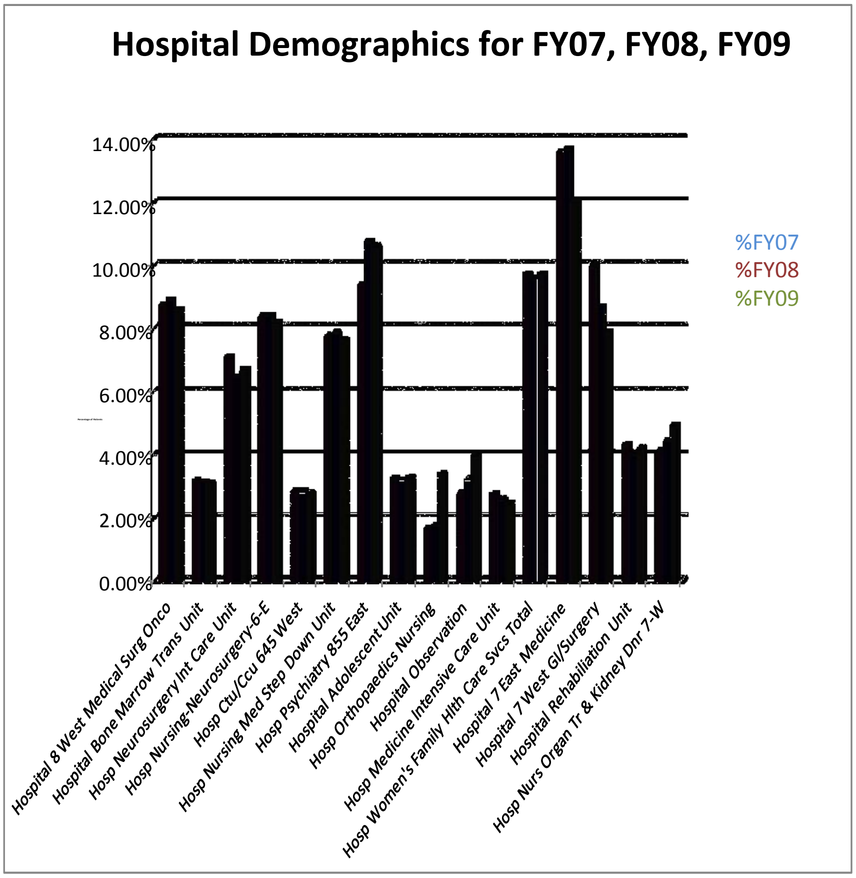
A. Demographics Among the Groups

Demographics of the populations of the Medical Center during the time of the study were analyzed. In addition, the types of patients in the preintervention and postintervention groups who fell were examined.

1. **Demographics of Medical Center Population Over Time**

A review of the types of patients who were admitted to UIMCC during the 3 fiscal years of this study was completed. The review was undertaken to determine whether a major shift in the patient populations during the three phases of the study occurred that would have an impact on the results. Comparison of the patient types over the course of the study will help control for the history effect of this study. The results indicated a significant difference between 13 of the 17 groups. This was likely due to the large numbers of patients in each category over the years, because the larger the *N*, the more likely that a significance will be found. A review of the actual numbers, as well as the percentage makeup of each medical unit, did not yield clinically significant differences across the years. As shown in TABLE IV, each medical unit had less than a 2% change over the 3 fiscal years measured. To provide a visualization of the difference between the 3 fiscal years, the percentages are displayed in Figure 19. Of the approximately 100,000 admissions in each of the 3 years, the largest concentration of admissions was at 7 East Medicine.

Figure 19. Percentage of Patients for 3 Fiscal Years per Medical Unit.



FY = fiscal year; Ctu = cardiothoracic unit; Ccu = cardiac care unit; Tr = transplant; Dnr = donor.

In addition to reviewing the admitting unit for adult patients at UIMCC over the 3 fiscal years of the study, age, gender, ethnicity and payer mix were also examined. As shown in Table VI, the average age of the patients at UIMCC during the study period was relatively constant at around 47 years of age with the range being 46.90 to 47.56. Also shown in TABLE VI, the gender of the adult patients from September 2006 through November 2008 remained relatively constant with around 63% female and 37% male with a range of 61.86-63.72% female and 36.28-38.14% male. Ethnicity of the UIMCC adult patient population during the study period (TABLE VII) also revealed a relatively consistent demographic, with only a 1%–1.5% difference in the various ethnicities of the patients at UIMCC.

The last patient demographic compared across time to ensure that no major changes co-occurred during the study period that could impact the intervention was the payer mix of the patient. TABLE VIII reveals less than a 1% change among the three groups for each payer mix tracked by UIMCC. These relatively constant patient demographics during the time period of the study support that the changes seen after the intervention were the result of the intervention and not another significant change in the demographics of the patients.

In addition to the potential impact of patient demographic changes on the outcomes of the intervention, changes in nursing staff, too, could impact the results of the study. TABLE IX demonstrates a minimal change in nursing staff during the study period. The turnover rates during the 3-year study period ranged from 4.60% to 6.56%. UIMCC has a small staff turnover ratio relative to national averages. According to the American Association of Colleges of Nursing (2007), the average turnover rate was 13.9%. By comparison, UIMCC has a relatively small and stable turnover rate, which should not have an impact on the intervention.

2. **Demographics of Patients Falls Pre- and Postintervention**

Additional demographic comparisons were made between the preintervention and postintervention groups to assess whether there was a difference between the two groups with respect to demographics. An evaluation of the demographics of the patients who fell can be made by viewing Figure 13, which shows that the nursing unit that had the most patient falls (i.e., 77 falls) in the preintervention group was 6 East. This unit makes up only 8.21%–8.44% of the admissions to the hospital over the 3 fiscal years evaluated. The second largest number of falls (i.e., 51) that occurred in the preintervention group by nursing unit was at 5 East. This unit makes up only 4.01%–4.34% of the admissions to the hospital. In the postintervention group, the 7 East nursing unit was the unit with the largest amount of patient falls (i.e., 57). This unit makes up the largest amount of admissions, with 12.03%-13.71%. In the postintervention group, the 5 East unit again was the nursing unit with the second largest number of falls, at 47. Although the nursing unit with the most falls (Figure 13) does not match the unit with the most admissions (TABLE IV), it does match up with the literature on falls, which indicates that they often occur in neurologically impaired patients. This was a focus in the FPP that was rolled out in the Medical Center and may have been the reason that the neurological unit was the one with the largest decrease in falls after implementation of the program.

As mentioned previously, patients' risk for falls can be impacted by their diagnoses, and patients with neurological impairments are at the highest risk for falls. As represented in Figure 12, patient falls are examined by primary admitting diagnoses. As anticipated, the primary diagnosis at admittance for both the pre- and postintervention-group patients who fell was a neurological disorder. Approximately 34% of patients in both the pre- and postintervention groups had an admitting diagnosis of a neurological disorder.

In the preintervention group, 54% of the patients who fell were male, compared with 45% in the postintervention group. The percentages of patients in the preintervention group who had only one fall compared with the postintervention group were 82.6% and 84.2%, respectively, which indicates that the program did not have an impact on patients who were repeat fallers.

As depicted in Figure 14, most falls in the preintervention group occurred overnight. Most falls in the postintervention group occurred during the day shift. Shift change was defined as the hour before and the hour after the change of nursing shift (i.e., 6:00 A.M. to 8:00 A.M., 2:00 P.M. to 4:00 P.M., and 10:00 P.M. to 12:00 A.M). The percentage of patient falls in the preintervention group that occurred during a shift change was 31%. The percentage of patient falls in the postintervention group that occurred during a shift change was 22%. This decrease could be a result of increased awareness of staff of the importance of preventing patient falls at all times.

Figure 15 displays the pre- and postintervention data by month, and Figure 16 displays the pre- and postintervention data by day of the week. In reviewing the pre- and postintervention groups, there did not appear to be a seasonal factor related to falls at UIMCC. In addition, there did not appear to be a cyclical pattern related to the day of the week on which patients fell.

One pattern that held true for both the pre- and postintervention groups was that most falls occurred early in a patient's hospital stay. The first day of admission in both groups had the most falls, with 49 in the preintervention group and 40 in the postintervention group (Figure 17). The average length of stay over the period of examination was 6 days, a fact that did have an impact on the larger volume of patients who fell within the first 5 days.

To summarize, the demographics demonstrate that clinically, there was no difference between the types of patients at the Medical Center during the time of the study, based on their diagnoses at admission to the hospital within the study's time frame. In terms of admission volumes, there was only a 2% difference between any two medical units.

Demographics of the patients who fell revealed that patients with neurological diagnoses (and the respective nursing units that house those patients) tended to have the most falls. There was a decrease in falls during nursing shift change, as well as a decrease in the falls that occurred during the night shift. These decreases could be attributed to increased awareness of staff on all shifts and at all times. There did not appear to be any seasonal or cyclical effects related to falls. In addition, most falls occurred on the first day of admission. These demographic data may help to target updates or modifications to the FPP process in an attempt to decrease the fall rate, improve the program, and decrease the resulting impact on costs even further than this initial program was able to do.

B. Evidence that a Fall Prevention Program Decreases Fall Rates

Hypothesis 1 stated: Participation in the FPP will result in a significant decrease in the number of falls during hospitalization among adult patients 18 years and older who receive the intervention. There were 328 patient falls during the year prior to implementation of the fall prevention program. The average fall rate during the preintervention phase was 2.66. During the initial implementation phase, there were 78 patient falls, and the average fall rate during this phase was 2.47. The year after the initial implementation phase, there were 278 patient falls. The average fall rate during the postintervention phase was 2.22. A *Z*-test for proportions revealed a statistically significant difference in the fall rate between the preintervention and postintervention groups. In real terms, there were 50 fewer patient falls per year after implementation of the FPP. This is statistically significant not only for those patients who did not fall, but also for the medical center in terms of decreases in liability and risk, with 50 fewer incidents that would have had the potential for liability.

Additional analysis of fall rates comparing the preintervention and postintervention groups based on the MFS cutoff score for UIMCC of $\geq$40 was performed. The statistics for the preintervention and postintervention groups based on a MFS score below and at/above 40 are displayed in TABLE XV.

TABLE XV

PATIENT STATISTICS FOR MORSE FALL SCALE ABOVE AND BELOW CUTOFF

Statistics	Preintervention Group	Postintervention Group
# Patient Days	123,060	124,438
# Falls total	328	278
# Falls with MFS <40	148	108
# Falls with MFS ≥40	180	170
Fall Rate with MFS <40	1.20	0.87
Fall Rate with MFS ≥40	1.46	1.37
Proportion with MFS <40 (p; #falls/#patient days)	0.0012	0.00087
Proportion with MFS ≥40 (p; #falls/#patient days)	0.00146	0.00137

To test whether the difference in proportions was statistically significant, a *Z*-proportions test for two independent samples was conducted for a MFS score <40 and a MFS score ≥40. The results of the *Z*-proportions tests are provided in TABLE XVI and reveal that there was a significant change in the scores for patients who fell after the intervention, with a MFS score <40. This indicates that, compared with the preintervention group, the postintervention group had fewer patients with a MFS score <40 who fell. This shift could be the result of more accurate scoring by the nursing staff and/or the fact that fewer patients fell as a result of the standard interventions provided to the non–high-risk group of patients. Further studies could be performed to examine the decrease in patient falls in the lower-risk group.

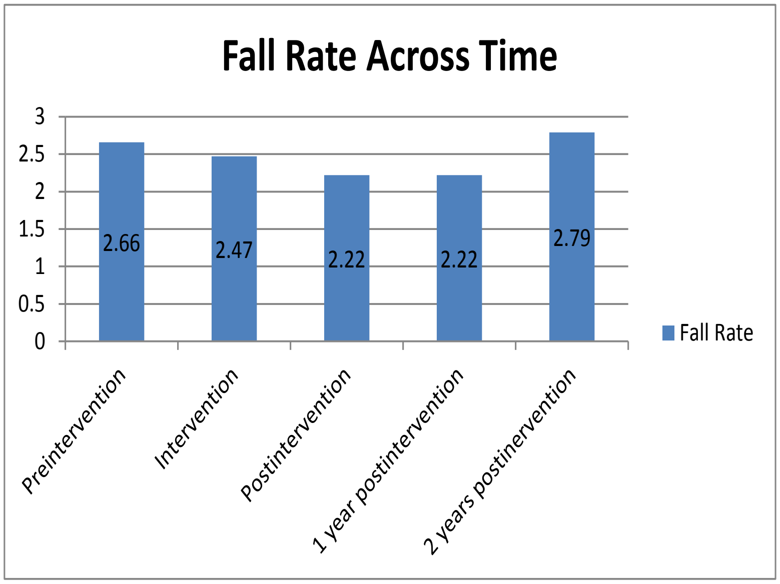
TABLE XVI

Z-PROPORTIONS FOR MORSE FALL SCALE CUTOFF

Comparison	pa-pb	*Z*	*p*
Preintervention vs Postintervention Patients with MFS <40	0.0003	2.59	0.0048
Preinterventino vs Postintervention Patients with MFS ≥40	0.0001	0.639	0.2614

The fall rate showed a significant decrease during the year after the intervention was implemented. Figure 20 shows the average fall rate 2 years beyond completion of this study. The preintervention phase (September 2006–August 2007) had a fall rate of 2.66; the implementation phase of the FPP (September 2007–November 2007) had a fall rate of 2.47; the year after implementation of the FPP, also known as the postintervention phase (December 2007–November 2008), had a fall rate of 2.22. One year after the postintervention phase (December 2008–November 2009), the fall rate was 2.22, and 2 years after the postintervention phase (December 2009–November 2010), the fall rate was 2.79.

Figure 20. Average Fall Rate Across Time.



This demonstrates that the improvement in the fall rate was sustained for 2 years beyond the initial FPP implementation. However, the improvement was not sustained into the third year postintervention.

There are several possible reasons that the initial improvement was not sustained beyond 2 years, and these provide an opportunity for additional studies. One possible factor in the loss of effect during the third year after implementation could be a change in staff, wherein new staff may not have received appropriate training. Other factors could include a significant change in patient population and/or a change in the makeup of staff who oversee the program. Competing or shifting goals of the institution, resulting in a focus on other areas of patient safety, could be another factor. The data and information available for analysis related to this increase in the fall rate 2 years postintervention was evaluated.

Data were reviewed for the 2-year postintervention period and factors that could impact the program were assessed to determine why there was an uptick in the fall rate 2 years postintervention. Comparison of age and gender in TABLE VI reveals no change in age or gender between the study period and 2 years postintervention.

An evaluation of ethnicity between the study period and the 2 years postintervention period (Table VII) shows that the percentages of African Americans, American Indian/Alaskan, Caucasian, and Asian/Pacific Islander remained relatively constant, with <1% change in any of these groups. There was an increase of approximately 12% in Decline/Unkown/Other that corresponded to a decrease of approximately 12% in Hispanic. This could be due to changes in immigration policies that may cause Hispanic patients to be less likely to declare their ethnicity. Further studies would need to be performed to determine whether there was a true shift in the demographic in the group 2 years after intervention compared with the study period groups, or if it was a change in reporting by patients.

In the comparison of payer mix in TABLE VIII, no significant changes in payer mix were seen in the 2-year postintervention group compared with the study periods. The data reveal <2% change across the payer mix and do not appear to be a contributing factor in accounting for the uptick in the fall rate 2 years postintervention.

While patient demographics remained relatively constant during the study and throughout the 2 years postintervention, two staffing changes occurred that could have impacted the fall rate 2 years postintervention. The first staffing change was an increase in nursing turnover. TABLE IX displays an increase in the turnover rate of nursing—from 5.69% during the 3-year span of the study to 8.25% during the second year postintervention. That is an increase of approximately 30% in nursing turnover during the second year postintervention compared to all previous years. The American Association of Colleges of Nursing (2007) indicated that staffing shortages contribute to patient deaths and injury.

The second staffing change that could have impacted the 2-year postintervention fall rate was that of the multidisciplinary Fall Prevention Committee disbanding 1 month into the 2-year postintervention assessment period. It did not regroup for more than 18 months, which meant that there had been no oversight of the program for 11 of the 12 months of the 2-year postintervention period. Lack of program leadership could have been a contributing factor to the increase in the fall rate during the second year after the study.

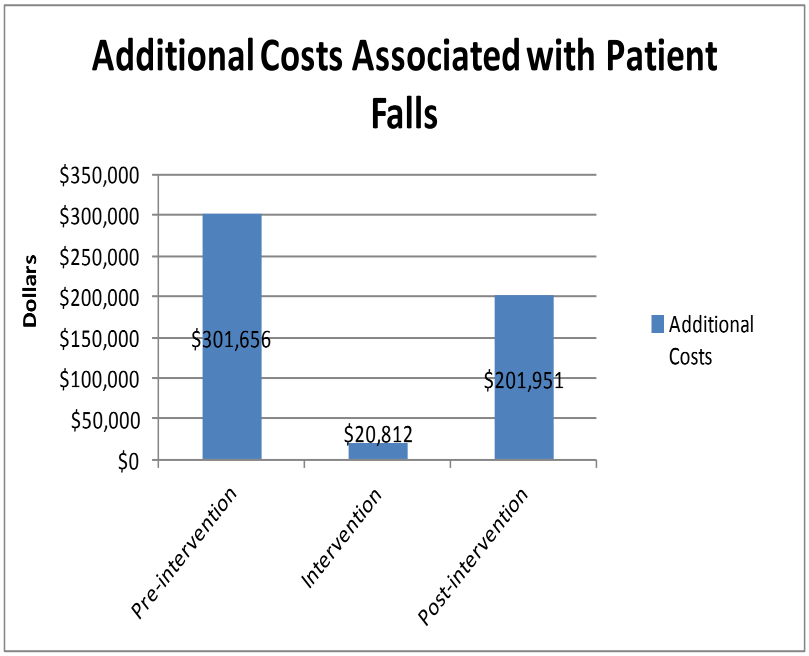
Given the fact that there was a significant effect with the first implementation of the FPP, reimplementation of the same program should be considered and examined by UIMCC. This program not only succeeded initially, but its success also was sustained for 2 years after implementation. The reasons for the success having ceased during the third year after implementation should be further investigated, and the program should be reviewed and reimplemented. Otherwise, failure to comply with The Joint Commission's mandate could cause problems for the institution.

C. Evidence that a Fall Prevention Program Decreases the Severity of Falls

Hypothesis 2 stated: Participation in the FPP will result in a significant decrease in the severity of injuries resulting from patient falls during hospitalization among those who received the intervention compared with those who did not. The levels of severity that were evaluated were None, Minor, Moderate, and Major. These levels of severity, defined by The Joint Commission, are described in Figure 10. An evaluation of the preintervention, intervention, and postintervention phases revealed no significant difference in the severity of injury among the patients in each group. In the preintervention group, 79.0% of the patients who fell had no injury, compared with 76.2% in the postintervention group. Of the patients who sustained a minor injury, 16.5% were in the preintervention group and 19.9% were in the postintervention group. Of the patients who suffered a moderate injury, 2.1% were in the preintervention group and 2.2% were in the postintervention group. The percentage of patients who sustained a major injury was 2.4% in the preintervention group and 1.8% in the postintervention group.

Extrapolation of the cost of injury for both groups revealed a difference of $99,705 in related costs. The costs included additional testing as a result of the fall, as well as additional procedures and hospital days related to injury from a fall. The costs were compared with the same rate of procedures over both periods (e.g., a CT scan of the head was listed at $1,516 per scan for both the preintervention and postintervention groups). Appendix C lists the costs for each test or procedure performed, as well as room-associated charges. In the preintervention group, 89 patients required additional tests and procedures, combined with 38 additional hospital days as a result of falls, for a total estimated cost of $301,656. In the postintervention group, 63 patients had additional tests and procedures, combined with 42 additional hospital days, at a cost of $201,951. These costs are displayed in graphic form in Figure 21. This represents a savings of approximately $100,000 dollars for the hospital in 1 year and can be considered significant to the hospital’s bottom line.

Figure 21. Additional costs associated with patient falls.



Given the differences in time for the intervention phase compared with the pre- and postintervention time frames, the dollar amounts for each phase were extrapolated to monthly figures. The costs associated with injuries from patient falls in the preintervention group was $25,138 per month. The intervention group incurred a cost of $6,937 per month on injuries related to patient falls. The postintervention group had an average cost of $16,829 per month related to fall-related injuries.

There were 50 fewer falls in the postintervention group compared with the preintervention group. The biggest difference in terms of severity of falls was between the no-injury group and the preintervention group. Despite the moderate-to-major injury groups having had only a few more cases in the preintervention group, it made a difference in the overall costs between the groups.

Further analysis of financial impact specific to harm level revealed that both the total costs and the costs per case for the no-harm and minor-harm score groups decreased. Total costs per harm group and costs per case for each harm group are displayed in TABLE XVII. These two categories had the largest impact on cost. This impact is likely the result of the largest decrease in falls having been in the postintervention group compared with the preintervention group. Although there was a decrease in the number of cases in the moderate- and major-harm categories in the postintervention group compared with the preintervention group, the total costs and costs per case were slightly higher in the postintervention group. This is likely due to a small number of cases with high-cost procedures. One procedure more or less greatly impacts the costs for these two groups. The total cost per case is $193.24 less in the postintervention group.

TABLE XVII

TOTAL COST BY HARM LEVEL

Type of Harm	Number of Cases Pre	Number of Cases Post	Total Costs Pre	Total Costs Post	Costs per Case Pre	Costs per Case Post
No Harm	259	211	$71,858	$38,681	$277.44	$182.46
Minor Harm	54	55	$34,376	$24,086	$636.59	$437.93
No-Minor Harm	313	266	$106,234	$62,767	$339.41	$235.97
Moderate Harm	7	6	$13,734	$19,906	$1,962.00	$3,317.67
Major Harm	8	5	$181,688	$119,278	$22,711.00	$23,855.60
Moderate-Major Harm	15	11	$195,422	$139,184	$13,028.13	$12,653.09
Total	328	278	$301,656	$201,951	$919.68	$726.44

D. Evidence that a Fall-Prevention Program Changes the Types of Falls

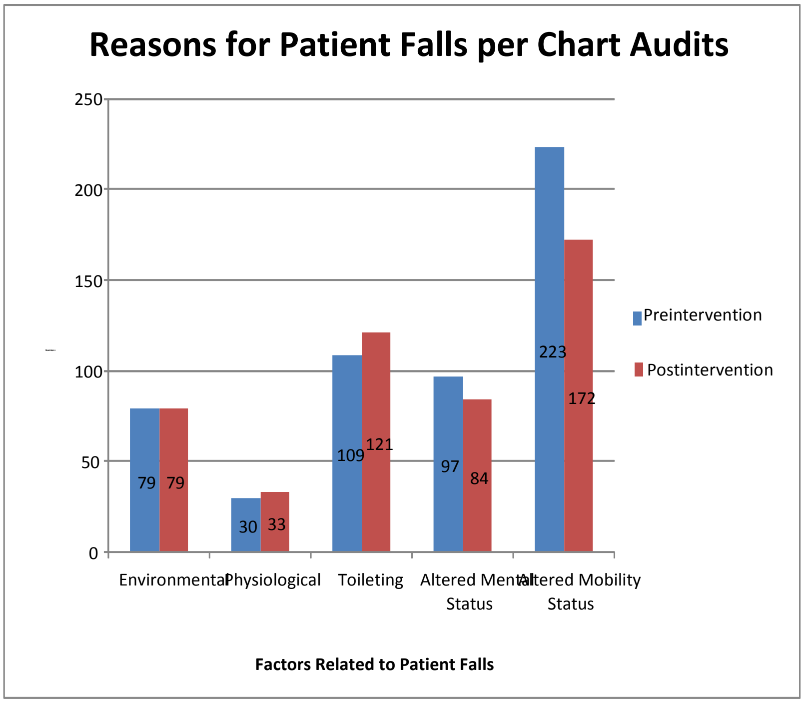
Hypothesis 3 stated: Participation in the FPP will affect the type of falls that occur during hospitalization among patients who receive the intervention. A chi-square test revealed no difference between the preintervention and postintervention groups related to the type of falls that hospitalized patients experienced, based on the occurrence form completed by the health-care professional who reported the falls into the MIDAS Occurrence Reporting System. The two types of falls reported most frequently across the preintervention, intervention, and postintervention groups were

“From Bed” and “Ambulating without Permission.” The majority of falls at all three time points were from bed and from ambulating without permission, while the fewest falls occurred during transfer, shower/tub/toilet attended, and fainting/seizure (TABLE XIV).

An analysis of the pre- and postintervention results from TABLE XIV reveals that activities that involved the healthcare worker demonstrated a shift. The activity of ambulation was assessed as with and without permission. The percentage of those who fell while ambulating without permission increased by 7.3% (10 more patients) in the postintervention group compared with the preintervention group. The percentage of those who fell while using the shower/tub/toilet while unattended decreased by 1.2% (8 fewer patients). These numbers can indicate that the program was effective in identifying patients who should not be walking unattended and those should not be left alone for bathroom needs. When patients ambulate without permission, it could indicate that although staff may have identified them as needing to be attended while walking, patients’ own decisions about whether to follow the program may impact the program’s success.

When chart audits were completed, the health-care professional’s notes were reviewed to determine the factors that affected patient falls. Figure 22 reveals the reasons identified in patient charts for falls. Many of the falls were a result of multifactorial components. For example, a patient who may have been trying to get to the toilet might also have mobility deficits. In the preintervention group, there were 328 falls, and among the categories listed in the chart audits (i.e., environmental, physiological, toileting, altered mental status, and altered mobility status), 538 reasons were identified for a patient having had a fall. In the majority of the falls, a mobility impairment constituted one of the reasons, with 223 of the 328 falls involving impaired mobility as part or all of the reason that a patient fell. In other words, 68% of the falls involved a mobility impairment that contributed to a patient having had a fall.

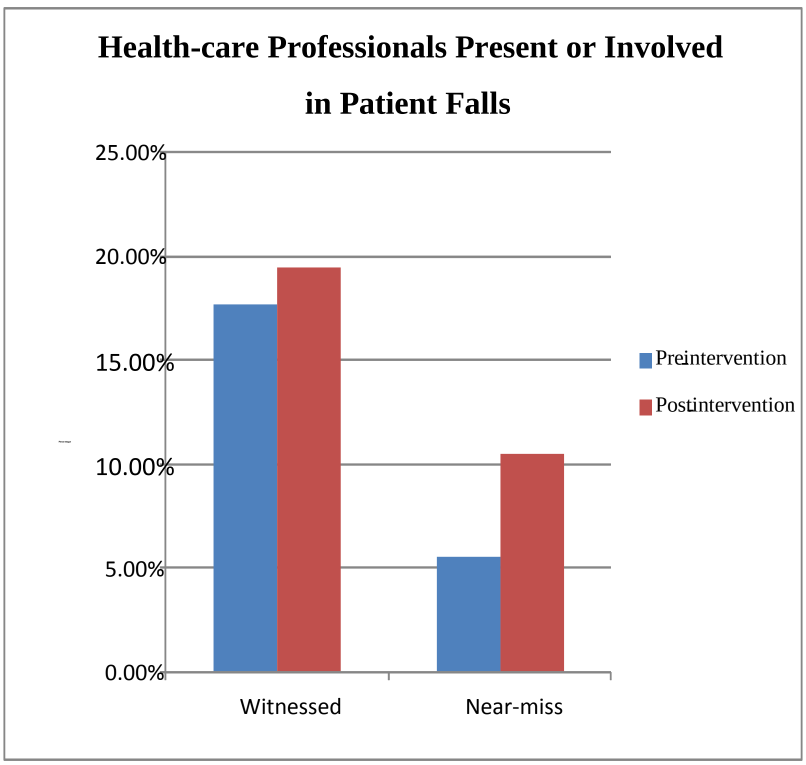
Figure 22. Reasons for patient falls per chart audits.



In the postintervention group, there were 278 falls with 489 identified reasons for patients having had a fall. As with the preintervention group, impaired mobility most often was the reason patients in the postintervention group had a fall. Impaired mobility continued to be the largest factor, with 172 of the 278 falls, or 62%, related to the patient having impaired mobility. Between the preintervention and postintervention groups, the altered mobility status category appeared to have undergone the greatest change in terms of being part of the reason for the falls, with a decrease of 51 cases.

In addition to the causes of falls, other environmental factors that might change with the FPP are the number of witnessed falls and the number of “near-miss” falls. These two factors are important because a witnessed fall means that a health-care professional was present when the patient fell. A near-miss fall would have even greater impact. A near-miss fall is one in which a health-care professional helps the patient during their fall by assisting them or lowering them to the ground, thereby decreasing the risk of injury because the fall is more controlled. In the preintervention group, the percentage of witnessed falls increased from 17.70% (57 out of 322) to 19.42% (54 out of 278). The number of near-miss falls also increased in the postintervention group. In the preintervention group, 18 out of 328 falls, or 5.49%, were assisted falls. In the postintervention group, 29 out of 278 falls, or 10.43%, were assisted falls. These numbers are represented graphically in Figure 23. Both of these changes—an increase in witnessed falls and near-miss falls—indicate a safer environment.

Figure 23. Witnessed and near-miss patient falls.



E. <u>Unintended Consequences of the Fall-Prevention Program</u>

A risk of implementing a large, institution wide program is that, with the attention required to focus on the new program, unintended and often negative consequences could occur in other areas. Efforts to prevent falls in hospitalized patients could result in an increased use of restraints, both physical restraints and restraints effected by sitters. Additionally, if staff is worried that patients might fall, they might be inclined to confine patients to bed, which could result in their developing skin breakdown or pneumonia.

Data from UIMCC on restraints, skin breakdown, or pneumonia did not become available until after 2008, so it cannot be formally evaluated at this time. Of the patients who fell, the number of patients in the pre- and postintervention groups who were given restraints was 3 each. Sitters were utilized in 10 cases in the preintervention group and in 7 cases in the postintervention group. During chart reviews, there were no reports of noticeable skin breakdown or pneumonias in either group. This could be attributable to a lack of documentation rather than a lack of impact of the program. Unfortunately, there are no formal data to indicate whether one or the other scenario is related to unintended consequences.

F. <u>Program Implementation</u>

Adequate implementation of the FPP is critical to its success. When the program first rolled out, an online learning module (Appendix B) was delivered as a required educational course to all staff that interacted with patients. They were given the time frame of September through November of 1997 to complete the module. There was a >96% completion rate for staff. Additional nursing training took place on the nursing units and focused on correctly scoring patients with the Morse Fall Scale so that patients would be categorized accurately. Focus also was placed on the interventions that would be implemented for patients who were and were not at risk for falling.

The percentage of patients in the preintervention group who fell and who were scored incorrectly was 11.89%, compared with the postintervention group, in which only 5.75% of the patients were scored incorrectly. In the preintervention group, the percentage of patients who had a MFS score of ≥40, which would put them into the high-risk group, was 54.46%, compared with the postintervention group, in which 61.15% of the patients were identified as being at high risk for falling. The percentage of patients in the preintervention group for whom intervention implementation was documented was 49.08%, compared with the postintervention group, in which 57.91% of the patients received this documentation. These numbers indicate that the implementation of the FPP produced an effect on proper documentation of who might be at risk.

Analysis of the Morse Fall Scale scores for the preintervention and postintervention was performed. For all patients admitted to UIMCC during the preintervention phase, the average MFS score was 29.71 and the average highest MFS score 36.41. For all patients admitted to UIMCC during the postintervention phase, the average MFS score was 32.32 and the average highest MFS score was 43.61. This increase in both the overall average as well as the highest MFS score is consistent with the scoring comparisons made of the patients who fell in both groups. This shift is consistent with staff education on the MFS as part of the FPP.

The Morse Fall Scale is standardized in its use but may not accurately cover the construct that is measured. Misfitting items indicate a problem with the item fitting the intended construct. Fit statistics provide objective information on the fit of the items, and if the item does not fall into the infit statistics of 0.7 to 1.3, the item is not a good fit and therefore the construct that was intended to be assessed is not actually being assessed (Wright and Linacre, 1994). Although it is outside the context of this study, future studies could reanalyze these measurement scales with use of the Rasch model for item fit. This could help determine whether the MFS items might need to be revised or removed.

G. <u>Limitations of the Study</u>

One of the main limitations of this study was the inability to roll out a pilot unit or randomize the implementation, due to The Joint Commission's mandated time line. The comparison group is historical, and although the percentage differences among the types of patients seen at the Medical Center during the 3 years that the study spanned were small, there were mild differences. In addition, during the time in which the two comparison groups were evaluated over two separate periods, there is a risk that the environment could have changed significantly. Although this risk could not be controlled, it was accounted for in the time line detailed in Figure 11. In addition, a qualitative assessment of key personnel related to patient safety at UIMCC confirmed that the other safety initiatives in place within the Medical Center during the study period did not directly relate to fall prevention. The researcher also attempted to gather national data related to fall rates from National Database of Nursing Quality Indicators and

UHC for the period before and during the time of the study. Neither organization had that data available to share for facilities similar to UIMCC.

In addition, the National Quality Measures Clearinghouse indicates that national hospital fall rate data are still incomplete, so accurate fall rates for baseline comparison at a national level remain limited (National Quality Measures Clearinghouse, 2010). The Institute for Clinical Systems Improvements, reporting on a review of observational studies, found that fall rates in hospitals ranged from 1.3 to 8.9 falls per 1,000 patient dates, with even higher rates in eldercare, neurology, and rehabilitation units (Institute for Clinical Systems Improvements, 2012). Data for helping to determine any obvious trend historically or during the study period do not appear to be available.

Another limitation of this study was the inability to generalize the findings to other hospitals. Demographics on the types of patients served by UIMCC should help to determine similar facilities in which this FPP could be used and similar results could be expected. In addition, the FPP was based on best practices and evidence, so although this study had limitations related to variables specific to hospitalized-patient fall prevention, it might be worth trialing in any hospital that seeks to decrease its fall rate.

Lastly, there was a statistically significant decrease in the fall rate in the preintervention and postintervention groups. However, when the longevity of the FPP was evaluated, it was found that this decrease did not persist into the third year. Therefore, further studies are needed to determine how those initial, positive effects might be maintained.

H. <u>Conclusions</u>

When The Joint Commission mandated that hospitals needed to have a formal fall prevention program developed and implemented by 2006, it set the stage for the conduction of a natural experiment; that is, the pre- and postimplementation periods of the mandated intervention program could be evaluated. In addition, a system was in place that was already collecting the data related to patient falls, and this allowed for analysis.

The findings of this study suggest that implementation of a FPP in a large, urban medical center resulted in a significant decrease in the fall rate of hospitalized patients. During the year following implementation, 50 fewer falls occurred—a fact that is significant not only statistically, but also clinically (i.e., whenever a fall is prevented).

Although there was no statistical significance between the pre- and postintervention groups in terms of the severity of injury caused by falls, the postimplementation group had a decrease in falls-related costs of approximately $100,000. This fact has financial significance for the hospital, particularly in light of the implementation of the Medicare never events, because such costs must now be absorbed by the facility.

The FPP did not appear to have a significant impact on the types of falls in hospitalized patients in either the preintervention or postintervention group. Although the types of falls that did occur did not change significantly, there do appear to be differences between the pre- and postintervention groups that could have an impact on possible changes to the program. Further analysis of the differences in the reasons that patients fell should be analyzed to determine further interventions that could have an impact on the fall rate. These modifications in the FPP could be analyzed on one nursing unit and compared to similar unit to observe the effect of the program change in a more controlled study not limited by mandates.

The overall findings of this study are that this FPP decreased the fall rate and decreased costs related to injury but did not significantly affect the types of falls that occurred. A future study could implement this same FPP program in other hospitals and analyze its effect. Another area of research could involve reimplementation of the current study and include a cyclical component, provided that there would be no long-lasting effects beyond 3 years. Such a study could determine whether, over a longer period with reimplementation of the FPP on an annual basis, there would be an impact on the fall rate. Another option would be to modify the current FPP based on the knowledge derived from this study, implement it in one medical unit, compare that unit with a similar medical unit, and then analyze the impact.

Further analysis of the information related to patient falls could also yield information that can lead to an improved intervention program. Such a program would result in decreases hospitalized-patient falls. An improved intervention program includes but is not limited to analysis of other activities that occur in the hospital on different days to determine whether any of those activities correlate with an increased number of falls on certain days of the week. In addition, any changes that occurred on specific nursing units that may have impacted fall rates and intervention effectiveness could be examined, and further analysis of the patient's length of stay at the time of the fall could be conducted. More in-depth analysis of the various factors surrounding patient falls could provide insight into program changes that could enhance the current fall prevention program.

Preventing falls in hospitalized patients continues to be a focus of hospitals' patient safety efforts. Examination of these efforts needs to continue so that the most effective fall prevention program can be found.

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APPENDICES

APPENDIX A List of Never Events

Appendix A is reprinted with permission from *National Quality Forum Updates Endorsement of Serious Reportable Events in Healthcare.* Retrieved from National Quality Forum Web site: http://www.qualityforum.org/pdf/news/prSeriousReportableEvents10-15-06.pdf

National Quality Forums List of 28 'Never Events'

* ASA, American Society of Anesthesiologists; ABO, the ABO Blood Classification System; HLA, human leukcyte antigen. Source: The National Quality Forum: Press Release: *National Quality Forum Updates Endorsement of* Serious Reportable Events in Healthcare. Oct. 16, 2006. http://www.qualityforum.org/pdf/news/prSeriousReportableEvents10-15-06.pdf (last accessed Dec. 4, 2007).

Surgical Events

1 Surgery performed on the wrong body part
2. Surgery performed on the wrong patient
3. Wrong surgical procedure performed on a patient
4. Unintended retention of a foreign object in a patient after surgery or other procedure
5. Intraoperative or immediately postoperative death in an ASA Class I patient

Care Management Events

6. Patient death or serious disability associated with a medication error (e.g., errors involving the wrong drug, wrong dose, wrong patient, wrong time, wrong rate, wrong preparation, or wrong route of administration)
7. Patient death or serious disability associated with a hemolytic reaction due to the administration of ABO/HLA–incompatible blood or blood products
8. Maternal death or serious disability associated with labor or delivery in a low-risk pregnancy while being cared for in a healthcare facility
9. Patient death or serious disability associated with hypoglycemia, the onset of which occurs while the patient is being cared for in a healthcare facility
10. Death or serious disability (kernicterus) associated with failure to identify and treat hyperbilirubinemia in neonates
11. Stage 3 or 4 pressure ulcers acquired after admission to a healthcare facility
12. Patient death or serious disability due to spinal manipulative therapy
13. Artificial insemination with the wrong donor sperm or donor egg

Product or Device Events

14. Patient death or serious disability associated with the use of contaminated drugs, devices, or biologics provided by the healthcare facility
15. Patient death or serious disability associated with the use or function of a device in patient care, in which the device is used or functions other than as intended
16. Patient death or serious disability associated with intravascular air embolism that occurs while being cared for in a healthcare facility

Environmental Events

17. Patient death or serious disability associated with an electric shock or elective cardioversion while being cared for in a healthcare facility
18. Any incident in which a line designated for oxygen or other gas to be delivered to a patient contains the wrong gas or is contaminated by toxic substances
19. Patient death or serious disability associated with a burn incurred from any source while being cared for in a healthcare facility
20. Patient death or serious disability associated with the use of restraints or bedrails while being cared for in a healthcare facility
21. Patient death or serious disability associated with a fall while being cared for in a healthcare facility

Patient Protection Events

22. Infant discharged to the wrong person
23. Patient death or serious disability associated with patient elopement (disappearance)
24. Patient suicide, or attempted suicide resulting in serious disability, while being cared for in a healthcare facility

Criminal Events

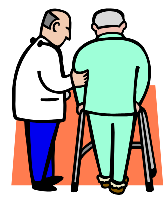
25. Any instance of care ordered by or provided by someone impersonating a physician, nurse, pharmacist, or other licensed health care provider
26. Abduction of a patient of any age
27. Sexual assault on a patient within or on the grounds of the health care facility
28. Death or significant injury of a patient or staff member resulting from a physical assault (i.e., battery) that occurs within or on the grounds of the healthcare facility

APPENDIX B

Educational Materials Provided to Clinical Staff

University of Illinois Medical Center Fall Prevention Program

Developed & Presented By:
Fall Reduction Task Force
July 2007



University of Illinois Medical Center at Chicago

Objectives

- Develop a culture of safety within the Medical Center by increasing awareness of all medical center staff regarding patient falls.
- Identify patients at high risk for falls.
- Reduce the number of patient/client falls.

APPENDIX B (continued)

Falls: The Facts

- More than 33% of adults 65 years and older fall at least once a year and seek medical attention.
- Of those who fall, 20-30% suffer moderate to severe injures (such as broken bones).
- Fall-related injuries are 5x more likely to require hospitalization than any other cause.

CDC 2006

Question

- Falls are the largest category of reported incidents in hospitals

- A. True
- B. False

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

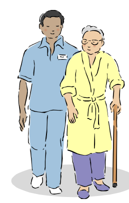
Correct Answer

- True. Falls are the largest reported safety incidents that occurs in hospitals.

APPENDIX B (continued)

Most Falls are Preventable

- Although it may not be possible to prevent *every* fall, *most* falls are preventable.
- The Medical Center has developed a program to address the problem of patient falls.



APPENDIX B (continued)

Question

- *Most* falls are not preventable

- A. True
- B. False

APPENDIX B (continued)

Correct Answer

- False. Most falls are preventable and that is why the Medical Center has developed a Fall Prevention Program to attempt to prevent falls from happening.

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

The Joint Commission stance

- The Joint Commission requires the assessment of fall risk as a National Patient Safety Goal.
  - GOAL 9: Reduce the risk of patient harm resulting from falls.
  - UIMC response: Implement a program to reduce falls then measure to see if the number of falls has decreased.

APPENDIX B (continued)

A Culture of Safety

- The best way to prevent falls is to promote a culture of safety throughout the Medical Center.
- It is the responsibility of every employee to create a safe environment.

APPENDIX B (continued)

Question

- The Medical Center's response to the Joint Commission call to reduce falls is:

- A. Implement a fall reduction program
- B. Evaluate if there are less falls
- C. Both A and B
- D. None of the above

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- Both A and B are correct. The Medical Center is implementing a Fall Prevention Program to try and decrease the number of falls that occur in the hospital.

APPENDIX B (continued)

Risk Factors for Falling

- Age (>65)
- History of Falls
- Fear of Falling
- Bowel or Bladder Incontinence
- Cognitive impairments
- Dizziness/vertigo
- Depression
- Postural hypotension
- Osteoporosis
- Decreased Vision
- Balance or Inner Ear problems
- Poor Lighting
- Restraints
- Prolonged length of stay in hospital
- Functional impairments
- Weakness
- Multiple Medications
- Multiple Medical Problems
- Foot problems

APPENDIX B (continued)

Question

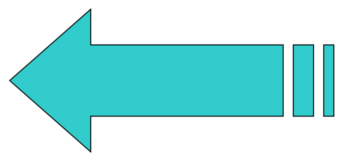
- Which are risk factors for falling?

- A. Age (>65)
- B. Dizziness
- C. Depression
- D. All of the above

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.



APPENDIX B (continued)

Correct Answer

- All of the above are correct. Age (>65), dizziness and depression as well as many other factors can increase a person's risk of falling.

APPENDIX B (continued)

Near Fall Definition

- Near Fall – a sudden loss of balance that does not result in a fall or other injury. This can include a person who slips, stumbles or trips but is able to regain control prior to falling.

APPENDIX B (continued)

Standard Fall Precautions Definition

- Standard Fall Precautions – are measures staff take to reduce fall risk for ***All*** patients and to ensure safety for all patients at the Medical Center.

APPENDIX B (continued)

Examples of Standard Fall Precautions

- Some examples of standard fall precautions include orienting patient to surroundings, answering the call light promptly, providing non-slip footwear, reviewing medications.

- Click here to review the list of Standard Fall Precautions.

APPENDIX B (continued)

Standard Fall Precautions

- Orient patient to surroundings.
- Demonstrate use of nurse call system and have patient return demonstrate.
- Provide adequate environmental lighting, especially at night.
- Answer call light promptly.
- Evaluate the need and frequency of scheduled observations.
- Provide bed clothing that does not drag on floor or otherwise interfere with patient's mobility and safety.
- Provide non-slip (treaded slippers socks/hard soled shoes) footwear.

APPENDIX B (continued)

Standard Fall Precautions (Cont)

- Instruct patient to call for assistance as needed for transfers and ambulation.
- Ensure patient is as comfortable as possible (ie, administer pain medications, position for comfort).
- Position frequently used patient items within arm’s reach.
- Maintain bed in lowest position with wheels locked.
- Maintain two side-rails up at all times. Use a third rail as appropriate.
- Encourage early and frequent ambulation; assist as needed.
- Educate patient and family on fall prevention strategies.

APPENDIX B (continued)

Standard Fall Precautions (Cont)

- Develop/implement toileting schedule for patients unable to independently toilet.
- Initiate PT consult if indicated.
- Utilize assistive devices to promote patient’s safety and independence.
- Provide physically safe environment (ie, eliminate spills, clutter, electrical cords, and unnecessary equipment).
- Ensure adequate handrails in bathroom, room and hallways.
- Position toilet seats to a height appropriate for the patient (ie, place risers or use commodes) as appropriate.
- Review medication regimen.

APPENDIX B (continued)

Question

- All of the following are Standard Fall Precautions *EXCEPT:*

- A. Educate patient and family to surroundings
- B. Review medication regimen
- C. Provide non-slip footwear
- D. Answer call light only if you aren't too busy

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- D is the correct answer. Call lights should be answered promptly to prevent patients from trying to get up on their own and having a fall.

APPENDIX B (continued)

High-Risk Patients Definitions

- High-Risk Patients – identified as those patients who have a Morse Fall Scale score of ≥40.

- UIMCC Fall Risk Scale - Morse Fall Scale is a screening tool to assess patient’s risk for fall that is done at admission and every shift.

APPENDIX B (continued)

Question

- A patient who has a Morse Fall Scale score of $\geq$40 is identified as high risk

- A. True
- B. False

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- True. A patient with a Morse Fall Scale score of $\geq$40 is at risk for falling and High Risk Interventions should be implemented.

APPENDIX B (continued)

High Risk Interventions

- High Risk interventions – are steps staff take to ensure the safety of patients identified as High-Risk.
- Examples of high risk interventions include use of Green wristbands, personalized toileting schedule and assigning care companions as needed.
- Click here to review the list of High Risk Interventions.

APPENDIX B (continued)

High Risk Interventions

- Apply green high risk fall precaution wristband to patient.
- Communicate all high risk patients during handoff procedures.
- Evaluate the patient's need for family supervision and/or care companion.
- Communicate high risk status to patient, identified caregivers, and patient's healthcare providers.
- Minimize or reduce fluid intake after 6:00 pm as medically appropriate.
- Administer diuretics and/or other medications that cause frequent urination no later than 5:00 pm to avoid frequent night elimination whenever possible.

APPENDIX B (continued)

High Risk Interventions (Cont)

- Provide bedside commodes if patient has difficulty ambulating to bathroom.
- Instruct patient to rise slowly from bed and dangle feet as to minimize orthostatic hypotension.
- Utilize bed and chair alarms as necessary.
- Place patients in a room closer to nurses' station.
- Implement personalized toileting schedule as appropriate .

APPENDIX B (continued)

Question

- All of the following are High-Risk Interventions *EXCEPT*:

- A. Identify high risk patients with use of GREEN wristband
- B. Consider use of care companions
- C. Use personalized toileting schedules
- D. Never use bed or chair alarms

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- D is the correct answer. Bed and chair alarms should be considered for patients that are at high risk of falling.

APPENDIX B (continued)

APPENDIX B (continued)

Question

- What is the color of wristband that identifies a patient as being a high risk for falls?
- A. Blue
- B. Green
- C. Orange
- D. Purple

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- GREEN is the correct answer. When a patient is identified as high risk, a GREEN wristband with the words 'Fall Precaution' on it will be placed on the patient.

APPENDIX B (continued)

APPENDIX B (continued)

Common Medications Linked with Falls

- Benzodiazepines
- Antidepressants
- Antipsychotics
- Alpha-blockers
- Beta-blockers
- Calcium Channel blockers
- ACE inhibitors
- Angiotension II receptor blockers
- Centrally acting alpha-adrenergic agonists
- Nitroglycerin-containing drugs
- Diuretics
- Direct-acting vasodilators
- Hypoglycemic drugs
- Opioid analgesics
- Anticonvulsants
- Antihistamines
- Muscle relaxants
- Sedative-hypnotics
- Antiparkinsonian drugs
- Antiemetics
- Antidiarrheal drugs
- Antisecretory drugs
- Antiulcer drugs

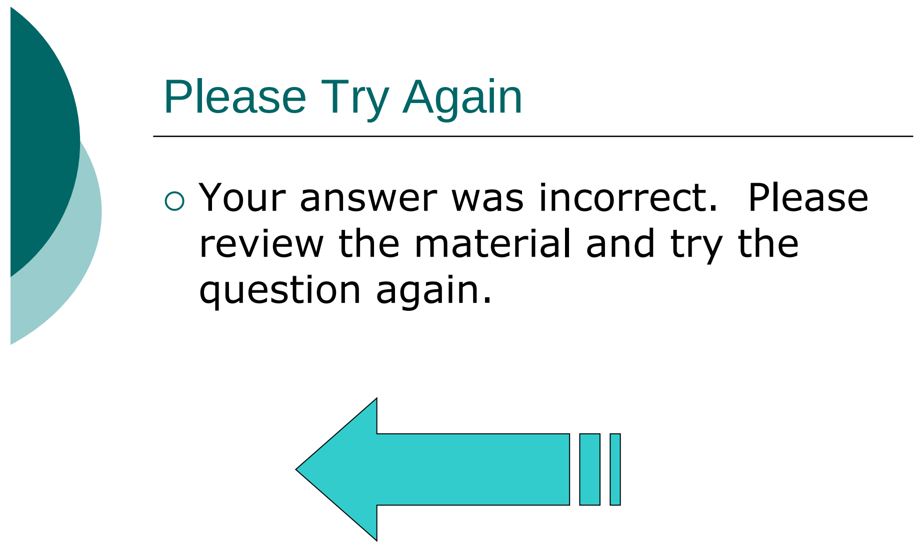
APPENDIX B (continued)

Question

- Many types of medications may increase risk of patient falls

- A. True
- B. False

APPENDIX B (continued)



APPENDIX B (continued)

Correct Answer

- True. There are many types of medications that increase a patients risk for falling. Use of multiple medications can also increase the patients risk of falling.

APPENDIX B (continued)

Review of UIMC internal data:

- Patients with cognitive deficits, mental status changes or difficulty thinking have a high risk for falling.
- Patients who have neurological involvement such as a stroke also have a high risk for falling.

APPENDIX B (continued)

Question

- Patients with cognitive deficits are at a higher risk level for falling

- A. True
- B. False

APPENDIX B (continued)

Please Try Again

- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- True. Patients who have cognitive as well as neurological impairments are at a higher risk for falling.

APPENDIX B (continued)

Patient Education

- Electronic Patient Education Database and brochures on fall prevention techniques are available for patient and include information about:
  - How to prevent a fall during a hospital stay.
  - How to prevent a fall at home using a home safety checklist.

APPENDIX B (continued)

Patient Education continued

- Electronic Patient Education Database can be accessed by Medical Center Staff via the intranet.
- Brochures are available in outpatient clinic areas and on inpatient units.
- Electronic Patient Education Database/CareNotes can be accessed via the Intranet.

APPENDIX B (continued)

Question

- Patient education materials are available throughout the medical center on how to prevent falls

- A. True
- B. False

APPENDIX B (continued)

Please Try Again

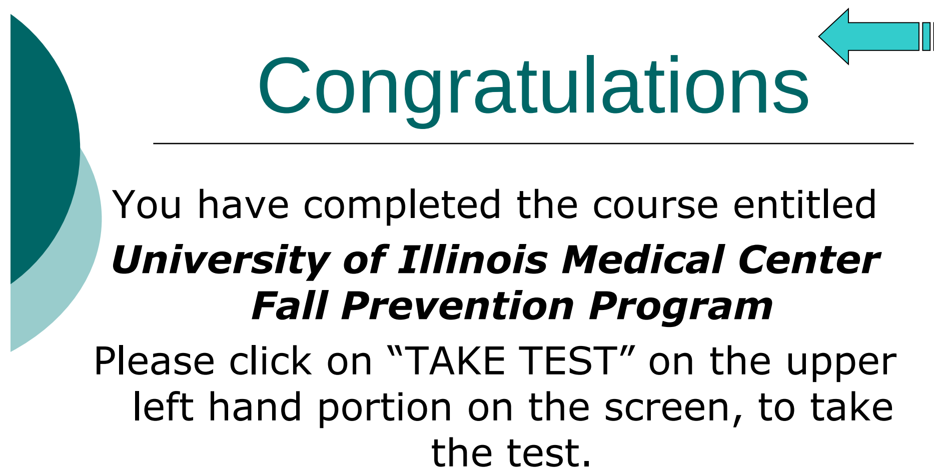
- Your answer was incorrect. Please review the material and try the question again.

APPENDIX B (continued)

Correct Answer

- True. There are patient education materials available throughout the Medical Center that can be given to the patient and/or caregivers.

APPENDIX B (continued)



APPENDIX C

List of Costs for Tests, Procedures, and Rooms

Test, Procedure, or Room	Costs per Test, Procedure, or Room
Computed tomography (CT) Head	$1,516
CT Spine	$1,516
CT Maxiofacial	$1,516
CT Abdomen	$1,516
CT Pelvis	$1,516
CT Arm	$1,516
CT Hip	$1,516
CT Abdomen and Pelvis	$3,032
X-ray Ankle	$175
X-ray Hip	$193
X-ray Knee	$193
X-ray Foot	$175
X-ray Skull	$333
X-ray Cervical Spine	$193
X-ray Wrist	$193
X-ray Hand	$193
X-ray Arm	$193
X-ray Elbow	$193
X-ray Humerus	$193
X-ray Shoulder	$175
X-ray Back/Spine	$193
X-ray Chest	$193
X-ray Pelvis	$193
X-ray Sacrum	$333
X-ray Ribs	$175
Magnetic resonance imaging Head	$3,939
Steristrips	$100
Transthoracic Echocardiogram	$2,470
Peripheral-vascular study of Lower Extremity	$331
Electroencephalogram	$375
Acute Stroke	$5,348
Subdural Hematoma	$4,000
Rib Fracture	$1,000
Humerus Fracture	$1,000
Shoulder Fracture	$1,000
Foot Fracture	$1,000
5^{th} Digit of Foot Fracture	$1,000

APPENDIX C (continued)

Pneumothorax	$1,000
Ankle Sprain	$500
Lower-extremity Hematoma	$500
Speciality Consultations (e.g.,Orthopedics, Neurology, Medicine, Plastic Surgery)	$350
IV Hydration	$250
Permanent Catheter Insertion	$250
Physical Therapy Evaluation	$223
Upper-extremity Brace	$147
Cane	$48
Drainage of Subdural Hematoma	$4,000
Internal Fixation of Ankle	$20,000
Open Reduction and Internal Fixation	$35,039
Closed Reduction Upper Extremity	$5,000
Operating Room (1st hour)	$4,988
General Anesthesia (1st hour)	$1,596
ICU Bed	$3,670
Stepdown Bed	$1,590
Rehab Bed	$1,590

VITA

NAME: Keir Ringquist, PT, MS, GCS

EDUCATION:

Doctoral candidate in School of Public Health, Current
University of Illinois at Chicago, Chicago, Illinois 60612
Anticipated completion date of May 2013

Master of Science in Physical Therapy, May 1998, Central Michigan University, Mount Pleasant, Michigan 48859

Bachelor of Arts in Elementary Education, December 1993, Michigan State University, East Lansing, Michigan 48824

TEACHING:

Department of Physical Therapy, UIC
PT 618—Posture and Movement Across the Lifespan, Guest Lecturer, 2004-2008

PT 634—Neuromuscular Dysfunction II, Field Experience Leader, 2005-present

PT 636—Applied Pathophysiology, Field Experience Leader, 2004-present

PT 638—Integration and Assessment I, Co-coordinator, 2004-present

PT 639—Integration and Assessment II, Co-coordinator, 2005-present

EMPLOYMENT:

Jan 2011-Present, Director of Physical Medicine and Rehabilitation Services, University of Illinois at Chicago Medical Center, Chicago, Illinois

Nov 2005-Jan 2011, Coordinator of Inpatient Physical Therapy Services, University of Illinois at Chicago Medical Center, Chicago, Illinois

Aug 2010-Present, Clinical Instructor, University of Illinois at Chicago, Department of Physical Therapy, Chicago, Illinois

June 2001-Nov 2005, Supervisor, Inpatient Physical Therapy, University of Illinois at Chicago Medical Center, Chicago, Illinois

July 1998-June 2001, Physical Therapist I, University of Illinois at Chicago Medical Center, Chicago, Illinois

Feb 1999-Dec 2001, Contract Physical Therapist, Advocate Health Care at Lutheran General Hospital, Park Ridge, Illinois

Certification:
Board Certified Clinical Specialist in Geriatric Physical Therapy, 2003-present

LICENSURE:

Licensed Physical Therapy, State of Illinois, License Number 070-010938

AWARDS:

Class Act Award, July 2007
UIC Award of Merit Recipient, Oct. 2005
Award of Excellent Service, UIMCC, Nov 2001

PROFESSIONAL MEMBERSHIPS:

American Physical Therapy Association, 1995-present

Acute Care Section of American Physical Therapy Association, 2002-present

Geriatric Section of American Physical Therapy Association, 2000-present

Health Policy and Administration Section of American Physical Therapy Association, 2004-present

Health Promotion and Wellness Special Interest Group, 2004-2008

Illinois Physical Therapy Association, 1998-present

Michigan Physical Therapy Association, 1995-1998

PUBLICATIONS:

Muthukrishnan, S., Eviota, A., Ringquist, K., Mohapatra, S., and Aruin, A.: Compelled body weight shift technique to facilitate rehabilitation of individuals with acute stroke. *International Scholarly Research Network* Vol. 2012, Article ID 328018, 7 pages.

Piepenbrink, K., Straube, D., and Ringquist, K.: University of Illinois PT facility and PT vision 2020. *PT Priority* 2005.

PROFESSIONAL PRESENTATIONS:

Eviota, A., Ringquist, K., Sambit, M., Aruin, A., and M. Muthukrishnan: Compelled Body Weight Shift Therapy in Individuals with Acute Stroke. Poster presented at the IPTA Fall Conference, Bloomington, IL, September 2009.

K. Ringquist: Child with CP and Motor Learning Activities. Poster presented at the APTA Conference, Combined Sections Meeting, Indianapolis, IN, February 2000.

Ringquist, K., Straube, D., and M. Keehn: Impact of Various Factors on a PT Inpatient Department Waiting List. Poster presented at the APTA Conference, Combined Sections Meeting, San Diego, CA, February 2006.

Straube, D. and K. Ringquist: Rasch Analysis of the Physical Therapy Outpatient Satisfaction Survey. Paper presented at the APTA Conference, Combined Sections Meeting, Las Vegas, NV, February 2009.

RESEARCH:

ALS Multicenter study, Research Assistant, University of Illinois Medical Center at Chicago, June 2005-January 2007

Compelled Body Weight Shift Therapy in Individuals with Acute Stroke Related Hemiparesis study, Researcher, University of Illinois at Chicago, July 2008-present

Consultative/Commission on Accreditation of Rehabilitation Facilities, Program Advisory Surveyor, July 2009-present

POSITIONS:

IPTA PT Priority Magazine, Member of the Editorial Board, February 2006-2009
Hands for Health Nonprofit Organization, Chairperson of Funding & Treasury, 1996-1997

SERVICES:

Fall Prevention and Reduction Committee, Member, University of Illinois Medical Center, March 2011-present

Fall Prevention and Reduction Committee, Chairperson, University of Illinois Medical Center, Fall 2007-Spring 2011

Fall Task Force, Chairperson, University of Illinois Medical Center, Spring 2006-Fall 2007

Documentation Standards Committee, Member, University of Illinois Medical Center, Winter 2005-present

Rehabilitation Unit Operations Team, Member, University of Illinois Medical Center, Summer 2001-present

Clinical instructor to multilevel PT interns from 8 different physical therapy programs, averaging 30+ weeks of clinical education per year, 1999-present