

2006 NORA Partnering Award for Worker Safety and Health Winner
Project Title: Slip, Trip and Fall (STF) Prevention in Health Care Workers

Nature of the Partnership and Involvement by its Members

This research was a collaborative effort between BJC Health System (4 study hospitals) and Washington University School of Medicine (academic medical center that provides occupational health services to BJC employees), the US Veteran's Health Administration (VHA, 4 study hospitals), the American Federation of Government Employees (AFGE), the Liberty Mutual Research Institute for Safety - LMRIS (case-crossover/case follow-back studies), Johns Hopkins University (case-crossover/case follow-back study), the Finnish Institute of Occupational Health-FIOH (lab studies-floor, shoe, contaminant slipperiness) and the National Institute for Occupational Safety and Health-NIOSH (descriptive analysis, hazard assessments, and intervention field study). The partnership represents an unprecedented collaboration between private sector and public sector US hospitals, organized labor, private and public sector health and safety researchers, and international researchers with cooperation from manufacturers of footwear, flooring and floor wax.

The partnership evolved from a previous successful collaboration between BJC Health System, a large nonprofit health care system in the United States that combines urban, suburban, and rural health care facilities and NIOSH. The previous study addressed patient lifting injuries, the biggest injury problem in the hospital corporation in 1998. The widespread implementation of safe patient lifting programs resulted in significant reductions in overexertion injuries attributed to patient lifting. As a result, slip, trip and fall injuries became the highest cost injury problem in the Health System, over 1.4 million worker compensation dollars were expended for STF incidents in 2001. Extensive discussions and planning ensued between BJC, NIOSH, LMRIS, and FIOH (research collaborators with shared research interests in slips, trips and falls). These discussions launched this innovative NORA-motivated research partnership to concurrently apply multiple research methods to the same study population. The VHA also approached NIOSH with similar concerns over high STF injury rates and requested involvement of several of their regional medical centers in the project. The technical aspects of the project were influenced by the key research investigators' collaboration in the seminal Hopkinton Conference, *The Measurement of Slipperiness*, which resulted in a special issue of the journal *Ergonomics* (Courtney et al., *Ergonomics*. 2001 Oct 20;44(13)) and a book Chang, Courtney, Grönqvist. and Redfern, Eds. 2003. *Measuring Slipperiness- Human Locomotion and Surface Factors*, London: Taylor and Francis, Ltd., 180pp. ISBN 0-415-29828-8), which won the 2003 William Floyd Medal from the Ergonomics Society for contributions to slip, trip and fall prevention.

Worker representation/participation: The American Federation of Government Employees (AFGE) and an international committee of STF and postural stability experts peer-reviewed the research protocol prior to the study. The AFGE accompanied researchers during the slip, trip and fall hazard assessments covering millions of square feet of walkway and floor surfaces in VA hospitals. Extensive participation and buy-in of the BJC workers were essential to the success of this prevention program. A Risk Management Safety Council developed policies on the implementation of the slip, trip and fall intervention program and met quarterly to allow workers to provide input on injury prevention issues. BJC also instituted an Occupational Health Nurse Council which meets monthly to provide a forum for health care providers at all BJC entities to discuss occupational medical care for workers and injury prevention issues. Workers were asked to identify the most dangerous walking and working surfaces encountered inside and outside the hospitals during the performance of their jobs. Each participant was surveyed about shoe comfort and slipperiness, and shoes were purchased based on worker preferences.

Slip-resistant shoe and flooring manufacturers: Slip-resistant shoe manufacturers (Lehigh, Inc., Laja, Inc., and Shoes for Crews, Inc.), slip-resistant flooring manufacturers (Altro Inc. and Armstrong) and floor wax companies (Johnson, Bruhlin, and Butcher) were included in the study.

These companies' contributed to this project by cooperating with the independent testing of their products in the lab and field but were not part of the research partnership because researchers did not want to give any one manufacturer an unfair market advantage or create the appearance of a conflict of interest. Based on the independent lab tests of all shoes and flooring, products that performed optimally were selected for evaluation in the field study. Products were subsequently purchased and implemented in the participating hospitals without extensive involvement of the manufacturers.

Nature and Significance of the Problem

Globally, falls represent the third leading cause of disability after depression and anemia. Falls are also the second leading global cause of accidental death, after motor vehicle collisions. In developed countries, STFs on the same level contribute between 20 and 40 percent of disabling workplace injuries (Courtney et al., 2001). The health services sector is the largest employer in US private industry with some 10 million workers. In 2002, more US health care workers were injured than workers in construction and mining combined. STFs accounted for the largest proportion of lost time injuries to health care workers (21%). The incidence rate of same level STF injuries in hospitals was considerably higher than private industry (39.9 vs. 25.4 per 10,000 FTEs). The large population of workers at risk and the frequent occurrence makes STF incidents a substantial problem for health care workers.

Project Description

Study Design and Methods: This project concurrently applied the following study methods:

- 1) NIOSH researchers conducted a descriptive analysis of six-years of historical STF incident surveillance data from the study hospitals to target intervention strategies;
- 2) Liberty Mutual and Johns Hopkins researchers conducted case-crossover and case follow-back studies by telephone interviewing hospital employees who suffered a fall; digital photographs of their shoe soles and flooring conditions at the fall site were also collected to identify transient risk factors and describe STF circumstances to target interventions;
- 3) FIOH conducted laboratory studies to evaluate the slipperiness of hospital flooring (existing and promising slip-resistant flooring) and shoes (most commonly worn and promising slip-resistant), tested with a range of contaminants (dry, water, water/cleaning solution, and glycerol (simulated grease)) and;
- 4) NIOSH incorporated the findings from the three companion studies along with on-site hazard assessments at the study hospitals to establish a 'best practices' STF injury prevention program. NIOSH conducted a prevention effectiveness field study that designed, implemented and evaluated the 'best practices' STF prevention program in five acute care hospitals.

Results and Key Findings

Descriptive Analysis: The descriptive analysis identified 337 STF workers' compensation claims; highest injury rates were among food services/kitchen workers and EMS personnel. The highest frequency of STF incidents occurred among nursing staff. Narratives of all cases were reviewed to examine the details of the circumstances, locations, and patterns of work-related STF incidents and to identify countermeasures that could be implemented and evaluated as part of the field study.

Case-crossover/Case-followback Study: The first 123 health care workers who reported a STF to the occupational health department were recruited and interviewed using a structured telephone questionnaire. Participants were predominantly female (86%) with a mean age (range) of 46 (19-67). Nurses (33%), secretaries or clerks (13%), and health technologists and technicians (9%) were the most frequently reported occupations. One hundred and eight subjects (88%) fell: 53% after slipping, 32% after tripping. Liquid contaminants (e.g., water, cleaning solutions) were involved in 36% of the events. Sixty-four percent of the STF occurred at a transitional area: dry/wet (32%), one type of floor to another (22%), or uneven surfaces (15%). Forty-one percent of workers fell

forward, 23% fell to the side, and 21% fell backward. While the hands, knees, and buttocks were most often the points of impact, the back, knees, ankles/feet were most frequently injured. Strains and sprains (29%), contusions (27%), and non-specific pain and soreness (22%), were typical. Other injuries included abrasions, fractures, edema and lacerations. Overall, 94% of subjects were injured with an average of two injuries per STF event. Data from this study were used to emphasize control of contaminants and improved surface transitions and conditions in the intervention study.

Exposure Assessment in the Field and the Lab: The laboratory study conducted by FIOH identified slip-resistant shoes and flooring that performed optimally under wet, greasy and dry conditions. The intervention study provided slip-resistant shoes to food service and housekeeping staff. Slip-resistant floors were installed during renovations. NIOSH and Liberty Mutual tribologists used slip meters to examine the slipperiness of floor surfaces at study sites that were of concern to hospital safety staff.

Field Study: The field study, conducted in conjunction with BJC Health System and the VA hospital system, compared the injury, disability, and injury-related cost experience of a cohort of approximately 35,000 hospital staff for a 6 year pre-intervention period (1996-2001) with a 36 month post-intervention period (2003, 2004, and 2005) in five hospitals. Workers' compensation data, OSHA 200 logs, employee first reports of an injury, and personnel records were used to compute injury rates. The "best practices" slip, trip and fall intervention consisted of slip-resistant shoes for food service workers and housekeeping staff, slip-resistant flooring added during renovations, revised housekeeping procedures, on-site hazard assessments to identify and eradicate STF hazards, ice cleats for home health nurses, and STF hazard awareness was promoted through paycheck inserts and e-mails. Housekeeping managers wore beepers with numbers advertised through e-mails notifying all staff to promptly reports spills and other contaminants on the floor. Outside the hospitals, an aggressive snow and ice removal program strategically located containers with ice melting chemicals that could be applied when they noticed icy conditions. Downspouts were re-routed under sidewalks at three shuttle bus stops after descriptive analyses identified a STF injury cluster. Hazard assessments revealed that the down spouts were dumping freezing water onto the sidewalk. A training program educated all hospital staff on the importance of preventing STF incidents. Preliminary analyses of 9 years of workers' compensation data in the BJC Health System hospitals indicates the comprehensive 'best practices' STF prevention program resulted in an estimated 25% reduction in workers' compensation expenses attributed to STF incidents.

Translation:

- 1) This study used the collective findings from the descriptive analyses, lab studies, case follow-back and case-crossover study and risk assessment walkthroughs to design and implement a multi-faceted "best practices" STF intervention that had a measurable effect on injuries.
- 2) Peer-reviewed publications are being drafted for all studies within the project.
- 3) A laymen's document will be developed for distribution to all US hospitals to encourage replication of the countermeasures that were determined to be effective.

Dissemination of Research Findings and Impact to Improve Worker Safety

The BJC Health System hospitals experienced an estimated 25% reduction in workers' compensation costs attributed to same level STF incidents after implementation of the prevention program, based on 71,411,000 worker-hours, representing 35,705 worker-years. This reduction reduced the hospitals STF incidence rate from above to below the industry average when compared to national data. It is anticipated that the findings from the portfolio of studies in this project will continue to provide information to prevent STF incidents in healthcare settings and potentially the prevention of same level falls in other workplaces. The results of various component studies have been presented at NOIRS 2003, the 2004 American Industrial Hygiene Conference and Exhibition, the XVII World Congress on Safety and Health at Work 2005, and accepted for presentation and

publication at the 2006 International Ergonomics Association Conference.

Limitations of the Intervention Study

The study was originally designed to randomly assign the intervention to specific hospitals and monitor the impact relative to control hospitals. The housekeeping manager at some of the experimental hospitals also served as manager at some of the control hospitals. Her excitement about the positive effects of the program led to the introduction of housekeeping STF prevention products to the control hospitals, thus contaminating the control group. Also, this study was only able to assess the overall impact of the comprehensive prevention program rather than the independent effects of components of the STF prevention program.

Relevant NORA Priority Areas

The broad scope of this multidisciplinary study makes it relevant to the following eight NORA priority research areas: (1) Intervention Effectiveness Research; (2) Low Back Disorders; (3) Traumatic Injuries; (4) Control Technologies and Personal Protective Equipment; (5) Organization of Work; (6) Exposure Assessment Methods; (7) Social and Economic Consequences of Workplace Illness and Injury; and (8) Surveillance Research Methods.

Intervention Effectiveness Research (IER)

This study advances the goal of the NORA IER team by increasing intervention research.

Traumatic Injuries, Low Back Disorders, and Musculoskeletal Disorders

The primary outcomes from slips, trips and falls are traumatic injuries and low back disorders.

Control Technologies and Personal Protective Equipment

Engineering controls (slip-resistant shoes/flooring) were a key element of the prevention program.

Organization of Work

The nature of work was changed by revising housekeeping procedures for work performed by the housekeeping staff by always maintaining dry lanes for pedestrian traffic by blocking staff access to wet floors during cleaning, floor stripping and waxing. The importance of keeping floors clean and dry was emphasized to all hospital staff through e-mails and paycheck inserts to change the culture and mindset of hospital staff to assume widespread responsibility for keeping floors clean and dry. Housekeeping manager's were provided with beepers with advertised numbers that employees could call when they noticed a spill. Paper towels were mounted near elevators, nursing stations, and cafeteria exits, to provide convenient clean up materials. Pop-up wet floor signs were mounted outside elevators, nursing stations, and outside the cafeteria for use by staff to cover spills while housekeeping was being summoned to clean the floor.

Exposure Assessment Methods

The laboratory study quantified the friction characteristics and slipperiness of 15 types of flooring (10 existing and 5 promising slip-resistant), 10 types of shoes (6 commonly worn by hospital staff and 4 promising slip-resistant shoes), 3 floor waxes, tested under wet, dry, wet with water and cleaning solutions, and grease to examine the slipperiness under a 1,000 conditions.

Social and Economic Consequences of Work

This study demonstrated that prevention programs can reduce workers' compensation expenses.

Surveillance Research Methods

All available sources of injury data at the participating nursing homes were integrated into the statistical analyses for this study. Workers' compensation reports, OSHA 200 logs, and first reports of incidents were merged with human resource data to compute injury rates by age, gender, and length of employment. Human resource records provided data on age, gender, tenure, and number

of hours on the job (less sick leave and vacation time) per year for each employee.