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Falls in hospital increase length of stay regardless of degree of harm

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Abstract

Rationale, aims and objectives Acute inpatient falls are common and serious adverse events that lead to injury, prolonged hospitalization and increased cost of care. To determine the difference in total acute hospital care length of stay (LOS) for patients with and without an in-hospital fall (IHF), regardless of degree of harm.

Methods This was a retrospective observational study at a 728-bed acute care teaching hospital. We used propensity scores to match 292 patients with 330 controls by case mix group, sex, Resource Intensity Weights and week of admission. We used two administrative databases: hospital fall incident reporting system and Discharge Abstract Database. We reviewed all IHF incidents for patients 18 years and older, admitted to inpatient acute care hospital units/programs between 1 November 2009 and 31 August 2011.

Results The average LOS for IHF cases was 37.2 days [median 26.5 days; interquartile range (IQR) 14, 54] and 25.7 days (median 13 days; IQR 5, 33) for matched control patients. Survival analysis results indicated that patients who did not have an IHF were 2.4 times (95% CI 2.1, 2.7; $P < 0.001$) more likely to be discharged earlier from acute care than patients who had an IHF.

Conclusions Experiencing either an injurious or a non-injurious fall during an acute care hospitalization was associated with prolonged LOS.

Introduction

In the hospital setting, falls are common and serious adverse events that lead to injury, functional decline, higher costs and prolonged hospital stays [1–5]. International research reports a wide range of values for the incidence of in-hospital falls (IHFs) with 2–15% of inpatients experiencing at least one fall [6,7]. Canadian data from a tertiary acute care hospital in Ontario found that serious injury after an IHF resulted in patients staying, on average, an additional 34 days and costing an additional $CAD 31 000 per patient [8]. While in the United States, Bates and colleagues [1] observed that patients from an urban tertiary care hospital with an injurious hospital fall (e.g. fracture, dislocation, laceration) stayed 12 days longer than controls, who did not fall, when matched on age, gender and length of stay (LOS) up to the time of the fall.

Importantly, increased hospital stay exposes patients to the risks of iatrogenic illness (i.e. nosocomial infection and falls) and functional decline, with increased burden for both patients and hospitals. For patients, the consequences of increased hospital stay include recurrent admissions, premature admission to residential care homes, permanent loss of independence and diminished quality of life [9]. Likewise, hospitals face the cost of avoidable complications associated with hospital care, prolonged LOS, and access and flow issues in the system due to bed shortages.

Therefore, our primary objective for this study was to determine the average LOS for patients with and without an IHF (injurious and non-injurious), and whether there was a difference in acute care LOS for patients who experience an IHF during hospital stay when compared with a matched group of patients without an IHF. Secondary objectives for this study were to identify the case mix group (CMG) codes associated with the highest number of IHFs and to describe other factors related to LOS.

Methods

Research design

We extend the work of Hill and colleagues [2] by conducting a retrospective, observational study using administrative databases to determine the difference, if any, in acute care total LOS between patients who experienced an IHF compared with patients without an IHF and matched by CMG, Resource Intensity Weights (RIW), sex and week of admission. The RIW are the relative costs (intensity of resource use) that are generated based on the diagnostic code or procedure; they are determined by the CMGs and also account for age, health status and status at discharge [10]. Our primary outcome of interest was the total hospital LOS. We obtained approval from our local hospital and university research ethics board prior to starting the study.

Setting and population

We used the administrative data obtained from a 728-bed acute care teaching hospital that provides highly specialized quaternary care services to residents of the city of (removed for blinding). Annually, there are 29 402 acute care discharges from this teaching hospital.

Inclusion/exclusion criteria

We reviewed all IHF incidents for patients 18 years and older, who were admitted to hospital between 1 November 2009 and 31 August 2011; we included all admissions to inpatient acute care hospital units/programs. We classified cases as the first patient admission with an IHF.

Data extraction

We extracted fall incident information from the Patient Safety & Learning System (PSLS), the hospital's adverse event database. For reporting, we used the standard definition of a fall as 'unintentionally coming to rest on the ground, floor or other lower level with or without an injury' [11]. We extracted data from the files for patients (18 years+) with a fall reported during the period 1 November 2009 to 31 August 2011. This query returned 1994 fall reports, from which we removed 9 duplicate entries and 37 entries without identifying information, leaving 1948 fall reports. A data analyst used this list to extract the patient's Discharge Abstract Database (DAD) information for all admissions between 1 November 2009 and 31 August 2011. As the PSLS and DAD were not linked, we manually combined the information from both datasets. We matched the PSLS fall event date to the DAD entry that included the date of the fall. If a patient had more than one admission during the study period, we included only the first admission. During this cleaning process, we removed 285 entries because of: the inability to match to the DAD record due to errors in personal health number and/or medical record number; the fall did not occur during an acute care admission while in hospital; or it was not the patient's first admission during the study period ($N = 356$). For each patient, we accounted for all falls that occurred during their first admission of the study period. After compiling the information, there were 1307 unique entries for patients with IHFs while admitted to hospital during the time period.

We grouped the IHF cases by CMG code and sorted them from highest to lowest by the number of falls occurring in each of the different 273 CMGs [2]. From this list, we selected the top 10 CMGs with the highest total number of patient falls to generate a comparison group of controls without IHF (Table 1). The main fields included in this query were the same as those for the IHF group. We removed all records for patients already identified as having an IHF in the case group from the dataset, and selected only the first admission for each control. This resulted in 4200 unique entries in the comparison control group.

Statistical analysis

We used descriptive statistics for demographic information and the characteristics and distribution of patients with and without IHF. Frequency and percentages were used for categorical variables, such as sex, degree of harm and discharge disposition. We described patient characteristics with continuous variables, such as age, using the mean [standard deviation (SD)] or median [range or interquartile range (IQR)], wherever appropriate. We expressed crude rates of IHF as rate/1000 bed days.

Table 1 Distribution of patients in each of the top 10 CMGs depending on whether patients sustained an IHF

		Number (%) of patients		
CMG description	Number (%) of falls ($n = 398$)	IHF ($n = 292$)	Unmatched No IHF ($n = 4200$)	Matched No IHF ($n = 330$)
Dementia	87 (21.9)	49 (16.8)	155 (3.7)	53 (16.1)
Ischaemic event of central nervous system	52 (13.1)	39 (13.4)	505 (12.0)	46 (13.9)
Palliative care	37 (9.3)	33 (11.3)	337 (8.0)	37 (11.2)
Viral/unspecified pneumonia	30 (7.5)	27 (9.2)	783 (18.6)	26 (7.9)
Organic mental disorder	39 (9.8)	26 (8.9)	144 (3.4)	37 (11.2)
General symptom/sign	45 (11.3)	26 (8.9)	405 (9.6)	36 (10.9)
Heart failure without cardiac catheter	29 (7.3)	25 (8.6)	490 (11.7)	25 (7.6)
Fixation/repair hip/femur	30 (7.5)	24 (8.2)	360 (8.6)	32 (9.7)
Chronic obstructive pulmonary disease	27 (6.8)	23 (7.9)	441 (10.5)	19 (5.8)
Lower urinary tract infection	22 (5.5)	20 (6.8)	580 (13.8)	19 (5.8)

CMG, case mix group; IHF, in-hospital fall.

Table 2 Median (and interquartile range) difference in LOS between patients with an IHF and those without

	Length of stay (days)			
	IHF		No IHF*	
CMG description	Median (IQR)	*N*	Median (IQR)	*N*
Dementia	59 (46, 90)	49	32 (18, 56)	53
Ischaemic event of central nervous system	34 (20, 70)	39	30.5 (7, 76)	46
Organic mental disorder	29.5 (14, 67)	26	19 (5, 34)	37
General symptom/sign	29 (14, 64)	26	7.5 (3.5, 19)	36
Lower urinary tract infection	19.5 (10.5, 44)	20	6 (4, 17)	19
Heart failure without cardiac catheter	22 (14, 40)	25	7 (4, 11)	25
Fixation/repair hip/femur	17 (15, 41.5)	24	14.5 (10.5, 25)	32
Palliative care	18 (7, 39)	33	14 (5, 29)	37
Viral/unspecified pneumonia	16 (7, 29)	27	7 (4, 21)	26
Chronic obstructive pulmonary disease	16 (7, 24)	23	8 (3, 20)	19

*Patients were matched.
CMG, case mix group; IHF, in-hospital fall; IQR, interquartile range; LOS, length of stay.

We used a propensity score method to control for potential sampling bias in the assessment of the effect of having an IHF on total LOS in acute care [12]. We matched cases and controls based on their RIW score, sex, CMG code (recoded into dummy variables), as well as the week of admission. We estimated propensity scores with a logit model. We matched cases and controls one-on-one without replacement in a descending order by finding the nearest neighbour but allowing for tied propensity scores using the PSMATCH2 Stata macro [13]. We performed visual inspection of the propensity score distribution. We also summarized the matched data on the covariates and assessed the success of matching by examining differences in the matching variable's distribution between cases and controls using Student's *t*-tests and chi-square tests (data not shown).

We used a Cox regression model to verify a difference in LOS between patients with and without IHF, and calculated hazard ratios and their 95% confidence intervals, and we explored associations between LOS and discharge disposition and alternate level of care (ALC). We used Stata/MP 10.1 (StataCorp LP, College Station, TX, USA) software to analyse the data.

Results

Of the patients who experienced at least one fall during their inpatient acute care hospitalization, 83% (1081/1307) experienced only one fall, while the remaining patients experienced two or more falls (median 1; range 1–12 falls). In total, there were 1663 fall events, which translated into 437 526 bed days (3.80 falls/1000 bed days). The top 10 CMGs with the highest number of patients with IHF contained 292 patients, with 398 falls. This accounted for 22.3% (292/1307) of all patients with IHF and 23.9% (398/1663) of all falls. From the matched dataset, 81% of cases (236/292) experienced only one IHF, while the remaining patients experienced two or more IHFs (median 1; range 1–12 falls). Of the total number of IHFs, 56.3% (224/398) resulted in no harm, 38.7% (154/398) resulted in minor harm, and 5.0% (20/398) resulted in moderate to severe harm to the patient. We were able to find a match for all cases, certain with tied propensity scores, for a total of 330 controls in the matched no IHF group.

Within the IHF group, 54.1% (158/292) were men, with a mean age of 78.7 years (SD 12.8; range 18–72 years). For the no IHF group, men represented 50.3 and 47.6% of the patients for the matched and unmatched groups, respectively. Similarly, the mean age was 75.7 years (SD 15.1; range 23–98 years) and 72.7 years (17.1; range 18–105 years), respectively. The distribution of the cases and controls by CMGs is highlighted in Table 1. Median RIW score was 3.0 (IQR 1.5, 5.6), 2.3 (IQR 1.1, 3.9) and 1.1 (IQR 0.8, 2.1) for the IHF, matched no IHF and unmatched no IHF groups, respectively.

Table 2 presents the median (IQR) LOS between patients with IHF and those without. Having an IHF was found to be highly correlated with acute care LOS in the Cox regression model: patients who did not have an IHF were found to be 2.42 (95% CI 2.14, 2.72) times more likely to be discharged earlier from acute care than patients who had an IHF ($P < 0.001$). The median LOS for IHF cases was 26.5 days (IQR 14, 54) and 13 days (IQR 5, 33) for matched controls. Eighty-two patients (28.1%) had an acute care LOS of 50 days or longer. This result was found to be positively correlated with experiencing more than one fall event ($P < 0.001$).

We explored the association between the discharge disposition distribution of both IHF cases and controls for the top 10 CMGs. Almost half (47.3%) of the patients with IHF were transferred to continuing care, while over a third (36.7%) of the controls were discharged home. In total, 92 patients died during their stay; 45.7% were cases. Most ($n = 51$) were from the palliative care group (cases and controls). The average number of ALC days for IHF cases was 10.4 days (median 0; IQR 0, 14 days) and 6.3 days for matched controls (median 0; IQR 0,1 day). Interestingly, 'dementia' (CMG code 670) was associated with the highest average number of ALC days in both the IHF and control groups (average 29.7 and 14 days, respectively). Both discharge disposition codes (analysed as dummy variables) and number of ALC days ($P < 0.001$) were found to be associated with acute care LOS. Being discharged home and signed out against medical advice (both $P < 0.001$) were inversely correlated with acute care LOS.

Discussion

In this study, we note that IHFs were highly correlated with acute care LOS, and patients who did not have an IHF during their admission were twice as likely to be discharged earlier from acute

care, compared with someone with an IHF. These results extend previous studies that measured the difference in LOS following an IHF in other countries [1–3,8,14]. However, the uniqueness of our work is the relation between *any* IHF, regardless of the degree of harm, and LOS.

While LOS is widely used to evaluate complications, such as infection rates within medical and surgical units, it does not happen routinely for non-injurious falls. This is likely due to the fact that DAD and hospital adverse event databases are not linked, making it difficult to evaluate how various characteristics of falls affect LOS. Currently, in-hospital hip fracture is the only indicator related to falls that is captured within the DAD and reported by the Canadian Institute for Health Information [15]. While injurious falls are often viewed as being most clinically relevant, our findings indicate that experiencing any type of IHF is associated with a longer LOS and therefore can increase the total cost of care during hospitalization.

A secondary objective of this study was to identify the top 10 CMG codes that are associated with the highest number of IHFs. The CMGs with the highest total number of patients with IHF were 'Dementia' and 'Ischemic Event of Central Nervous System' (Table 1). In a similar study conducted by Hill and colleagues [2], they reported six diagnosis related groups (DRGs) with the highest proportion of IHF – all of the DRGs listed in that study also occurred in our top 10 list of CMGs with the highest number of IHF, including dementia, stroke, respiratory conditions, and hip and femur procedures. While DRGs and CMGs are not the same, the algorithm for assigning the codes within these patient classification systems is similar [10]. In general, diagnostic codes of the primary disease classification [10th International Statistical Classification of Diseases and Related Health Problems (ICD-10)] associated with prolonged LOS are respiratory, congestive heart failure, neoplasm (tumour) and cerebrovascular accident (stroke) [16]. In addition to these medical conditions, increased LOS was also associated with: discharge to alternative living arrangements (e.g. residential care); age 80 years and older; women; nosocomial infection (e.g. sepsis, urinary tract infection and pneumonia); venous thromboembolism; delirium and/or dementia; deconditioning; and falls and fall-related complications [16–19]. A prospective observational study completed in England reported that patients with high physical dependency (e.g. requiring assistance with daily activities such as dressing, bathing or eating) stayed in hospital 40% longer than patients with lower physical dependency after excluding effects of health care resource group and other covariates [20]. Recognizing that there are variations in LOS, there are some medical conditions, such as noted in our study and others, that have the highest number of IHF, and thus can enable managers and clinicians alike to focus their limited resources on providing research-informed fall prevention interventions as a priority to patients within these CMGs.

Through descriptive analysis, we found that the many IHF cases (47.3%) were discharged to continuing care versus the greater part of matched controls (36.7%) who were discharged home. Continuing care is a general term used to describe the system of care that provides supportive health, social and other supportive services to older adults and people with disabilities [21]. Continuing care is most commonly delivered in long-term care, supportive living settings such as residential care and rehabilitation units or hospitals [21].

Where patients are discharged can affect their LOS and may partly explain why there is a difference in the LOS for IHF cases compared with matched controls that did not have an IHF. For example, delays in the transition period between acute care and post-acute settings such as residential care or rehabilitation can increase LOS. These periods are classified as ALC when patients no longer require the intensity or specialized medical care provided in acute care hospitals but are not able to be discharged to the community or a post-acute care provider [21]. These delays in discharge are due to a complex combination of care needs, social needs and institutional relationships [21]. Delayed discharge and especially ALC days are an inefficient use of scarce hospital resources resulting in fewer available acute care beds which limits the number of hospital admissions, resulting in congestion in the emergency department, restricting facility transfers and cancelled elective surgeries [21]. Consequently, health care managers place a lot of emphasis on ALC days and prolonged LOS [21].

Study limitations

We note some study limitations. First, although this was a retrospective observational study, we used propensity score matching to reduce the possibility of selection bias [22]. However, it is possible that potentially important covariates were not included in our analysis that could bias the results. Within a CMG, there is significant variation in resource consumption and LOS among patients [23]. To account for this variation, the CMG+ methodology identifies five factors (age, co-morbidity, flagged interventions, intervention event and out-of-hospital interventions) that are used in the calculation of RIW, but not used as part of the CMG assignment [23]. Age and co-morbidity are two important factors that affect both falls and LOS [4,6,16]. However, as we were unable to obtain reliable co-morbidity data, RIW was used in the propensity score matching as the best available estimate. Future studies may want to match directly with age and specific co-morbidities rather than using RIW as an estimate.

A second limitation of this study is that it relied solely on fall incident reports in the PSLS to identify IHF. The validity and reliability of the data captured by the PSLS is unknown and, due to the large number of events captured during the study period, we did not verify incident reports through a manual chart review. While cleaning and collating the data from the DAD and PSLS, we identified the presence of data entry errors within the fall incident reports. In addition to the fall events lost through data entry errors, it is also possible that some fall events were not reported by staff. Together, these two factors would have resulted in an underreporting of the number of fall events and as such the reported fall rate would be a conservative estimate of the true rate.

Conclusion

Falls are a common and serious problem within acute care hospitals which occur more commonly in certain CMGs, including those associated with cognitive impairment (dementia and organic mental disorder), stroke, hip and femur procedures, infections (pneumonia and urinary tract infection), respiratory disease, heart failure and palliative care. Within these CMGs, experiencing a fall during an acute care hospitalization is associated with prolonged LOS. Implementing research-informed fall prevention

interventions may reduce LOS and may result in reduced hospitalization costs and, importantly, reduced burden for patients and their families.

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