Falls in the acute hospital setting — impact on resource utilisation

Keith D Hill, Michelle Vu and Willeke Walsh

Abstract

Objective: To determine the resource utilisation of patients who fall within an acute metropolitan hospital.

Design: Retrospective observational study, part of a larger falls prevention project in a 323-bed acute care, tertiary teaching hospital in Melbourne, Australia. A review of falls incidents was undertaken for all patient admissions for 18 months from January 2002, excluding the Day Procedure Unit, Intensive Care Unit, Coronary Care Unit and the Emergency Department.

Procedure: The most common diagnosis related groups (DRGs) associated with fallers were identified, and within each DRG, fallers were matched to non-fallers by age and gender. Difference in hospital length of stay (LOS) and disparity in resource consumption by these two groups were calculated.

Results: The DRG with the highest proportion of fallers was "Dementia and other chronic disturbances of cerebral function" (24%). Three of the top six DRGs had significantly longer LOS for fallers compared with non-fallers ("Delirium", "Stroke" and "Respiratory conditions") ($P<0.05$). Hospital-related costs were significantly higher for fallers compared with non-fallers for the DRG "Stroke with severe/complicating diagnosis/procedure" only ($P< 0.05$).

Conclusions: Inpatient LOS and total associated costs for patients who fell and were classified among the DRGs with the highest proportion of fallers were substantially higher than those of matched non-fallers. Effective falls prevention activities targeting these high-risk groups should be a priority, in the context of broader falls prevention activities within a hospital setting.

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What is known about the topic?

Falls are a common problem in hospitals; however there is little research on the association of diagnosis related groups (DRGs) and falls.

What does this paper add?

DRGs of dementia (24%), delirium (22%) and "Other disorders of the nervous system with catastrophic or severe complications or co-morbidity" (22%) were the DRGs with the highest proportion of patients who fell while in hospital. Falls in the acute hospital setting were shown to have a substantial effect on length of stay and costs associated with hospitalisation.

What are the implications for practitioners?

In addition to general falls prevention strategies, practitioners need to target falls prevention activities to patients in DRGs with a higher proportion of people who fall. Hospital managers need to consider the potential for reduced length of stay, reduced hospitalisation costs, and increased throughput that may be achieved with effective falls prevention activities, even if some interventions require additional funding or resources.

FALLS AMONG OLDER PEOPLE are widely recognised as a major public health problem. One third of people aged 65 years and over living in the community fall each year.[1-3] The incidence of falls is reported to be higher in inpatient (hospital) settings, including acute care, aged care and rehabilitation wards. There are wide variations in the reported falls rate in acute care hospitals, ranging from 2% to 5% of all admissions,[4,5] and between 2.9 and 18.2 falls per 1000 bed-days.[6,7] Within this setting, fallers are commonly those admitted to medical or neurological wards.[8,9] Similarly, almost half of patients in some high risk groups, such as those with stroke, fall at least once during their hospitalisation.[10] In Aus-

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tralian hospitals, patient falls comprise 38% of documented adverse events,[11] with similar figures reported internationally.[12,13]

The occurrence of a fall during hospitalisation can result in a number of adverse consequences. Between 30% and 40% of falls result in injury, such as cranial trauma, soft tissue injury and fractures.[8,9,14] In an acute care hospital in Denmark, 7% of all hip fracture patients treated in the orthopaedic surgery ward were as a result of an in-hospital fall.[15] In addition to the physical trauma, fallers may also experience negative psychological effects. Fear of falling and anxiety can often cause loss of self-confidence in mobility tasks and decline in function.[16,17] All of these factors may contribute to prolonged hospitalisation and/or increase the likelihood of discharge to residential care.[18,19]

Falls among patients in the hospital setting also have a significant impact on the health care provider. Such adverse events may be considered as a surrogate indicator of the quality of care provided. Falls may cause distress for both staff and family members. Furthermore, falls have the potential to increase health resource expenditure arising from increased length of stay (LOS), added diagnostic procedures and/or surgeries.[20]

Although falls have been recognised as having an impact on LOS and resource utilisation, few studies have attempted to quantify this. The Quality in Australian Health Care Study, which examined the frequency, nature and outcomes of adverse events, estimated that the total cost of falls in hospitals was $2.1 million per annum.[11] Bates et al conducted a case–control study in a tertiary care hospital in the United States.[21] They found that fallers stayed 12 days longer and had charges US$4233 higher than their non-faller counterparts matched on age, gender, and LOS up to the time of the fall.

Given the potential negative outcomes resulting from falls, there has been growing focus on finding effective approaches to addressing this problem. There is strong evidence in the literature that falls prevention programs can be effective for older people living in the community.[22,23] Until recently, there has been limited evidence to support falls prevention initiatives in the hospital environment. Haines et al[24] demonstrated a significant effect in reducing falls using a multidisciplinary falls risk assessment and targeted intervention approach in a subacute hospital setting. Healey et al[25] found a reduction in the relative risk of recorded falls in older hospitalised people through the use of a core care plan targeting falls risk-factor reduction.

While this recent growth in research evidence of effective approaches to falls prevention in hospital settings is promising, further research is required in this area to determine the benefits obtained from these types of interventions in terms of their cost effectiveness. An initial step in achieving this is to examine the resource utilisation patterns associated with falls in the acute setting. This information could be used within an economic evaluation and assist in guiding decision makers to allocate appropriate resources to falls prevention activities in hospitals.

The aims of this study were:

- to identify the most common diagnosis related groups (DRGs) associated with inpatient falls in an acute hospital setting;
- to determine whether there was a difference in hospital LOS between patients who fell and age and gender matched non-fallers within these DRGs; and
- to calculate the resource consumption (ie, costs) for patients who fell during their hospitalisation within these DRGs relative to matched non-fallers.

Methods

Design

A retrospective observational study design was used to examine the health care utilisation patterns of patients who had experienced a fall during their hospitalisation. It was conducted as part of a wider multi-factorial falls prevention project, "Avoiding the Tumble" which was implemented at the hospital site.

Setting and population

The study took place at Western Hospital, a 323-bed acute care teaching hospital. A review of all in-hospital falls incidents for patient admissions between January 2002 and June 2003 was undertaken. Admissions to all hospital wards/units were included, except for those wards/units identified on a previous review of falls incidents to have very low

rates of falls. Wards/units that were excluded from the analyses on this basis were the Day Procedure Unit, Intensive Care Unit, Coronary Care Unit and Emergency Department.

Procedures

The Australian Refined Diagnosis Related Groups (ARDRG) classification system was utilised to categorise the clinical characteristics of all patients admitted during the study period. The DRG classification is made for all patients by health information staff following discharge from hospital, based on documentation completed by the treating medical staff in the medical history.

Falls incident information was ascertained from the hospital's adverse event database. Throughout the duration of this review period, a standardised definition of a fall was promoted — "an event which results in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of: sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure".[26] Fallers were grouped by DRG, and the proportion of fallers in each DRG was compared. Hospital LOS was also retrieved from the hospital patient database.

To determine whether falls had an impact on the length of stay, a comparison group of non-fallers was identified for each of the DRGs with the highest proportion of fallers. Patients who fell more than once during an admission were only included in this analysis once, relating to their first fall. The comparison group was selected from those patients who had the same DRG during the same study time period but who did not fall. Each faller was matched to a non-faller by age and gender (within the same DRG). If there was more than one non-faller of the same age and gender within the same DRG, a number was randomly drawn by one of the researchers to determine which patient would be used. This occurred without knowledge of any additional information about this patient, including LOS data.

A cost analysis was conducted in line with the costing standards that are utilised in all Victorian Hospitals and required by the Victorian Department of Human Services. For the DRGs that showed significant differences in hospital LOS between fallers and non-fallers, the cost of the resources consumed during the episode of care was calculated for each faller and matched non-faller. Resource items recorded in the hospital's patient costing system included nursing staff care, allied health input, medical staff and other departmental services such as radiology. For each of the resource items, total costs were calculated as the direct cost for providing the service (eg, salaries, consumables) plus an allocation of an appropriate share of the overhead costs (eg, finance, human resources, cleaning). The database with costings was introduced part-way through the study, resulting in costings data only being available for the latter half of this period.

Statistical analysis

Analyses were performed using SPSS version 10 (SPSS Inc, Chicago, Ill, USA). The proportion of fallers within each DRG was calculated. For the six most common DRGs associated with falls, independent *t*-tests were used to determine if there was a significant difference in the LOS and hospital costs between the faller group and the comparison group of non-fallers ($P<0.05$). A matched pair was excluded from the analysis if a patient within either group had an LOS greater than 50 days, to minimise the potential for a small number of outliers to skew data.

Results

During the review period, there were 1073 falls by patients occupying 135 772 bed-days, which was equivalent to 7.90 falls/1000 bed-days. The DRG with the highest proportion of patients falling was "Dementia and other chronic disturbances of cerebral function" (B63Z), followed by "Delirium" (B64Z), "Other disorders of the neurological system with catastrophic or severe complications or comorbidity" (B81A), and "Stroke with severe/complicating diagnosis/procedure" (B70A) (Box 1). Between 12% and 24% of patients in each of the six DRGs with the highest proportion of fallers fell at least once during their hospitalisation.

Data for the six most common DRGs were further analysed. Within these groups (which accounted for 15% of all falls), 53% were female, and fallers had an average age of 79.0 years (SD, 10.7; range 40 to 97 years). The age distribution of fallers in the six

1 Percentage of fallers in each diagnosis related group (DRG)

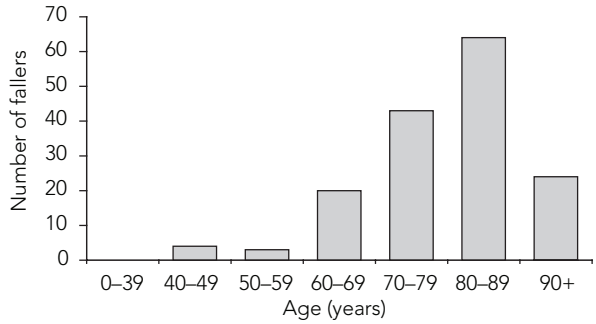
DRG	Description	No. of patients admitted	No. of fallers within DRG	% of fallers within DRG
B63Z	Dementia and other chronic disturbances of cerebral functions	58	14	24%
B64Z	Delirium	110	24	22%
B81A	Other disorders of the neurological system with catastrophic or severe complications or co-morbidity	74	16	22%
B70A	Stroke with severe/complicating diagnosis/procedure	285	46	16%
I08A	Other hip and femur procedures with catastrophic or severe complication or co-morbidity	158	21	13%
E62A	Respiratory infections/inflammations with catastrophic complication or co-morbidity	325	39	12%

DRGs with the highest proportion of fallers is shown in Box 2. It is noteworthy that 11% of fallers in these DRGs were aged less than or equal to 65 years.

Age and gender matched non-fallers were selected (see Methods) within each of the six DRGs. To minimise skewing of LOS data, 21 pairs were excluded from the LOS analyses because one or both of a pair had a long (>50 days) length of stay. In 90% of these exclusions, it was the faller who had the LOS greater than 50 days. This is considered a conservative approach, likely to reduce the ability to detect real differences between the matched pairs. Average LOS for the six DRGs with the highest proportion of fallers ranged from 16.5 days ("Delirium") to 25.9 days ("Stroke") for the fallers, and from 6.6 ("Respiratory conditions") to 16.8 days ("Hip and femur procedures") for age and gender-matched non-faller patients (Box 3). For each of the six DRGs, the average LOS for fallers was longer than their matched non-faller counterparts (Box 3), with these differences being statistically different for DRGs of "Delirium", "Stroke", and "Respiratory conditions". The remaining three DRGs had fewer than 20 cases each, reducing the power to identify a statistically significant difference. The difference in LOS between groups ranged from a minimum of 4.4 days/faller for patients with "Other disorders of the nervous system" (34% increase), to a maximum increase of 11.4 days/faller for patients with "Respiratory conditions" (173% increase).

Costings data were calculated for the three DRGs that had a statistically significant difference in LOS. The costing system was implemented from 1 Jul 2002, and therefore the costs for patients admitted between 1 Jan 2002 to 30 Jun 2002 were not available. Consequently, there was a substantial amount of missing data. This occurred where one of the two, or both individuals in each pair were unable to have the costings data retrieved. For those paired data sets with complete costings data available for these three DRGs, results indicated that the total hospital-related costs for fallers was about double that of non-fallers (Box 4). This difference was significantly higher for fallers in the DRG "Stroke with severe/complicating diagnosis/procedure (B70A)" ($P = 0.001$). The difference was not statistically significant for the other two groups analysed (Box 4).

2 Age distribution of fallers in the six diagnosis related groups with the highest proportion of fallers



3 Average difference between fallers and non-fallers for each diagnosis related group (DRG) on overall length of stay in hospital

DRG	Length of stay (days)		Average difference in length of stay	*P* value
	Non-fallers	Fallers		
Dementia (B63Z) (N = 11)	12.9	22.6	9.7 days	0.063
Delirium (B64Z) (N = 20)	9.0	16.5	7.5 days	0.017*
Other disorders of nervous system (B81A) (N = 14)	13.1	17.5	4.4 days	0.373
Stroke (B70A) (N = 40)	15.5	25.9	10.4 days	0.000*
Hip and femur procedures (I08A) (N = 17)	16.8	21.9	5.1 days	0.234
Respiratory conditions (E62A) (N = 35)	6.6	18.0	11.4 days	0.000*

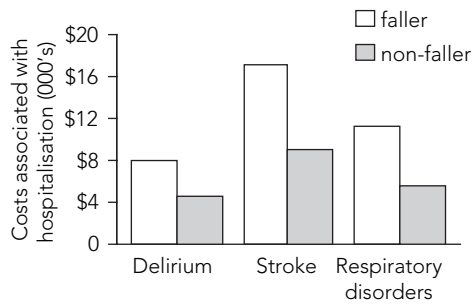
* Significant difference on independent t-test ($P < 0.05$); excluding those with one or both members of a pair with LOS > 50 days ($n = 21$: B63Z x 2; B64Z x 4; B81A x 2; B70A x 6; 108A x 4; E62a x 3).

Discussion

There have been a number of studies highlighting the high costs associated with falls for older people living in the community,[27-30] however there are few data about costs associated with falls in hospitals, particularly in the Australian health care setting. A study in the United Kingdom estimated costs of treating orthopaedic fall-related injuries that occurred in hospital over a 3-year period to be about £127000 (covering surgery and bed-costs only), with most patients with these injuries requiring between 1 and 5 weeks' additional stay in hospital.[31] Results similar to those of our study were obtained in another study in the US.[21] This previous study showed that hospital LOS was 12 days longer, and hospitalisation costs US$4233 higher for fallers than their non-falling counterparts when matched on age and gender and admission time frame. An important difference in our study methodology was analysis within DRGs, which ensures similar groupings of admission causes. It should be noted that the results from our own study, and those of Bates and colleagues[21] and Nadkarni and colleagues[31] only incorporate costs associated with falls while an inpatient. Clearly, for some of these fallers the increased costs persist after discharge in terms of potential need for additional therapy and community support services, as well as indirect costs such as anxiety experienced by patients or caregivers, and these costs were not considered in these studies.

This is the first study reporting falls rates by DRG, and highlighting the DRGs with the highest proportion of fallers. The six DRGs with the highest falls rates were the focus of this study. The majority of these DRGs were not surprising, given that previous risk factor studies in the hospital setting have highlighted the importance of cognition, neurological disorders such as stroke and Parkinson's disease, and history of serious falls-related injuries such as hip fractures as important risk factors for falls.[8,19,32] Another recent study highlighted the interaction between these major contributors to falls risk, reporting that 45% of hip fracture patients who fell in hospital after an operation were delirious on the day of the fall.[33] Only "respiratory infections/inflammation" was a common DRG associated with falls which has not been previously reported as a

4 Costs associated with hospitalisation for fallers and matched non-fallers



falls risk factor in hospital studies (12% within this DRG fell during their hospitalisation).

Falls rates in hospitals are clearly unacceptably high, and sustained evidence-based efforts are required to reduce the magnitude of this problem. Some approaches to falls prevention in hospitals can be achieved with relatively little resources to achieve practice change and improved knowledge and skills of staff, as demonstrated by Haines and colleagues[24] and Healey and colleagues.[25] However, if groups at substantially higher falls risk can be identified, targeted interventions should be considered. Results of our study identified that patients admitted with diagnoses of dementia or delirium, or stroke or other major neurological disorders, have high risk of falling during their hospitalisation. Specific falls prevention activities need to be targeted to these high-risk groups, in addition to a standard falls prevention approach instituted for all patients. For example, patients in these high fall-risk groups should be considered for strategies to increase observation by use of "sitters",[34] bed and chair alarms,[35] and closer position to the nursing station, or perhaps injury minimisation approaches such as hip protectors. Furthermore, the results of our study highlight the likely cost savings, reduced LOS and increased throughput if falls in hospitals can be avoided. The potential cost savings are likely to be substantial, and therefore falls prevention strategies that may require some up-front costs (eg, bed/chair alarms, organisation-wide training) may be cost effective in the longer term. These approaches of targeting individuals in high-risk DRGs need to be considered in the broader context of other falls prevention activities, such as addressing environmental and other systemic factors.

There were several limitations in this study. Within a DRG, factors such as severity of illness or level of comorbidity might vary to a degree, and therefore might be confounders to observed group differences in hospital length of stay. The magnitude of this effect would be attenuated because the split indicator assigned to the final DRG (the last letter of the DRG code) is related in part to severity of condition. Future studies could aim to match on one or both of these factors (severity/comorbidity) as well, although the matching process becomes more complex and perhaps less feasible as more factors are added to the matching process. The second limitation was the availability of the costing data for only part of the study timeframe. The main effect of this was to limit the number of matched pairs available for the cost analyses, limiting sample size and power to identify significant differences. However, the trends were clear in all groups that costs were substantially increased for fallers compared with their matched non-faller counterparts.

In conclusion, falls are a common problem in acute care hospitals, and occur more commonly in certain DRGs, including those associated with cognitive impairment (dementia and delirium), stroke, other major neurological disorders, hip and femur procedures, and respiratory infections and inflammation. Within these DRGs, fallers have longer length of stay, and increased costs associated with their hospitalisation.

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Competing interests

The authors declare that they have no competing interests.

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