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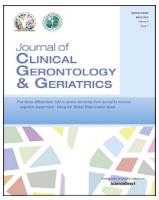

Original article

Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards

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ABSTRACT

Background: New hospital designs with single rooms have emerged in recent years, where increased risks of falls have been reported. The objective of this prospective study was to measure the incidence and outcome of inpatient falls (IFs) in high-risk dementia patients being treated in single rooms and multibedded wards (MB-Ws).

Methods: A total of 100 patients with dementia were recruited across the two hospital settings in South Wales. Baseline characteristics and falls data were collected for the total length of stay (LoS) in the hospital.

Results: There was no significant difference between the two cohorts as suggested by mean age, sex, activities of daily living, comorbidity burden, polypharmacy, or care needs. The number of patients who sustained an IF at the two sites was similar ($p = 0.83$). Time to first fall was not significantly different (single rooms = 12 ± 18.6 days, MB-Ws = 11.4 ± 12.4 days; $p = 0.89$). Fifty-three IFs were sustained by 16 patients in single rooms compared with 23 IFs by 15 patients in MB-Ws. Mean IF/patient treated in single rooms was 3.3 (range 1–9) and this was significantly higher than those treated in MB-Ws (mean 1.5; range 1–3, $p = 0.03$). One patient sustained hip fracture at each site; otherwise, there was no significant difference with regard to other injuries and mortality. Mean LoS for patients with dementia having recurrent falls in single rooms (58.86 ± 41.44 days) was significantly higher as compared with MB-Ws (26.13 ± 20.91 days).

Conclusion: Patients with dementia were at an increased risk of recurrent IF in single rooms compared with MB-Ws. Recurrent IF could be correlated with longer LoS but it is difficult to establish the cause and effect due to the low power of the study. There was no significant difference in terms of injury or mortality between the two settings.

1. Introduction

Worldwide populations are aging. The United Kingdom is facing a significant rise in the aging population and an associated rise in the prevalence of dementia.[1,2] The number of people in the UK aged 65 or over has now reached 11 million and it is estimated that over 800,000 people have dementia in the UK.[1,2] This number is projected to rise to over 1 million by 2025.[2] This inevitably places pressure on hospitals to provide safe inpatient stays for older patients, given that up to one-third of inpatients may have cognitive impairment.[2] Dementia is associated with impaired mobility and people with dementia are at two to three times higher risk of fall.[3–6] The fracture rate in people with dementia is more than three times higher as compared with the age- and sex-adjusted fracture rate in the general population.[3]

Inpatient falls (IFs) are the most commonly reported safety incidents and account for almost two-fifths of the patient safety incidents reported to the National Reporting and Learning System. A 2011 National Patient Safety Agency report estimated 282,000 falls/year including 900 severe incidents of patient harm and 90

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deaths on National Health Service wards.[7] Rates from 2.9 falls/1000 patient-bed-days to 16 falls/1000 patient-bed-days have been reported from different types of patient accommodation in the community hospital, intermediate care provision, or acute settings.[7,8] The risk of IF is highest in single rooms,[9] and associated poor outcomes have been reported.[10]

There is a dearth of studies examining the impact of dementia and IF in single rooms as compared with the traditional wards.[11] The aim of this study is to investigate the incidence and outcome of IF prospectively in patients with dementia treated in single rooms compared with those with dementia treated in traditional multibedded wards (MB-Ws).

2. Methods

2.1. Study design

This is a prospective observational study to measure the impact of the hospital environment on patients with dementia.

2.2. Setting

Ysbyty Ystrad Fawr (YYF) is the first newly built, local general hospital commissioned in the UK to provide 100% single rooms with an en suite facility under the Aneurin Bevan University Health Board (south Wales, UK). It was opened in 2011 with the aim of minimizing hospital-acquired infections and enhancing privacy and dignity by providing single rooms.[12,13] The same Health Board also has another site, the Royal Gwent Hospital (RGH) in Newport, which is a traditional multibedded district general hospital. Both sites admit acute and subacute patients to the National Health Service bed irrespective of the income or personal status.

The National Health Service is the publicly funded health-care system for United Kingdom. It is the largest and the oldest single-payer health-care system in the world.

2.3. Data and measurements

In this prospective study, 100 consecutive patients with known dementia irrespective of age as criteria were observed at YYF (with 100% single rooms) and RGH (MB-Ws). Inclusion criteria were older persons with known dementia admitted with acute illness. Patients with dementia with a terminal illness or requiring palliative care were excluded. Patients were recruited between May and June 2015 and recruitment was stopped when 50 consecutive patients were recruited at each site. IFs data were collected from the entire admission record.

Nursing staff, physiotherapists, and doctors collected patient information and recorded it in the medical notes. This information was subsequently collated from clinical notes onto the standardized data-collection form by an individual study coordinator. Individual patient characteristics recorded from clinical notes included age, sex, dementia subtype, activities of daily living on admission measured by Barthel Index,[14] extended activities of daily living,[15] comorbidity burden measured by the Charlson Comorbidity Index,[16] number of medications, place of residence, carer support, who they live with, falls history, and reason for admission.

A fall was defined as an incident whereby the patient comes to rest on the floor or a lower level, with or without loss of consciousness. The standard hospital data for critical incidents of IF are recorded on Datix. Datix is web-based patient safety software for health-care risk management, which provides a comprehensive oversight of risk management activities including an incident of IF. Further analysis was undertaken for each incident of IF to measure fall-related adverse outcomes including an injury, hip fracture, length of stay (LoS), and both inpatient mortality and 30-day postdischarge mortality.

2.4. Statistical analysis

Data were anonymized and recorded onto a password-protected Microsoft Excel (Redmond, WA, USA) spreadsheet to protect patient confidentiality. Data analysis was performed using IBM SPSS 20 (Armonk, NY, USA) and Microsoft Excel. Data are presented as means ± standard deviation.

The incidence of falls is described as mean falls/inpatient faller and IFs/1000 patient-bed-days. Mean falls/inpatient faller was calculated by dividing the total number of falls by the number of patients who sustained IF. Falls incidence density/1000 patient-bed-days was calculated by dividing the total number of falls at each site by the total sum of bed-days used by all the patients included in the study at each respective site.

Independent t test was used to compare the mean value of the two independent groups (YYF and RGH) to establish any statistical differences between baseline characteristics, specific falls information, LoS, discharge destination, and mortality. A Chi-square test was used to compare observed and expected frequencies with regard to inpatients and previous history of falls prior to admission. The level of statistical significance at which the null hypothesis was rejected was chosen as 0.05.

This observational study was carried out to evaluate the impact of the new service provision (100% single rooms) in comparison with the existing service (MB-Ws), which is also provided by the same Health Board. All questions and forms required to carry out the study were sent to the Research and Development (R&D) Department at Aneurin Bevan University Health Board, in order to assess risks to patient identification and the Health Board. The R&D Department approved the study with no further need for ethical approval. The R&D Department's decision was justified on the basis that this observational study was carried out only to evaluate current service and no personal information other than hospital identification number, date of birth, and sex will be recorded for service evaluation purpose only and no personal identifiable information will be shared or published. The outcome data including LoS, mortality, and discharge to care home used in this study are currently being recorded by the Health Board routinely. Consent was still taken for this service evaluation in case patients need to be contacted or interviewed to complete any missing clinical data.

3. Results

A total of 100 patients were recruited into the study, with 50 patients at each site. The average age of patients in single rooms at YYF was 83.1 ± 8.5 years and age was not significantly different from those admitted at RGH with MB-Ws (85 ± 8.4 years, $p = 0.35$). There were a higher proportion of female patients at both sites: 27 at YYF and 34 at RGH ($p = 0.15$). As much as 76% (38/50) of patients at both sites were admitted from their own home, whereas the remaining 24% (12/50) were admitted from a nursing or residential home. All patients required assistance with extended activities of daily living and all received some form of community care, whether it is informal, formal, or both. There was no significant difference between the baseline characteristics of the two cohorts as suggested by mean age, sex, activities of daily living, comorbidity burden, polypharmacy, or overall carer support (Table 1).

The reason for admission varied and included predominantly medical indications, with some surgical indications. The most common reason for admission at both hospitals was falls (YYF, $n = 13$; RGH, $n = 16$). Other reasons for admission were confusion, collapse, general deterioration, shortness of breath, urinary tract

Table 1
Baseline characteristics of patients with dementia admitted to single rooms and MB-Ws.

	YYF (single rooms)	RGH (multibedded wards)	*p*
No. of patients	50	50	>0.95
Age, mean ± SD (y)	83.1 ± 8.5	84.5 ± 8.4	0.35
Female, *n/N* (%)	27/50 (54)	34/50 (68)	0.15
Dementia subtype			
Not specified, *n/N* (%)	26/50 (52)	29/50 (58)	0.55
Alzheimer's, *n/N* (%)	7/50 (14)	11/50 (22)	0.30
Vascular, *n/N* (%)	16/50 (32)	8/50 (16)	0.061
Dementia with Lewy bodies, *n/N* (%)	1/50 (2)	2/50 (4)	0.56
Barthel Index, mean ± SD	9.1 ± 4.9	9.04 ± 3.1	0.90
Comorbidity burden, mean ± SD	6.7 ± 1.1	7.0 ± 1.8	0.32
No. of medications, mean ± SD	10.0 ± 4.2	8.9 ± 4.1	0.23
Place of original residence			
House, *n/N* (%)	31/50 (62)	30/50 (60)	0.83
Flat, *n/N* (%)	3/50 (6)	2/50 (4)	0.65
Bungalow, *n/N* (%)	4/50 (8)	6/50 (12)	0.50
Nursing home, *n/N* (%)	3/50 (6)	7/50 (14)	0.18
Residential home, *n/N* (%)	9/50 (18)	5/50 (10)	0.25
Help with all extended activities of daily living, *n/N* (%)	50/50 (100)	50/50 (100)	>0.95
Carer support			
Formal, *n/N* (%)	20/50 (40)	29/50 (58)	0.072
Informal, *n/N* (%)	21/50 (42)	13/50 (26)	0.091
Overall, *n/N* (%)	9/50 (18)	8/50 (16)	0.79
Living with			
Partner/spouse/relative, *n/N* (%)	21/50 (42)	13/50 (26)	0.091
Alone, *n/N* (%)	17/50 (34)	25/50 (50)	0.11
Care Home residents, *n/N* (%)	12/50 (24)	12/50 (24)	>0.95

MB-W = multibedded ward; RGH = Royal Gwent Hospital; SD = standard deviation; YYF = Ysbyty Ystrad Fawr.

infections, diarrhea, and vomiting. Table 2 presents the indications for admission, as recorded in the medical notes, across the two sites.

Fifty-three incidents of IF were reported in single rooms as compared with 23 incidents in MB-Ws. The mean number of falls/inpatient faller in single rooms was more than two times (3.3 ± 2.75) as compared with MB-Ws (1.5 ± 0.83), thus showing a significant difference between the two sites ($p = 0.035$). However, the total number of patients who sustained IF at the two sites was almost similar: 32% (16/50) patients at YYF single rooms and 30% (15/50) at RGH MB-Ws ($p = 0.83$). The number of IFs in single rooms for the patients with falls ranged from one to nine whereas in comparison the range of IF in MB-Ws was one to three. The profile of IF including clinical outcomes in patients with dementia at the two sites is shown in Table 3.

Table 2
Reasons for admission to YYF (single rooms) and RGH (MB-Ws).

YYF	*N* = 50	RGH	*N* = 50
Fall	13	Fall	16
Generally unwell	6	Collapse	7
Confusion	4	SOB	3
General deterioration	4	Generally unwell	3
Urinary tract infection	4	Diarrhea/vomiting	3
Reduced mobility	3	Confusion	3
Collapse	2	Reduced consciousness	2
Diarrhea/vomiting	2	General deterioration	2
Chest pain	2	Chest pain	2
Deep vein thrombosis	1	Weight loss	1
Cellulitis	1	Supraventricular tachycardia	1
Dementia	1	Seizure	1
Paresthesia	1	Reduced mobility	1
Dehydration	1	Nausea	1
Musculoskeletal pain	1	Hematemesis	1
SOB	1	Fracture	1
Hallucinations	1	Failed discharge	1
Agitation	1	Cellulitis	1
Pressure sore	1		

MB-W = multibedded ward; RGH = Royal Gwent Hospital; SOB = shortness of breath; YYF = Ysbyty Ystrad Fawr.

The most common reason for admission for patients with dementia at both hospitals was falls (YYF, $n = 13$; RGH, $n = 16$). The majority of patients who sustained an IF had a prior history of falls in the community (YYF = 14/16; 87.5% and RGH = 14/15; 93.3%). A Chi-square test was performed for both sites assessing whether a history of falls was associated with IF. No relationship was found between a history of falls prior to admission and IF in single rooms ($\chi^2 = 1.39$, $p = 0.06$). A relationship was, however, evident in MB-Ws ($\chi^2 = 2.10$, $p = 0.04$).

In this study, the overall LoS in single rooms for all patients, including both those who experienced an IF and those who did not was 39.7 ± 30.8 days. This was significantly higher than in those admitted to MB-Ws (21.8 ± 17.0 days, $p = 0.001$). The LoS for patients who sustained IF in single rooms was also significantly higher than those admitted to MB-Ws (Table 3). Falls/1000 patient-bed-days (based on combined LoS for all patients at each site) at YYF were higher (27.08 ± 22.48) as compared with RGH (21.06 ± 11.45) but this was not significantly different ($p = 0.35$).

The majority of fallers at both sites sustained either no or minor injuries except for one patient who sustained a hip fracture. There was no significant difference in the inpatient mortality or 30-day post-discharge mortality at either site. Of those 16 patients who sustained an IF in single rooms, four patients required a new care home placement at discharge. This was significantly higher as compared with MB-Ws where only one patient out of 15 having an IF required a new care home placement ($p = 0.019$).

4. Discussion

Falls are a worldwide public health problem.[17] Patients admitted to hospital are at a greater risk of falling as compared with those in the community due to an unfamiliar environment, concurrent comorbidities, acute illness, and treatments.[18]

Most epidemiological studies investigating falls risk factors in cognitively impaired older people have been undertaken for community-dwelling or care home residents. Studies undertaken in nursing home residents demonstrated an association of injurious

Table 3
Profile of inpatient falls and clinical outcomes in single rooms and MB-Ws.

	YYF (single rooms)	RGH (multibedded wards)	*p*
Description of inpatient falls			
No. of patients	50	50	
Total number of IF incidents	53	23	
Proportion of patients who fall, *n*/*N* (%)	16/50 (32)	15/50 (30)	0.83
Falls/inpatient faller, mean ± SD	3.3 ± 2.75	1.5 ± 0.83	0.035
No. of days until first fall, mean ± SD	12.0 ± 18.6	11.4 ± 12.4	0.89
History of falls prior to admission, *n*/*N* (%)	35/50 (70)	37/50 (74)	0.66
Impact of fall			
No injury, *n*/*N* (%)	33/53 (62.2)	15/23 (65.2)	0.80
Minor injury, *n*/*N* (%)	19/53 (35.8)	7/23 (30.4)	0.65
Major injury, *n*/*N* (%)	0 (0)	0 (0)	>0.95
Hip fracture, *n*/*N* (%)	1/53 (2)	1/23 (2)	>0.95
Length of stay			
Mean ± SD (d), (all patients)	39.7 ± 30.8	21.8 ± 17.0	0.001
Median ± SD (d), (all patients)	30 ± 30.8	15 ± 17.0	0.001
Mean ± SD (d), (fallers)	58.86 ± 41.44	26.13 ± 20.91	0.01
Discharge destination			
Own home, *n*/*N* (%)	12/16 (75)	14/15 (93.3)	0.17
New care home, *n*/*N* (%)	4/16 (25)	1/15 (6.7)	0.19
Mortality			
Inpatient, *n* (%)	0 (0)	0 (0)	>0.95
30-d post discharge, *n*/*N* (%)	1/16 (6.3)	0/15 (0)	0.33

IF = inpatient fall; MB-W = multibedded ward; RGH = Royal Gwent Hospital; SD = standard deviation; YYF = Ysbyty Ystrad Fawr.

falls with moderate dementia and recurrent falls with severe dementia.[19,20] There is little evidence that environmental factors are strongly associated with falls risk in patients with Alzheimer's disease or Lewy body dementia.[21,22] However, falls are more common in the hospital environment. There have been several successful studies investigating fall prevention programs in the hospital setting. These studies have shown the benefits of comprehensive geriatric assessment, supervised exercise, and balance training; education; medication review; and provision of walking aids to reduce falls in the hospital.[23–27] A retrospective study examining 1611 incidents of IF, affecting a total of 676 patients over a period of 2 years, showed that older people with cognitive impairment have significantly higher incidence of IFs in a single-room environment when compared with inpatient fallers with normal cognitive function.[28] There is a dearth of evidence measuring the influence and impact of hospital environment like single rooms or MB-Ws on patients with dementia,[11] and in our knowledge, no randomized or case–control trial has been conducted for patients being admitted to two such environments.

The risk of IF further increases by two to three times in the presence of dementia or cognitive impairment.[3–6,28] There is evidence that the risk of IFs is 2.5 times higher in the single-room setting.[9] There is, therefore, a possibility that a person with dementia treated in single room could be at five to six times higher risk of falling as compared with those without dementia treated in traditional MB-Ws. In this prospective study, we observed that the incidence of falls is 2.3 times higher in people with dementia treated in single rooms as compared with those treated in MB-Ws. These results support previous studies, which show an increased incidence of IFs in single rooms compared with MB-Ws, despite our hypothesis that this would be much higher.

Following the opening of YYF hospital, concerns were expressed regarding the high incidence of falls, and as a result a systematic nurse-training program was implemented in 2013.[29] This program aimed to improve understanding of falls risk factors and to help nurses apply strategies to prevent IFs; consequently, a reduction in falls incidence at the YYF was noted.[29] Although this study has identified that patients in single rooms are at greater risk of falls than those treated on MB-Ws, the results are not as dramatic as previously shown or expected. This study supports that the implementation of the nurse-training program has been effective in terms of reducing the overall number of patients sustaining at least one IF; however, there is still a higher mean number of falls/inpatient faller in patients with dementia treated in single rooms. Therefore, there is a need to implement further intervention and quality improvement initiatives to minimize the risk of recurrent IF in patients at highest risk, particularly those admitted to single rooms.

It was observed that there is a lack of rigorous recording of IF incidents at RGH. In some cases, falls data recorded in clinical notes were not transferred to Datix and vice versa. Some employees at RGH were unfamiliar with this Datix system, which is web-based patient safety software for health-care risk management. The underreporting of IF at RGH can be suspected as a bias in this study, however, every possible effort was made to record each fall through review of case notes or the Datix system to minimize this bias. Documentation at single rooms was comparatively better, which could be an impact of regular systematic nursing training.[29,30]

It was also observed that the impact of IF on clinical outcomes across the two sites was similar with regard to hip fractures and mortality. This is reassuring given the high burden of hip fractures among older patients and associated care costs. These results are not as prominent as previously demonstrated and may reflect the small sample size used in this study.[3–6]

However, the overall mean LoS for all patients treated in single rooms (39.7 ± 30.8 days) was significantly longer than those treated in MB-Ws (21.8 ± 17.0 days). In addition, for those who experienced an IF in single rooms, there was a significantly higher LoS (58.86 ± 41.44 days) as compared with those who sustained a fall in MB-Ws (26.13 ± 20.91 days), demonstrating an association between IF and increased LoS in single rooms. This statistical difference was not noted for those patients who were treated in an MB-W ($p = 0.81$). It is, therefore, difficult to ascertain whether the increased LoS among those who had an IF can be attributed to this inpatient event, or whether it is related to the initial reason for admission. However, the significantly longer LoS among inpatient fallers in single rooms with the support of two times higher rate of falls/inpatient faller and higher falls/1000 patient-bed-days in single rooms indicates a possible relationship between IF and an

increased LoS in single rooms. This will remain an important area that warrants further investigation to ascertain the cause and effect of IFs in the single rooms and exclude the fact that prolonged LoS following IFs is irrelevant to the rooms.

Although the majority of patients who fell in either setting had a history of falls prior to admission, few patients with a falls history did not fall during the study. This suggests that although a falls history is a risk factor for IFs, it is not necessarily a predictor in the hospital setting. Some studies have investigated the risk factors of falls in the community which suggest that blurred vision, minimal outdoor activities, and overactive thyroid/parathyroid were associated with single falls.[31] Frailty, decreased body height, and taking sedatives/hypnotics were associated with recurrent falls.[31] History of previous falls and slow gait speed were associated with both single and recurrent falls.[31,32] Further investigation is therefore warranted, to understand why certain groups of patients are experiencing high levels of recurrent falls and whether targeted interventions for high-risk patients can be implemented to address this.

This study has certain strengths. It is a prospective comparative study. It is also the first study to compare incidence and impact of IF in the high-risk group of dementia patients across two different hospital settings: single rooms and MB-Ws. This study provides a valuable benchmark for further studies to enhance the quality of care and improve patient safety.

The major limitations of this observational study are the small number of patients observed and not measuring the impact of acute illness and hospitalisation such as malnutrition in patients with dementia. We also did not assess the patients for the severity of dementia as part of this service evaluation and this is another confounding factor. Therefore, we cannot be certain what impact these elements had on clinical outcome such as discharge destinations or mortality. The study is also based on data from one health board, and therefore, the ability to generalize to other areas is limited. It was only correlated that higher LoS could be due to recurrent IF as evidenced by higher falls density in single rooms, but the cause and effect could not be established due to a small number of patients observed. We did not measure the impact of IF on financial burden and morbidity. Although the two cohorts were well matched in terms of age, ability to do activities of daily living, comorbidity burden, polypharmacy, or care needs, it is still a low power study. The other possible source of bias is gender difference, which although was not statistically significant could still be confounding.

Both settings have their own benefits and disadvantages. Single rooms may prove to be a more favorable environment for patients in terms of dignity and privacy,[33] and a lower rate of hospital-acquired infections but at an expense of higher loneliness; by contrast, MB-Ws provide comparatively less privacy, a higher rate of hospital-acquired infections but better companionship. We, therefore, propose a larger sample size, which may provide a more comprehensive picture, with regard to appropriate environment—single-room accommodation or MB-W to care for patients with dementia admitted to acute hospitals. Further study investigating the high levels of recurrent falls in patients with dementia treated in two such environments is required to minimize adverse outcomes including hip fracture and long-term mortality.[10,12,34–36]

In conclusion, this study has identified that hospital environment does have an impact on older people with dementia who could be at an increased risk of recurrent IFs if treated in single rooms compared with MB-Ws. Our study results indicate that recurrent IFs are correlated with a longer LoS and new care home placement, but no significant difference was observed in clinical outcomes in terms of hip fracture or mortality in the two hospital environments.

Conflicts of interest

None of the authors have any financial or any other kind of personal conflicts with this article.

Authors' contributions

SK was responsible for data collection, data analysis, and interpretation; IS was involved in study design and data interpretation. Both authors contributed to the writing of the paper and approve the final version.

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