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# Readmission rates for fall-related injuries

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# Readmission rates for fall-related injuries

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## 1 Introduction

Falls are the leading cause of injury related hospitalisations among people aged 65 years and over in Queensland, representing 75% of total injury hospitalisations in this age group<sup>1</sup>.

Most falls are preventable. A number of risk factors for falling among older people have been identified. These are either related to a person's behaviour or condition such as age and illnesses, or related to a person's environment or their interaction with the environment, for example, falling off a ladder. A person's risk of falling increases as the number of risk factors accumulates<sup>2</sup>.

Queensland Health has developed a Falls Injury Prevention Program for hospitals and residential aged care facilities which is coordinated through the Patient Safety and Quality Improvement Service. The program works with Hospital and Health Services, Patient Safety Officers, health professionals (including GPs and occupational therapists) and the community to prevent falls and reduce harm from falls. The Queensland Stay On Your Feet® model for falls prevention in older people recommends that as a part of discharge planning for at risk patients, falls risk and prevention strategies and discharge referrals be sent to the patient's General Practitioner and/or community health professionals within 24-48 hours of discharge.

This study uses linked data to examine unplanned readmission rates for fall-related fractures among Queensland residents aged 50 years or older who had a previous fall-related fracture and were admitted to Queensland facilities. Unplanned hospital readmissions are considered an outcome indicator reflecting quality of care<sup>3</sup>, of which discharge planning is a component. Risk adjusted rates for readmission within two years of fall-related fractures occurring during the period 2008/09 to 2009/10 are presented by facility. These rates are based on the facility where patients were last discharged from for their initial fall-related fracture hospital stay. Time to readmission is also examined.

## 2 Methodology

Individual patient records were sourced from the Queensland Hospital Admitted Patient Data Collection and Death Registration Data Collection for the period 2008/09 to 2011/12. The initial extraction included any patient aged 50 years or older admitted to a Queensland facility with a fall code (Appendix 6.2) and a fracture code (Appendix 6.1) during the four year period 2008/09 to 2011/12. Any other admission where patient records recorded osteoporosis (Appendix 6.3) as either a principal or other diagnosis were also extracted and linked to the fracture patients.

The index episode was defined as the first acute care admission for a fall-related fracture occurring during the period 2008/09 to 2009/10. Readmissions were defined as a subsequent admission for a fall-related fracture to any hospital. The scope of readmission for risk-adjusted rates was restricted to a readmission for a fall-related fracture within two years of the index episode. It is likely that there are some patients in this cohort who were readmitted for complications associated with the first fracture-related stay, rather than admitted for a new fall-related fracture, however, we were unable to determine from the administrative data whether this was the case. Very few patients in the study cohort were readmitted with the same diagnostic codes as those recorded during the index stay.

Patient records were linked using probabilistic and deterministic methods. Unplanned readmissions for fall-related fractures in this study include two different types of admission:

- where the admission included a fracture-related episode of care, and was the first episode of care for the hospital stay, and the elective status assigned was "emergency"
- where the fracture was considered as acquired in hospital based on the onset flag.

If there were multiple episodes of care that met the criteria above within the same hospital stay, then the episode of care that was recorded first within the hospital stay was considered as the re-admission episode i.e. they were not counted multiple times.

Patient demographics such as age, sex, address and Indigenous status were based on the index episode. A Charlson Index was also developed for each patient to describe comorbidities associated with the index episode.

Transfers between facilities and statistical changes of episode (e.g. from acute care to rehabilitation) associated with the initial index admission for fall-related fractures were counted as a single hospital stay. Length of stay calculations for the index stay, therefore included transfers and statistical changes in episodes of care, however, leave days were excluded.

Death registration data were extracted and also linked to the index patients.

There were 19,286 eligible patients in the study cohort. Patients were excluded if they died during the index stay or had no readmission recorded but died within two years of their index stay (4,399 patients), leaving 14,887 patients. Patients who were readmitted beyond the two-year follow-up period were included in the index cohort, but not counted as being readmitted.

### 3 Output and Analysis

#### 3.1 Readmission rates

Of the 14,887 patients included in the analysis cohort, 14.3% (2,123) were readmitted for a fall-related fracture within two years of their index admission. An estimated 70.1% of patients were female, with a readmission rate of 15.2% compared with 11.2% for males.

Logistic regression modelling found that age, dementia, osteoporosis, hip surgery during index admission, pulmonary disease, and mild liver disease were significantly associated with readmission for fall-related fractures after adjusting for age and comorbidities (see Table 1). After adjusting for age and comorbidities, sex was not a significant predictor of readmission, with females having similar adjusted odds of readmission to males (OR: 1.03, 95%CI: 0.92 to 1.15).

Notably, hip surgery during index admission was not a significant predictor of readmission at a univariate level, but was found to be a significant predictor in the multivariate model, with those who had surgery found to have a reduced adjusted odds of readmission compared with those who did not (OR: 0.71, 95%CI: 0.63 to 0.79). In contrast, osteoporosis diagnoses at any stage during the study period increased the adjusted odds of readmission, in particular, diagnosis after index admission (OR: 4.33, 95%CI: 3.66 to 5.13). Of the eight Charlson Index comorbidities found to be associated with readmission at a univariate level, only three remained significant after adjustment for other potential confounders: dementia, mild liver disease and pulmonary disease.

Age was linearly associated with readmission, with the adjusted odds of readmission increasing by 4.9% (95%CI: 4.4% to 5.4%) per year for each year of age.

Table 1: Odds of readmission for fall-related fractures, Queensland, 2008/08 to 2009/10

Variable	Adjusted odds ratio (95% confidence interval)
<b>Age</b>	***1.05 per year (1.04 to 1.05)
<b>Sex</b>	
Male	1.0
Female	1.03 (0.92 to 1.15)
<b>Osteoporosis</b>	
Not recorded during study period	1.0
First diagnosed prior to index admission	***2.83 (1.98 to 4.03)
First diagnosed during index admission	***1.44 (1.21 to 1.71)
First diagnosed after index admission	***4.33 (3.66 to 5.13)
<b>Hip surgery during index admission</b>	
No	1.0
Yes	***0.71 (0.63 to 0.79)
<b>Dementia</b>	
Not recorded	1.0
Recorded	***1.45 (1.24 to 1.69)
<b>Pulmonary disease</b>	
Not recorded	1.0
Recorded	**1.39 (1.12 to 1.73)
<b>Mild liver disease</b>	
Not recorded	1.0
Recorded	**2.38 (1.45 to 3.92)
<i>Area under ROC curve<sup>(a)</sup></i>	0.704
<i>Hosmer and Lemeshow Goodness of fit</i>	<i>p=0.0483</i>

(a) ROC- Receiver operating characteristic. Values greater than or equal to 0.7 represent acceptable discrimination<sup>4</sup>.

\*p<0.05; \*\*p<0.001; \*\*\*p<0.0001

In order to comply with confidentiality principles and legislation, the identity of private hospitals has not been included in the results. These facilities were aggregated into two groups: 22 private facilities with less than 50 fall-related index separations, and 28 private facilities with more than 50 fall-related index separations (for these analyses, separations were counted for in-scope patients only - those who were excluded from the index cohort were not counted in volume calculations). Eighty-four public facilities with less than 50 index separations were also aggregated for reporting of risk-adjusted rates.

Queensland wide, 14.3% of patients in the study cohort were readmitted for fall-related fractures during the study period. At the facility level\*, risk adjusted readmission rates ranged from 7.6% up to

\* Please note that facilities have been de-identified in this version of the paper to allow it to be shared outside the Health Statistics Branch, prior to the results being shared with individual facilities.

21.8% (see Figure 1). The aggregated private facility groups and Public Hospital 27 had significantly lower risk adjusted readmission rates than the statewide average, while Public Hospitals 2, 3 and 4 had significantly higher risk adjusted readmission rates ( $p < 0.05$ ). Patients admitted to the small volume private facilities had a median age of 79 years and a median length of stay of 16 days compared with 77 years and 15 days at small volume public facilities. Median length of stay ranged from 1 to 23 days across the facility groupings, while median age ranged from 66 years up to 81 years.

The median age of patients from both Public Hospitals 3 and 4 was 68 years, among the lowest recorded. However, when stratified by readmission status, the median age of readmitted Public Hospital 2 patients was higher than those not readmitted (73.5 years compared with 67.0 years) (see Table 2). There was no difference in age at Public Hospital 4 between the two groups. These two facilities also had a relatively small number of patients diagnosed with osteoporosis (6.0% and 4.4% respectively).

Figure 1: Risk adjusted rate of readmission for fall-related fractures, Queensland, 2008/09 to 2009/10

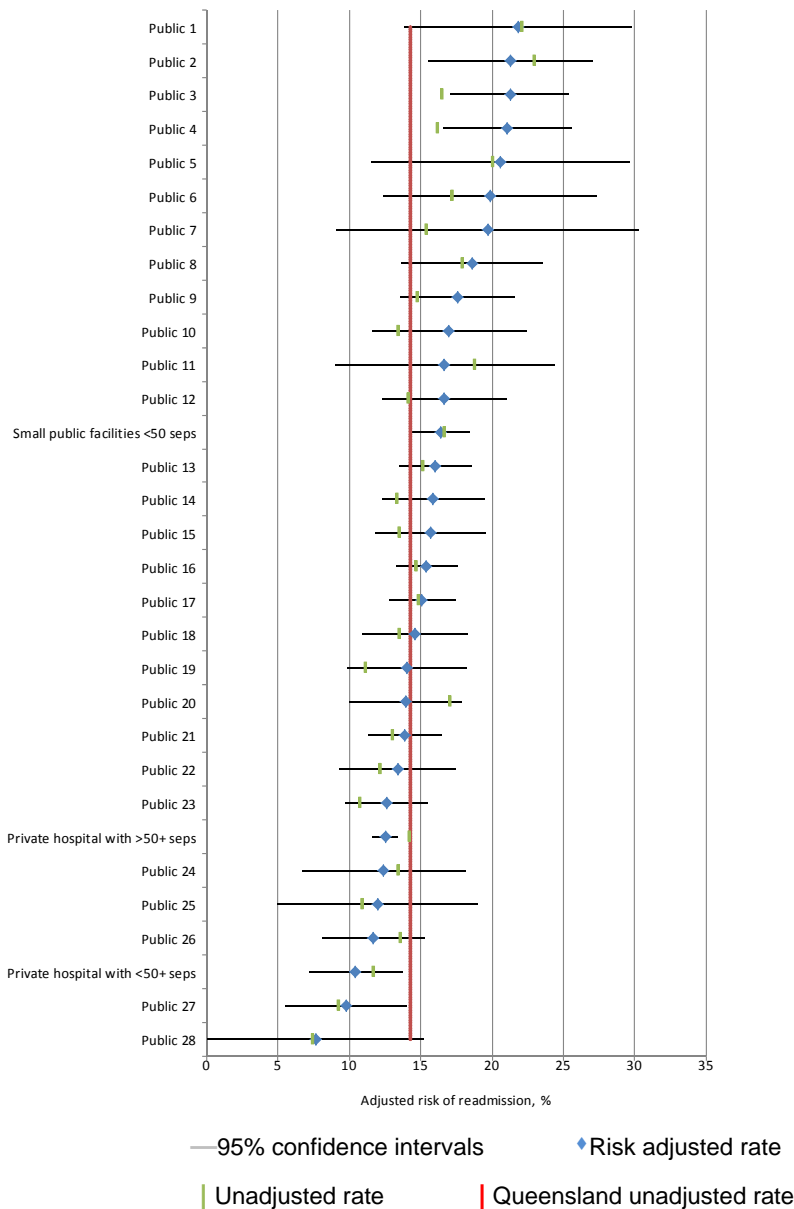


Table 2: Facility level readmission rates and characteristics, Queensland, 2008/09 to 2009/10

Index facility	Total separations - n -	Risk adjusted rate readmissions - % (95% CIs) -	Median (lower and upper quartiles)		Any osteoporosis diagnoses - % -
			Length of stay (days)	Age (years)	
Public 1	68	21.8 (13.9 to 29.8)	3 (1 to 11.5)	73 (61 to 83.5)	17.6
Public 2	122	21.3 (15.6 to 27.1)	1 (1 to 12) ↓	78 (68 to 86)	4.1
Public 3	352	21.3 (17.1 to 25.4)	1 (0 to 7) ↓	68 (59 to 78)	6.0

Index facility	Total separations	Risk adjusted rate readmissions	Median (lower and upper quartiles)		Any osteoporosis diagnoses
Public 4	297	21.1 (16.6 to 25.5)	3 (0 to 11) ↓	68 (58 to 79)	4.4
Public 5	55	20.6 (11.6 to 29.6)	7 (1 to 22)	73 (64 to 83)	10.9
Public 6	93	19.9 (12.4 to 27.4)	3 (0 to 22) ↓	74 (61 to 82)	6.5
Public 7	52	19.7 (9.1 to 30.3)	4 (0 to 15)	66 (57 to 76)	9.6
Public 8	190	18.6 (13.6 to 23.6)	6 (0 to 13)	74 (65 to 82)	5.3
Public 9	332	17.6 (13.6 to 21.6)	5 (1 to 12)	68 (60 to 79)	6.9
Public 10	201	17.0 (11.6 to 22.4)	3 (1 to 8) ↓	70 (62 to 79)	3.0
Public 11	64	16.7 (9.0 to 24.3)	8 (0 to 32) ↓	76.5 (62.5 to 84.5)	12.5
Public 12	277	16.7 (12.3 to 21.1)	6 (2 to 24)	70 (60 to 80)	6.9
Public facilities with less than 50 separations	1,028	16.4 (14.4 to 18.5)	15 (2 to 35)	77 (66 to 84)	8.4
Public 13	739	16.0 (13.5 to 18.6)	7 (1 to 22) ↓	75 (64 to 83)	8.3
Public 14	421	15.9 (12.3 to 19.5)	8 (2 to 20)	71 (61 to 82)	6.2
Public 15	356	15.7 (11.9 to 19.5)	7 (3 to 17) ↑	71 (60 to 80)	9.6
Public 16	994	15.4 (13.2 to 17.6)	7 (1 to 22) ↓	74 (64 to 83)	9.2
Public 17	814	15.1 (12.8 to 17.4)	8.5 (1 to 24)	73.5 (61 to 83)	15.1
Public 18	349	14.6 (10.9 to 18.3)	6 (2 to 17)	71 (61 to 83)	7.2
Public 19	332	14.1 (9.9 to 18.3)	8 (3 to 18) ↑	70 (60 to 82)	4.8
Public 20	223	14.0 (10 to 17.9)	19 (5 to 47) ↑	81 (72 to 86)	17.9
Public 21	713	13.9 (11.4 to 16.5)	9 (3 to 27)	72 (60 to 81)	14.4
Public 22	288	13.4 (9.3 to 17.5)	2 (1 to 6.5) ↓	71 (60 to 80.5)	7.6
Public 23	634	12.6 (9.7 to 15.5)	3 (1 to 8) ↓	70 (60 to 81)	6.9

Index facility	Total separations	Risk adjusted rate readmissions	Median (lower and upper quartiles)		Any osteoporosis diagnoses
Private facilities with more than 50 separations	4,703	12.5 (11.6 to 13.4)	12 (4 to 30) ↑	79 (67 to 86)	16.5
Public 24	127	12.4 (6.7 to 18.1)	23 (13 to 34) ↑	81 (74 to 85)	11.0
Public 25	101	12.0 (4.9 to 19.1)	6 (0 to 32) ↓	74 (64 to 81)	12.9
Public 26	288	11.7 (8.1 to 15.3)	21 (0 to 45)	78 (68 to 85)	21.9
Private facilities with less than 50 separations	360	10.5 (7.2 to 13.7)	16 (5 to 30) ↓	79 (66 to 84)	15.0
Public 27	260	9.8 (5.5 to 14)	5.5 (1 to 34) ↓	75 (61 to 83)	9.6
Public 28	54	7.6 (0 to 16.9)	17 (4 to 29)	77 (68 to 82)	5.6

↑ Risk adjusted rate for length of stay of three days or more was significantly higher than statewide rate of 71.9%.

↓ Risk adjusted rate for length of stay of three days or more was significantly lower than statewide rate of 71.9%.

### 3.2 Time to readmission

While time to readmission analyses focussed only on the first readmission, exploratory data analyses showed that 398 (2.2%) of patients were readmitted more than once for fall-related fractures during the follow-up period.

Predicted time to readmission showed that an estimated 10% of index patients had a readmission for a fall-related fracture within 16 months and 7 days (494 days; 95%CI: 456 to 532) of being discharged. Within 2 years and 8 months (972 days; 95%CI: 914 to 1033), 15% had been readmitted.

A survival analysis was conducted to assess the impact of predictors on time to readmission. It was found that predicted readmission times varied by osteoporosis diagnosis. Based on the model, predicted time for readmission of 10% of patients with no osteoporosis diagnosis recorded was 1 year and 9 months. In comparison, predicted time to readmission for patients with an osteoporosis diagnosis after the index fracture was much shorter with 10% readmitted within 57 days (95% CI: 34 to 87 days).

## 4 Discussion

Overall, these analyses found that 14.3% of patients over 50 years of age on admission for a fall-related fracture were readmitted with a fracture within 2 years. It is likely that not all readmissions were for new fractures, and that some of these were readmissions for complications or refracture of the original injury, however, we were not able to differentiate between these types of admission using the hospital admissions data. Nevertheless, in the context of effective discharge planning relating to falls prevention, both types of readmission are potentially of interest. It is also likely that longer follow-up would have led to higher readmission rates, as evidenced by a recent NSW study that found that 35% of people admitted over a six year period with a minimal trauma fracture were readmitted to the same hospital with a further fracture<sup>5</sup>.



Risk adjusted readmission rates developed for each hospital show considerable variation ranging from 7.6% up to 21.8%. Three public hospitals had significantly higher readmission rates than the state-wide rate of 14.3% after risk adjustment. In contrast, when aggregated, both low volume private hospitals, and higher volume private hospitals had significantly lower risk adjusted readmission rates than the state-wide average, as did another public hospital. The three public hospitals with higher readmission rates all have relatively low median length of stay and osteoporosis diagnosis rates, while those facilities with significantly lower readmission rates had relatively longer median length of stays and higher rates of osteoporosis diagnosis.

Unplanned readmission rates are frequently used as a proxy for quality of care, as at least some portion of them are potentially avoidable, however, it is also argued that a lack of continuity of care that exists post-discharge is a major source of readmissions<sup>6,7</sup>. In relation to fall-related fractures, discharge planning from Queensland hospitals under the falls injury prevention program ideally involves a coordinated approach to follow-up care in the community or aged care facility the patient resides in. It is not clear from these analyses, whether the significantly higher risk-adjusted readmission rates in some facilities are due to quality of care including discharge planning, poor continuity of care, personal behaviour, or some other unmeasured factor(s). However, the presence of variation despite casemix adjustment indicates that further investigation is warranted.

Avoidable falls leading to readmission to hospital may have a significant impact on the subsequent quality and length of life of the patient. These analyses show that there are variations at the facility level in unplanned readmissions that may be amenable to intervention during the hospital stay, through the discharge planning process and in the community.

The cohort definition for this study was based on what could be accessed readily via the available administrative data, but was likely not as specific as required for a study of this nature. Ideally, an optimal approach would examine variations in readmission for patients with osteoporotic fractures, but due to limitations in the recording of osteoporosis diagnoses, this was not possible. The cohort was instead defined using age, fracture type, and fracture mechanism, which reduced the sensitivity of the study to detect the main effect of interest. However, the finding of variation between facilities, even with this necessarily broad cohort, suggests that further investigations would be worthwhile.

## 5 Acknowledgements

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## 6 Appendix A.

The following disease classification codes for injury, fall type and osteoporosis were used to define the study cohort.

### 6.1 ICD-10-AM definitions - Injury codes

Risk factor	ICD-10-AM Codes
S02	Fracture of skull and facial bones
S12	Fracture of neck
S22	Fracture of rib(s), sternum and thoracic spine
S32	Fracture of lumbar spine and pelvis
S42	Fracture of shoulder and upper arm
S52	Fracture of forearm
S62	Fracture at wrist and hand level
S72	Fracture of femur
S82	Fracture of lower leg, including ankle
S92	Fracture of foot, except ankle
T02	Fractures involving multiple body regions
T08	Fracture of spine, level unspecified
T10	Fracture of upper limb, level unspecified
T12	Fracture of lower limb, level unspecified

### 6.2 ICD-10-AM definitions – External cause codes

Risk factor	ICD-10-AM Codes
W00	Fall on same level involving ice and snow
W01	Fall on same level from slipping, tripping and stumbling
W02	Fall involving ice-skates, skis, roller-skates or skateboards
W03	Other fall on same level due to collision with, or pushing by, another person
W04	Fall while being carried or supported by other persons
W05	Fall involving wheelchair
W06	Fall involving bed
W07	Fall involving chair
W08	Fall involving other furniture
W09	Fall involving playground equipment
W10	Fall on and from stairs and steps
W11	Fall on and from ladder
W12	Fall on and from scaffolding
W13	Fall from, out of or through building or structure
W14	Fall from tree
W15	Fall from cliff
W16	Diving or jumping into water causing injury other than drowning or submersion
W17	Other fall from one level to another
W18	Other fall on same level
W19	Unspecified fall

### 6.3 ICD-10-AM definitions – Osteoporosis codes

Risk factor	ICD-10-AM Codes
M80	Osteoporosis with pathological fracture
M81	Osteoporosis without pathological fracture
M82	Osteoporosis in diseases classified elsewhere

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