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Factors associated with hospital readmission and emergency visits among older adults–5-year experience in a busy acute hospital

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ABSTRACT

Background/Objective: We aimed to identify and compare factors associated with 30-day readmission and visit to Emergency Department (ED) post-discharge among elderly patients.

Methods: This was a retrospective cohort study of patients ≥65 years old who were admitted to a regional acute hospital in Singapore in 2011-2015. Data on demographics, admission and discharge details, comorbidity and functional status were extracted from the hospital's electronic clinical records and linked to data on emergency visits and death. The outcomes were (1) unplanned inpatient readmissions within 30 days of inpatient discharge, and (2) visit to ED within 30 days of inpatient discharge. Backward stepwise multivariable logistic regression was used to examine the association between patient characteristics and outcomes.

Results: There were 45,349 admissions for the analysis. Overall, 19.2% were readmitted and 22.2% visited ED post-30 day discharge. Several factors associated with 30-day readmissions and ED visits were shared, including males, functional impairment, higher number of hospital admissions, time of discharge, discharge to nursing home, Charlson cormorbidity index, length of stay and congestive heart failure.

Conclusion: The outcomes were predicted by multiple risk factors, some of which were shared and modifiable. Identification of these factors could aid in tailoring of prevention strategies and intensification of efforts at this growing group.

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INTRODUCTION

Hospital readmissions are common and costly.[1] Unplanned or emergency admissions represent around 65 per cent of hospital bed days in England.[2] The 30-day readmissions rate of 18% among the United States Medicare recipients is estimated to account for $17 billion yearly.[1] In an attempt to address this issue, hospital readmissions have been considered an indicator of quality of care in the hospital[3] and used in the monitoring of health system performance.[4]

Elderly patients are a high-risk group for hospital readmission.[5] Numerous studies have examined the factors for readmissions in this group of patients.[5-10] The risk factors for readmissions among the elderly include advanced age, needs for social services, previous

admissions, days spent in hospital, morbidity (e.g. Cumulative Illness Rating Scale or Charlson index), functional capacity, neuropsychological characteristics, urinary incontinence, caregiver support and satisfaction with life.[6] More recently, functional impairment is highlighted to increase risk of hospital readmission, especially those admitted for heart failure, myocardial infarction, or pneumonia.[7]

In Singapore, the proportion of elderly aged 65 years and above has increased from 8.4% in 2006 to 12.4% in 2016.[11] The ageing population in Singapore has contributed to an increased demand for healthcare services as the elderly who were aged 65 years and above constituted more than one third of the hospital admissions in public hospitals.[12] The compound annual growth rate in public hospital admission was 3.1% between 2006 and 2016, but the growth was 9% between 2015 and 2016. In 2016, admission to public hospitals accounted for 77% of the total admissions and attendance to public hospitals by people aged ≥65 years was 36.6% up from 34.5% in 2014.[13] Of note, the readmission rates for patients aged 65 years and older was around 19% from 2011 to 2013 and is an issue that has received much attention.[14,15]

Hitherto, there is still limited information on the risk factors of readmission and visit to the Emergency Department (ED) subsequent to discharge among the elderly in Singapore. Our objectives are to identify the risk factors associated with readmission and visit to ED of a hospital within 30 days post hospital discharge. The study findings will help clinicians identify patients at high risk of readmission and ED visit and hence suggest potential interventions to reduce these events.

METHODS

We conducted a retrospective cohort study of patients aged ≥65 years who were discharged from a regional acute hospital in the North Region of Singapore between January 2011 and October 2015. Data was extracted from the hospital's electronic clinical records. There were a total of 65,852 inpatient admissions identified. With reference to earlier studies on exclusion criteria,[9,16] the following were excluded: transfer to another acute hospital (0.9%), discharge against advice (1.2%), deaths in hospital (6.3%) and non-emergency admissions (10.4%).

Data was linked to records (as of 31 March 2017) from the Registry of Births and Deaths which collects data on live births, deaths and still-births in Singapore and its territorial waters. It is mandatory for all deaths in Singapore to be reported within 24 hours of occurrence under legislation (http://www.ica.gov.sg). This further excluded 8,694 inpatient admissions which were followed by death outside the hospital (13.2%). This resulted in a final sample of 45,349 admissions from 21,747 unique patients.

Linkage to data from the Emergency Department (ED) of the same hospital was also performed for outcome of ED visit. There were 116,275 ED visits from 49,199 unique patients between 1 Jan 2011 and 31 Oct 2015. Emergency visits with death (0.9%), discharge against advice or left without being seen (2.4%) and transfer to another hospital (0.1%) were excluded. This resulted in a final sample of 112,213 ED visits from 47,579 unique patients. In order to observe within a 30-day period post discharge for the outcome on ED visit, the data from patients discharged from hospital was limited to 30 September 2015. Hence there were 44,481 inpatients admissions from 21,391 unique patients for the linked dataset involving ED visits.

Ethics approval was obtained from the National Healthcare Group Domain Specific Review Board in Singapore.

Primary outcomes

We used hospital clinical data and the ED data to identify date of discharge for each admission and visit to ED respectively. Inpatient admission was deemed as unplanned if the date of admission was within 48 hours following date of ED visit. The primary outcomes were as follows: (1) Unplanned inpatient readmissions within 30 days of inpatient discharge "30-day unplanned readmissions";[17] and (2) visit to ED within 30 days of inpatient discharge "30-day visit to ED".

Other measurements

Data on demographics, admission and discharge details, health comorbidity and functional status were extracted from a hospital clinical database for inpatient admissions. Health comorbidity was expressed as Charlson comorbidity index based on discharge diagnoses.[18] The following functional areas were examined: bathing or dressing, feeding, walking, urinary continence and swallowing.

Statistical analysis

Analysis was carried out to identify the risk factors for all-cause readmission and all-case ED visit within 30 days. In view of multiple admissions or ED visits per patient, we examined admissions and ED visits instead of patients as our unit of analysis. Categorical data were expressed as number (percentage) and continuous data as means ± standard deviation. We studied differences in patient characteristics for readmissions and revisits to ED using Chi-Square test for categorical variables and independent t-test for continuous variables. Variables with $p < 0.20$ in bivariable logistic regression were selected for backward stepwise multivariable logistic regression ($p < 0.20$ for entry and $p < 0.05$ for stay). Variables with $p < 0.05$ are retained in the final multivariable model. Statistical analysis was done using STATA 14.0 (StataCorp LP, Texas, USA). Statistical significance is taken at $p < 0.05$.

RESULTS

30-day unplanned hospital readmission

The baseline characteristics of index admissions were shown in Table 1: 40.7% aged 65-74 years, 40.8% aged 75-84 years and 18.5% aged ≥85 years; 45.2% males; 69.4%

Chinese, 15.6% Malays and 9.4% Indians; 19.1% assisted and 9.4% dependent on bathing or dressing; 12.7% assisted and 4.7% on nasogastric (NG) or percutaneous endoscopy gastrostomy (PEG) feeding; 20.4% assisted and 12.7% dependent on walking; 10.8% discharged to nursing home; and 81.6% discharged between 1300 hours and 1700 hour.

Overall, the proportion of hospital readmissions within 30 days was 19.2%. Those who were readmitted tended to be older with age ≥75 years, males, from subsidized class, have more previous admissions, discharged to nursing home, discharged between 1300 hours and 1700 hours, and length of stay ≥7 days ($p < 0.05$). Compared to patients with no 30-day readmission, those who were readmitted also had poorer function in terms of bathing or dressing, feeding, swallowing, walking and urinary continence ($p < 0.001$). The proportions of CHF, COPD and pneumonia and Charlson index score ≥1 were also higher in the patients who were readmitted than those who were not ($p < 0.001$). See Table 1.

Backward stepwise multivariable logistic regression showed that males, assistance in bathing or dressing (vs. independence in bathing or dressing), NG or PEG feeding (vs. independence in feeding), assistance and dependence in walking (vs. independence in walking), higher number of hospital admissions, discharge between 1300 hours and 1700 hours (vs. discharge between 0700 hours and 1200 hours), discharge to nursing home, LOS 4-6 days and ≥7 days (vs. 0-3 days), Charlson index score 1 and ≥2 (vs. 0) and CHF were independently associated with subsequent 30-day inpatient readmission. See Table 2.

30-day visit to ED

Overall, the proportion of visit to ED within 30 days of inpatient discharge was 22.2%. Those who visited ED within 30 days of inpatient discharge tended to be older with age ≥75 years, males, from subsidized class, have more previous inpatient admissions, discharged to nursing home, discharged between 1300 hours and 1700 hours, LOS ≥7 days and Charlson index score ≥1 ($p < 0.001$). Compared to patients with no 30-day visit to ED or readmission, those who were readmitted also had poorer function in terms of bathing or dressing, feeding, walking, swallowing and urinary continence ($p < 0.001$). They were also more likely to be admitted for CHF, COPD and pneumonia ($p < 0.05$). See Table 3.

Backward stepwise multivariable logistic regression showed that males, assistance in feeding and NG or PEG feeding (vs. independence in feeding), assistance and dependence in walking (vs. independence in walking), higher number of previous hospital admissions, discharge between 1300 hours and 1700 hours (vs. discharge between 0700 hours and 1200 hours), discharge to nursing home, LOS ≥7 days, Charlson index score 1, CHF and COPD were independently associated with subsequent 30-day visit to ED. See Table 4.

DISCUSSION

The 30-day hospital readmission rate in the elderly was reported to range from 10.7% to 23.6% in other countries.[5,6,10,19,20] Most studies report readmission rates above 17%.[5,6,10,19] The variation in the readmission rates could be due to heterogeneity in age criteria (ranging from ≥65 to ≥75 years), definition of readmission, different settings and healthcare systems.[6] In our study, 19.2% of elderly patients had 30-day unplanned readmission, and this was in line with other studies.[5,6,10,19] Furthermore, more than one in five elderly patients visited the ED within 30 days post-discharge. Such findings present a major public health challenge.

There were many common factors associated with readmissions and ED visits within 30 days of discharge - male sex, functional impairment, higher number of hospital admissions, discharge between 1300 hrs and 1700 hrs, discharge to nursing home, Charlson comorbidity index, length of stay and CHF. This suggests that interventions to prevent readmissions are also likely to be relevant to the prevention of ED visits.

Our study also highlights the importance of functional impairment with hospital readmissions.[7,21] It is common in hospitalized adults, amenable to interventions and simple to measure.[7] In our study, the motor components of functional impairment, which include bathing or dressing, feeding and walking, are associated with 30-day readmission or ED visit. Functional impairment has been previously reported to be linked to outcomes of inpatient admission in the elderly such as nursing home placement and 1-year mortality in the elderly but few studies have specifically assessed the influence of functional impairment on rehospitalisation.[7] There were even conflicting findings on its role as a predictor of readmission.[5] Our finding confirms and highlights the importance of the functional ability on readmission in the elderly. Functional impairments place a heavy burden on hospitalized elderly and their caregivers; and so this provides patient-centered impetus for incorporation of functional status in routine clinical documentation for hospitalized elderly. In addition, the findings highlight the importance of ensuring that caregiving skills are adequate in post-discharge care, particularly for patients who are lacking in self-care capability. For example, patients with PEG/NG tube require their caregivers to be specially trained for long-term care.[22]

Our results corroborate with those of previous studies that have demonstrated relationships between previous hospital admissions, medical comorbidity and longer LOS with unplanned readmissions.[6] One possible explanation was that patients with longer LOS could be in poor health condition and have chronic illness, and the severity of condition could have contributed to risk of readmission.[6]

A novel finding was that discharge between 1300 hours and 1700 hours in index hospitalization was related to subsequent readmission and ED visit. This may suggest the importance of social determinants in the care of the elderly. The availability of care givers (suggested by their ability to pick patients up earlier) influences the care outcomes of the frail elderly. More studies should be done to explore the

Table 1. Characteristics of index hospitalisation according to 30 day-readmission

Variable/Patient Factors	All	30-Day Readmission		p-value
		No	Yes	
N	45,349	36,641	8,708	
Age group (%)				<0.001
65-74 years	18,451 (40.7)	15,536 (42.0)	3,065 (35.2)	
75-84 years	18,496 (40.8)	14,755 (40.3)	3,741 (43.0)	
≥85 years	8,402 (18.5)	6,500 (17.7)	1,902 (21.8)	
Gender (%)				0.003
Female	24,830 (54.8)	20,188 (55.1)	4,642 (53.4)	
Male	20,489 (45.2)	16,430 (44.9)	4,059 (46.7)	
Race (%)				0.428
Chinese	31,464 (69.4)	25,420 (69.4)	6,044 (69.5)	
Malay	7,056 (15.6)	5,667 (15.5)	1,389 (16.0)	
Indian	4,275 (9.4)	3,469 (9.5)	806 (9.3)	
Other	2,527 (5.6)	2,065 (5.6)	462 (5.3)	
Class (%)				<0.001
Private	4,232 (9.8)	3,589 (10.2)	643 (7.8)	
Subsidised	39,137 (90.2)	31,488 (89.8)	7,649 (92.3)	
Bath/Dress				<0.001
Independent	27,130 (71.5)	22,780 (74.4)	4,350 (59.5)	
Assisted	7,242 (19.1)	5,435 (17.7)	1,807 (24.7)	
Dependent	3,581 (9.4)	2,421 (7.9)	1,160 (15.9)	
Feeding (%)				<0.001
Independent	31,438 (82.6)	26,067 (84.9)	5,371 (73.2)	
Assisted	4,834 (12.7)	3,509 (11.4)	1,325 (18.1)	
NG/PEG	1,791 (4.7)	1,147 (3.7)	644 (8.8)	
Swallow (%)				<0.001
Normal	33,013 (89.5)	27,219 (91.1)	5,794 (82.6)	
Impaired	3,875 (10.5)	2,650 (8.9)	1,225 (17.5)	
Incontinence (%)				<0.001
No	30,553 (81.2)	25,358 (83.5)	5,195 (71.9)	
Yes	7,057 (18.8)	5,027 (16.5)	2,030 (28.1)	
Walking (%)				<0.001
Independent	25,538 (66.9)	21,514 (69.8)	4,024 (54.9)	
Assisted	7,785 (20.4)	5,991 (19.4)	1,794 (24.5)	
Dependent	4,835 (12.7)	3,326 (10.8)	1,509 (20.6)	
Admission factors				
Number of previous admissions	1 (0-2)	1 (0-2)	2 (1-4)	<0.001
Discharge destination (%)				<0.001
Home	37,611 (83.0)	30,575 (83.5)	7,036 (80.8)	
Nursing home	4,916 (10.8)	3,693 (10.1)	1,223 (14.1)	
Other HCs	2,812 (6.2)	2,366 (6.5)	446 (5.1)	
Day of week of discharge (%)				0.314
Sat-Sun	8,252 (18.2)	6,700 (18.3)	1,552 (17.8)	
Mon-Fri	37,097 (81.8)	29,941 (81.7)	7,156 (82.2)	
Time of day on discharge (%)				<0.001
0700-1200 hrs	7,535 (18.4)	6,320 (19.1)	1,213 (15.6)	
1300-1700 hrs	33,333 (81.6)	26,753 (80.9)	6,580 (84.4)	
Length of stay (%)				<0.001
0-3 days	16,287 (35.9)	13,842 (37.8)	2,445 (28.1)	
4-6 days	13,215 (29.1)	10,659 (29.1)	2,556 (29.4)	

Table 1. Characteristics of index hospitalisation according to 30 day-readmission (continued)

Variable/Patient Factors	All	30-Day Readmission		p-value
		No	Yes	
≥7 days	15,847 (34.9)	12,140 (33.1)	3,707 (42.6)	
Charlson index score (%)				<0.001
0	19,612 (80.5)	14,832 (81.2)	4,780 (78.1)	
1	3,447 (14.1)	2,483 (13.6)	964 (15.8)	
≥2	1,320 (5.4)	943 (5.2)	377 (6.2)	
Acute myocardial infarction (%)				0.109
No	44,154 (97.4)	35,697 (97.4)	8,457 (97.1)	
Yes	1,195 (2.6)	944 (2.6)	251 (2.9)	
Congestive heart failure (%)				<0.001
No	43,357 (95.6)	35,215 (96.1)	8,142 (93.5)	
Yes	1,992 (4.4)	1,426 (3.9)	566 (6.5)	
Stroke (%)				0.003
No	44,072 (97.2)	35,568 (97.1)	8,504 (97.7)	
Yes	1,277 (2.8)	1,073 (2.9)	204 (2.3)	
Chronic obstructive pulmonary disease (%)				<0.001
No	44,240 (97.6)	35,818 (97.8)	8,422 (96.7)	
Yes	1,109 (2.5)	823 (2.3)	286 (3.3)	
Pneumonia (%)				<0.001
No	43,080 (95.0)	34,893 (95.2)	8,187 (94.0)	
Yes	2,269 (5.0)	1,748 (4.8)	521 (6.0)	

NG=nasogastric; PEG=percutaneous endoscopic gastrostomy.

Table 2. Risk factors for 30-day readmission in multivariable logistic regression

Variable	OR (95%CI), p-value	
	Univariable	Multivariable
Age group (%)		
65-74 years	1.00	
75-84 years	1.28 (1.21-1.34), <0.001	
≥85 years	1.47 (1.38-1.57), <0.001	
Gender (%)		
Female	1.00	1.00
Male	1.07 (1.02-1.13), 0.003	1.21 (1.12-1.32), <0.001
Race (%)		
Chinese	1.00	
Malay	1.03 (0.97-1.10), 0.360	
Indian	0.98 (0.90-1.06), 0.580	
Other	0.94 (0.85-1.04), 0.255	
Class (%)		
Private	1.00	
Subsidised	1.36 (1.24-1.48), <0.001	
Bath/Dress		
Independent	1.00	1.00
Assisted	1.74 (1.64-1.85), <0.001	1.16 (1.03-1.30), 0.012
Dependent	2.51 (2.32-2.71), <0.001	-
Feeding (%)		
Independent	1.00	1.00
Assisted	1.83 (1.71-1.96), <0.001	-
NG/PEG	2.72 (2.46-3.01), <0.001	1.30 (1.09-1.55), 0.004

Table 2. Risk factors for 30-day readmission in multivariable logistic regression (continued)

Variable	OR (95%CI), p-value	
	Univariable	Multivariable
Swallowing (%)		
Normal	1.00	
Impaired	2.17 (2.02-2.34), <0.001	
Incontinence (%)		
No	1.00	
Yes	1.97 (1.86-2.09), <0.001	
Walking (%)		
Independent	1.00	1.00
Assisted	1.60 (1.50-1.70), <0.001	1.16 (1.03-1.31), 0.012
Dependent	2.43 (2.26-2.60), <0.001	1.48 (1.29-1.70), <0.001
Admission factors		
Log-transformed number of previous admission	1.65 (1.59-1.70)	1.70 (1.62-1.78), <0.001
Discharge destination (%)		
Home	1.00	1.00
Nursing home	1.44 (1.34-1.54), <0.001	1.21 (1.07-1.36), 0.003
Other HCs	0.82 (0.74-0.91), <0.001	-
Day of week of discharge (%)		
Sat-Sun	1.00	
Mon-Fri	1.03 (0.97-1.10), 0.313	
Time of day on discharge		
0700-1200 hrs	1.00	1.00
1300-1700 hrs	1.28 (1.20-1.37), <0.001	1.34 (1.19-1.50), <0.001
Length of stay		
0-3 days	1.00	1.00
4-6 days	1.36 (1.28-1.44), <0.001	1.16 (1.04-1.28), 0.006
≥7 days	1.73 (1.63-1.83), <0.001	1.30 (1.17-1.44), <0.001
Charlson index		
0	1.00	1.00
1	1.20 (1.11-1.31), <0.001	1.23 (1.11-1.38), <0.001
≥2	1.24 (1.10-1.40), 0.001	1.30 (1.10-1.54), 0.002
Acute myocardial infarction		
No	1.00	
Yes	1.12 (0.97-1.29), 0.113	
Congestive heart failure		
No	1.00	1.00
Yes	1.72 (1.55-1.90), <0.001	1.48 (1.27-1.72), <0.001
Stroke		
No	1.00	
Yes	0.80 (0.68-0.93), 0.003	
Chronic obstructive pulmonary disease		
No	1.00	
Yes	1.48 (1.29-1.69), <0.001	
Pneumonia		
No	1.00	
Yes	1.27 (1.15-1.40), <0.001	

NG=nasogastric; PEG=percutaneous endoscopic gastrostomy; OR=odds ratio; CI=confidence interval.
The multivariable model includes age group, gender, class, bathing/dressing, feeding, swallowing, incontinence, walking, log-transformed number of previous admissions, discharge destination, time of discharge, length of stay and Charlson index, acute myocardial infarction, congestive heart failure, stroke, chronic obstructive pulmonary disease and pneumonia.

Table 3. Characteristics of index hospitalisation according to 30 day –Emergency Department (ED) visit

Variable/Patient Factors	30 Day-ED Visit		p-value
	No	Yes	
N	34,589	9,892	
Age group (%)			<0.001
65-74 years	14,494 (41.9)	3,590 (36.3)	
75-84 years	13,941 (40.3)	4,212 (42.6)	
≥85 years	6,154 (17.8)	2,090 (21.1)	
Gender (%)			<0.001
Female	19,149 (55.4)	5,189 (52.5)	
Male	15,417 (44.6)	4,696 (47.5)	
Race (%)			0.437
Chinese	24,051 (69.6)	6,813 (68.9)	
Malay	5,377 (15.6)	1,552 (15.7)	
Indian	3,215 (9.3)	970 (9.8)	
Other	1,926 (5.6)	5,50 (5.6)	
Class (%)			<0.001
Private	3,388 (10.2)	758 (8.1)	
Subsidised	29,751 (89.8)	8,615 (91.9)	
Bath/Dress			<0.001
Independent	21,533 (74.5)	5,087 (61.1)	
Assisted	5,142 (17.8)	1,981 (23.8)	
Dependent	2,246 (7.8)	1,260 (15.1)	
Feeding (%)			<0.001
Independent	24,652 (85.0)	6,199 (74.3)	
Assisted	3,295 (11.4)	1,457 (17.5)	
NG/PEG	1,067 (3.7)	690 (8.3)	
Swallow (%)			<0.001
Normal	25,778 (91.3)	6,639 (83.1)	
Impaired	2,447 (8.7)	1,349 (16.9)	
Incontinence (%)			<0.001
No	23,989 (83.6)	6,013 (73.2)	
Yes	4,714 (16.4)	2,204 (26.8)	
Walking (%)			<0.001
Independent	20,357 (69.9)	4,703 (56.3)	
Assisted	5,648 (19.4)	1,996 (23.9)	
Dependent	3,105 (10.7)	1,648 (19.7)	
Admission factors			
Number of previous admissions	1 (0-2)	2 (1-4)	<0.001
Discharge destination (%)			<0.001
Home	28,875 (83.5)	8,030 (81.2)	
Nursing home	3,461 (10.0)	1,368 (13.8)	
Other HCs	2,245 (6.5)	492 (5.0)	
Day of week of discharge (%)			0.768
Sat-Sun	6,297 (18.2)	1,788 (18.1)	
Mon-Fri	28,292 (81.8)	8,104 (81.9)	
Time of day on discharge (%)			<0.001
0700-1200 hrs	5,941 (19.1)	1,376 (15.5)	
1300-1700 hrs	25,236 (80.9)	7,514 (84.5)	
Length of stay (%)			<0.001
0-3 days	12,964 (37.5)	3,030 (30.6)	

Table 3. Characteristics of index hospitalisation according to 30 day–Emergency Department (ED) visit (continued)

Variable	30 Day-ED Visit		p-value
	No	Yes	
4-6 days	10,089 (29.2)	2,863 (28.9)	
≥7 days	11,536 (33.4)	3,999 (40.4)	
Charlson index score (%)			<0.001
0	13,790 (81.3)	5,415 (78.8)	
1	2,289 (13.5)	1,063 (15.5)	
≥2	894 (5.3)	396 (5.8)	
Acute myocardial infarction (%)			0.105
No	33,695 (97.4)	9,607 (97.1)	
Yes	894 (2.6)	285 (2.9)	
Congestive heart failure (%)			<0.001
No	33,236 (96.1)	9,284 (93.9)	
Yes	1,353 (3.9)	608 (6.2)	
Stroke (%)			0.012
No	33,583 (97.1)	9,651 (97.6)	
Yes	1,006 (2.9)	241 (2.4)	
Chronic obstructive pulmonary disease (%)			<0.001
No	33,855 (97.9)	9,540 (96.4)	
Yes	734 (2.1)	352 (3.6)	
Pneumonia (%)			<0.001
No	32,931 (95.2)	9,315 (94.2)	
Yes	1,658 (4.8)	577 (5.8)	

NG=nasogastric; PEG=percutaneous endoscopic gastrostomy.

Table 4. Risk factors for 30-day Emergency Department (ED) visit in multivariable logistic regression

Variable	OR (95%CI), p-value	
	Univariable	Multivariable
Age group (%)		
65-74 years	1.00	
75-84 years	1.22 (1.16-1.28), <0.001	
≥85 years	1.37 (1.29-1.46), <0.001	
Gender (%)		
Female	1.00	1.00
Male	1.12 (1.07-1.18), <0.001	1.24 (1.14-1.34), <0.001
Race (%)		
Chinese	1.00	
Malay	1.02 (0.96-1.08), 0.557	
Indian	1.07 (0.99-1.15), 0.107	
Other	1.01 (0.91-1.11), 0.873	
Class (%)		
Private	1.00	
Subsidised	1.29 (1.19-1.41), <0.001	
Bath/Dress		
Independent	1.00	
Assisted	1.63 (1.54-1.73), <0.001	
Dependent	2.37 (2.20-2.56), <0.001	
Feeding (%)		
Independent	1.00	1.00
Assisted	1.76 (1.64-1.88), <0.001	1.18 (1.03-1.34), 0.015
NG/PEG	2.57 (2.33-2.84), <0.001	1.33 (1.09-1.61), 0.004

Table 4. Risk factors for 30-day Emergency Department (ED) visit in multivariable logistic regression (continued)

Variable	OR (95%CI), p-value	
	Univariable	Multivariable
Swallowing (%)		
Normal	1.00	
Impaired	2.14 (1.99-2.30), <0.001	
Incontinence (%)		
No	1.00	
Yes	1.87 (1.76-1.98), <0.001	
Walking (%)		
Independent	1.00	1.00
Assisted	1.53 (1.44-1.62), <0.001	1.18 (1.07-1.31), 0.001
Dependent	2.30 (2.15-2.46), <0.001	1.37 (1.18-1.60), <0.001
Admission factors		
Log-transformed number of previous admission(s)	1.75 (1.69-1.81), <0.001	1.75 (1.67-1.84), <0.001
Discharge destination (%)		
Home	1.00	1.00
Nursing home	1.42 (1.33-1.52), <0.001	1.19 (1.06-1.34), 0.004
Other HCs	0.79 (0.71-0.87), <0.001	
Day of week of discharge (%)		
Sat-Sun	1.00	
Mon-Fri	1.01 (0.95-1.07), 0.767	
Time of day on discharge (%)		
0700-1200 hrs	1.00	1.00
1300-1700 hrs	1.29 (1.21-1.37), <0.001	1.30 (1.17-1.46), <0.001
Length of stay		
0-3 days	1.00	1.00
4-6 days	1.21 (1.15-1.29), <0.001	-
≥7 days	1.48 (1.41-1.56), <0.001	1.10 (1.01-1.19), 0.022
Charlson index		
0	1.00	1.00
1	1.18 (1.09-1.28), <0.001	1.16 (1.04-1.29), 0.008
≥2	1.13 (1.00-1.27), 0.054	-
Acute myocardial infarction		
No	1.00	
Yes	1.12 (0.98-1.28), 0.109	
Congestive heart failure		
No	1.00	1.00
Yes	1.61 (1.46-1.78), <0.001	1.32 (1.13-1.53), <0.001
Stroke		
No	1.00	
Yes	0.83 (0.72-0.96), 0.011	
Chronic obstructive pulmonary disease		
No	1.00	1.00
Yes	1.70 (1.50-1.94), <0.001	1.35 (1.11-1.64), 0.002
Pneumonia		
No	1.00	
Yes	1.23 (1.12-1.36), <0.001	

NG=nasogastric; PEG=percutaneous endoscopic gastrostomy; OR=odds ratio; CI=confidence interval.
The multivariable model includes age group, gender, race, class, bathing/dressing, feeding, swallowing, incontinence, walking, log-transformed number of previous admissions, discharge destination, time of discharge, length of stay and Charlson index, acute myocardial infarction, congestive heart failure, stroke, chronic obstructive pulmonary disease and pneumonia.

importance of the caregiver. Their availability, competency and even their activation as care givers may be important determinants of caring for the convalescing elderly. Further studies may also be needed to understand the interplay of possible factors such as circumstances of discharge process and post-discharge care plan for discharge in the afternoon.

Discharge to nursing home in prior admission was associated with readmission and visit to ED. This is in line with earlier research.[8,23,24] A possible reason for the higher risk in this group was the poorer functional status than those in the community.[25] In our study, it was observed that patients discharged to nursing home tended to have poorer function in bathing or dressing (assisted: nursing home, 33.9%; home, 16.7%; other healthcare facilities, 25.5%; and dependent: nursing home, 34.3%; home, 6.2%; other healthcare facilities, 8.5%; p <0.001), as well as feeding compared to others (assisted: nursing home, 30.7%; home, 10.2%; other healthcare facilities, 14.7%; and requiring NG/PEG tube: nursing home, 20.0%; home, 2.7%; other healthcare facilities, 5.1%; p <0.001).

We have also observed that CHF, but not myocardial infarction, or pneumonia was associated with 30-day readmission[7] and 30-day ED visit, and COPD was associated with 30-day ED visit. Under the Hospital Readmission Reduction Program (HRRP), the Centers for Medicare and Medicaid Services (CMS) are required to cut down payments to hospitals for excess readmissions related to cardiac failure and COPD.[26,27] The findings suggest additional attention may be required to the quality of care of patients with CHF and COPD, possibly highlighting the importance of strategies and interventions to systematically manage these high risk groups.[28,29] These may also allude to the need to develop more continuing care services for CHF and COPD into the community from the hospital. An interesting pattern is that patients discharged to home are more likely to have be readmitted for CHF (4.8%) and COPD (2.7%) compared to those discharged to nursing home (CHF, 2.4%; COPD, 1.8%) and other healthcare institutions (CHF, 2.0%; COPD, 0.5%) (p <0.001). On the contrary, the proportions of ED visits for pneumonia are higher in patients discharged to nursing homes (9.2%) compared to those discharged to home (6.0%) and other healthcare facilities (4.7%) (p <0.001). Further studies may be needed to examine the pattern of readmissions for different common diseases. Nevertheless, our current findings suggest a need to tailor interventions for groups of elderly patients in different residential settings.

Our study has several strengths. To date, this was the first study in Singapore that explored the risk factors of elderly patients with two outcomes: readmission and visit to ED. In this study, we were able to link up hospital clinical data and ED data and uncover shared risk factors for the two outcomes. Some of these factors were modifiable (e.g. LOS and disease conditions) while others were non-modifiable (e.g. gender). Of note, these factors cover a wide range involving demographics, clinical, functional and operational aspects. These highlight the importance of multidisciplinary interventions to address the problem.[15] This study also involved a large sample over a five-year period. Another strength was the availability of information on functional status which was often lacking in administrative data. We were able to verify the vital status of the patients through linkage with death data from Registry of Births and Deaths which ensured the completeness and reliability of data.

There were also limitations in this retrospective study. Firstly, we did not have data on the readmissions or ED visits to other hospitals. This would mean the rates of hospital readmissions and visits to ED were underestimated. However, number of admissions to other hospitals were likely comparative small as our readmission rate of 19% was identical to the national rate during the same period.[14,15] Secondly, factors such as health behaviour, social support, educational level, cognitive function, family education and polypharmacy were not available. Thirdly, while the hospital have introduced a pilot transitional (post-acute) care program[15] to better manage some patients and to reduce readmissions, this research seeks to address areas for attention that may not have addressed by this program (e.g. CHF and COPD). It is a limitation that information on this pilot program was not incorporated into the electronic clinical records we have used, but the number of patients on the pilot program was relatively small (<3% of the total number of patients). Integration of the information into these electronic clinical records if and when any pilot program become mainstream will be important. Fourthly, we did not have information on the form of rehabilitation and severity of CCF and COPD. Such information might help direct the resources to the appropriate group of patients. Furthemore, our study was conducted in a regional hospital and this might have limited generalizability of results to other care settings. We did not develop a risk score for predicting readmission in the elderly. However, it has been reported that previous endeavours to predict readmission were met with little success.[15,30] This may be attributed to the complexities of readmission, and the cause and effect pathway could not be easily elucidated.[15] Nevertheless, the study will potentially enable healthcare providers to identify risk factors for readmission and ED visit, some of which are potentially modifiable. This will in turn guide allocation of resources and intensification of efforts in future strategies to lower readmission rates.

In conclusion, readmissions and ED visits 30 days post-discharge in the elderly patients pose a substantial healthcare. The outcomes were predicted by multiple risk factors, some of which were shared and modifiable. Identification of these factors could aid in tailoring of prevention strategies and intensification of efforts at targeted groups.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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