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Characteristics and outcomes of emergency interhospital transfers from subacute to acute care for clinical deterioration

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Abstract

Objective: To describe characteristics and outcomes of emergency interhospital transfers from subacute to acute hospital care and develop an internally validated predictive model to identify features associated with high risk of emergency interhospital transfer.
Design: Prospective case-time-control study.
Setting: Acute and subacute healthcare facilities from five health services in Victoria, Australia.
Participants: Cases were patients with an emergency interhospital transfer from subacute to acute hospital care. For every case, two inpatients from the same subacute care ward on the same day of emergency transfer were randomly selected as controls. Admission episode was the unit of measurement and data were collected prospectively.
Main outcome measures: Patient and admission characteristics, transfer characteristics and outcomes (cases), serious adverse events and mortality.
Results: Data were collected for 603 transfers in 557 patients and 1160 control patients. Cases were significantly more likely to be male, born in a non-English speaking country, have lower functional independence, more frequent vital sign assessments and experience a serious adverse event during first acute care or subacute care admissions. When adjusted for health service, cases had significantly higher inpatient mortality, were more likely to have unplanned intensive care unit admissions and rapid response team calls during their entire hospital admission.
Conclusions: Patients who require an emergency interhospital transfer from subacute to acute hospital care have hospital admission rates and in-hospital mortality. Clinical instability during the

first acute care admission (serious adverse events or increased surveillance) may prompt reassessment of patient suitability for movement to a separate subacute care hospital.

Key words: patient outcomes (health status, quality of life, mortality) < measurement of quality, adverse events < patient safety, risk management < patient safety, readmissions < complications, elderly < specific populations

Introduction

Subacute care is a vital component of Australian healthcare; 84% of public subacute care admissions follow an acute care admission [1]. Subacute care includes rehabilitation, geriatric evaluation and management (GEM), psychogeriatric and palliative care [2]. Subacute care aims to maximize patients' functional status to enable patients to live as independently as possible, with high quality of life [3]. In Victoria, Australia, health services are groups of hospitals in a specific geographical or municipal area that are part of one organization and governed by a single board. Acute and subacute care hospitals are geographically separated in many Victorian health services, therefore a common response to clinical deterioration in subacute care hospitals is ambulance transfer to the emergency department (ED) of an acute care hospital. Approximately 10% of rehabilitation admissions result in transfer to an acute care hospital [4], and in 2016, there were 60 889 such transfers in Victoria [5].

The only Australian multisite study of emergency interhospital transfers from subacute to acute hospital care was a retrospective audit conducted in four major publicly funded Victorian health services [6]. The median subacute care length of stay (LOS) preceding transfer was 43 h. Acute care hospital admission occurred in 87.2% of patients and 15.4% of patients died during their hospitalization [6]. Predictors of in-hospital mortality were comorbidities (OR = 1.2, $P = 0.004$) and the number of vital sign abnormalities in the 24 h preceding interhospital transfer (OR = 1.3, $P = 0.004$) [6]. International studies have focused on acute care readmissions from rehabilitation hospitals in elderly patients [7], trauma patients [8] and patients with stroke [9] or traumatic brain injury [10].

Studies of emergency transfers from subacute to acute hospital care to date are mostly retrospective [6–9] cohort studies [6, 7, 10]. Other studies have compared acute care readmissions from inpatient rehabilitation hospitals at 3 days, 7 days or 30 days [9] or have compared acute care admissions via the ED from a rehabilitation hospital versus patients from the community [8]. There are no published studies comparing subacute care patients who did and did not require an emergency interhospital transfer. Further, studies to date have not examined patient status in acute care immediately prior to subacute care admission, limiting judgements regarding readiness for transfer.

Emergency interhospital transfers from subacute to acute care hospitals increase risk and distress for patients, are expensive and use many healthcare resources, yet the risk factors for these transfers are poorly understood. The aims of this study were to describe the characteristics and outcomes of emergency interhospital transfers from subacute to acute hospital care for clinical deterioration and develop an internally validated predictive model to identify the features associated with higher risk of emergency interhospital transfer.

Method

A prospective case-time-control study [11] was conducted in 21 wards from eight subacute care hospitals in five major health services in Victoria, Australia. All subacute care hospitals were geographically separated from the acute care hospitals [12]. The study was approved by the Human Research and Ethics Committee at each site and at Deakin University and a waiver of consent was granted. The study population was patients admitted to inpatient rehabilitation or GEM units at the study sites. Patients admitted for palliative care were excluded. Cases were consecutive patients with an emergency interhospital transfer from subacute to acute hospital care during the data collection period. For every case, two inpatients from the same subacute care ward on the same day of emergency transfer were randomly selected as controls.

Using data from previous research [6] and from each health service 600 emergency transfers during a 12-month period were estimated. A sample size of at least 1500 (500 cases and 1000 controls) was adequate to detect a minimum 20% increase in adjusted odds ratios from multivariate logistic regression assuming an R^2 of 25% and meet the requirements of at least 10 events per variable [13]. To allow for missing data, recruitment of consecutive cases continued until there were 130 cases from the three largest health services (Sites 2, 3 and 5) and 100 cases from the two smaller health services (Sites 1 and 4). For cases and controls, the unit of measurement was the episode of care. Cases and controls were matched by time as they were recruited from the same ward on the same day.

Data collection

Data were collected prospectively from 22 August 2015 to 30 October 2016 and focused on four time points: T0 first acute care admission, T1 first subacute care admission, T2 transfer characteristics and outcomes (cases only) and T3 patient outcomes (following time of emergency interhospital transfer until health service discharge or death). Data were extracted from health service information systems and patient records by single person at each site. All data extractors underwent specific training, used a study-specific case report form and detailed data dictionary, and data validity was checked by a single researcher (M.S.).

Comorbidity status was calculated using the Charlson index [14] and based on ICD-10-AM (International Classification of Diseases, 10th Revision, Australian Modification) codes [15–17] and a score of zero means no comorbidities. The functional independence measure (FIM) ranged from 18 to 126 (the higher the score, the more independent the patient) [18]. Serious adverse events (SAEs) were defined as unplanned intensive care unit (ICU) admission(s), rapid response team (RRT) call(s) or cardiac arrest team call(s).

Data analysis

Descriptive statistics were used to summarize study data. Medians and interquartile ranges (IQR) are presented as data were not normally distributed. All variables were initially considered as potential predictors of emergency interhospital transfer. Categorical data were compared (cases versus controls) using the Cochran–Mantel–Haenszel (CMH) test to account for hospital clustering effects.

Bivariate logistic regression, controlling for health service, was used to compare continuous covariates. Multivariable logistic regression (enter approach) using variables that were statistically significant in bivariate analyses [19] was used to further examine the factors associated with emergency interhospital transfer. Predictive validity of the model constructed through multivariate logistic regression was evaluated through 10-fold internal validation approach [20]. Area under the receiver operating curves (AUROCs), root mean squared error (RMSE), mean absolute errors (MAE), Akaike information criterion (AIC), Bayesian information criterion (BIC) and Hosmer–Lemeshow goodness-of-fit test were reported to evaluate internal validation of the proposed predictive model [21].

Results

Data were collected for 603 transfers of 557 patients and 1160 control patients. Of the 603 transfers, 40 patients had two transfers and 3 patients experienced three transfers. For 563 transfers, two controls (n = 1126) were identified, 36 transfers had only one control, and four transfers had no control patients. There were 168 patients who featured as both a case and a control: they were either a control patient who suffered a deterioration requiring transfer, thus becoming a case; or alternatively, they were a case and then readmitted to subacute care, thus being eligible as a control.

Patient characteristics are summarized in Table 1. Cases had a greater proportion of males (51.9% vs 43.2%, $P = 0.001$) and were significantly more likely to have been born in a non-English speaking country (34.2% vs 27.0%, $P = 0.004$). The FIM scores were significantly lower in cases than controls (median 65 vs 71, $P < 0.001$).

T0: first acute care admission

Data from the first acute care admission were available from 576 cases and 1057 controls (Table 2). The most common acute care admission diagnoses for both groups are shown in Supplemental Data Table S1. During the first acute care admission, cases were more likely than controls to have a limitation of medical treatment order, SAEs and longer median LOS in acute care.

T1: first subacute care admission

The cases and control patient characteristics during their first subacute care admission are detailed in Table 2. Cases were significantly less likely than controls to have care plans recommending daily or twice daily vital sign assessments in the 24-h preceding emergency interhospital transfer and significantly more likely to have SAEs. The median time between subacute care admission and first cardiac arrest call was 3.8 days for cases (IQR = 1.1–6.9) and 4.1 days for controls (IQR = 1.4–20.6) ($P = 0.12$). The median time between subacute care admission and first RRT call was 15.3 days for cases (IQR = 8.0–22.2) and 15.4 days for controls (IQR = 9.4–22.7) ($P = 0.71$).

T2: transfer characteristics and outcomes (cases only)

There were 603 emergency interhospital transfers from subacute to acute care in 557 patients (Table 3). The most common reasons for transfer are shown in Supplementary Data Table S1. The median subacute care LOS preceding transfer was 11.0 days (IQR = 4–24 days); 8.9% of transfers (n = 54) occurred within 1 day of subacute care admission.

The median time between cardiac arrest call and emergency transfer was 1.2 h (IQR = 0.7–50.6). The time between cardiac arrest call and transfer was within 2 h in 18 cases, 6.2 h in one case, greater than 2 days in 7 cases and unknown in 3 cases. The median time between RRT call and transfer was 2.5 h (IQR = 1.0–25.0). The time between RRT call and transfer was within 2 h in 107 cases, within 6 h in 144 cases, greater than 24 h in 58 cases, and unknown in 61 cases.

The transfer characteristics and outcomes are shown in Table 3. The majority of transfers (74.4%) occurred via emergency ambulance and required ED care at the acute care hospital (76.3%). When ED care was required, 48.7% of cases required emergency care within 30 min of ED arrival. Median ED LOS was 6 h (n = 422), and in 22.6% of transfers, the ED LOS was ≤4 h. Acute care hospital admission was the most common transfer outcome (81.1%). Only 11.8% of cases returned to subacute care without acute hospital admission. In-hospital death during acute care admission occurred for 10.2% of admitted patients (excluding deaths in ED). At the conclusion of acute care readmission, 55.9% of patients

Table 1 Patient characteristics by group

	Cases (N = 603)		Controls (N = 1160)		AOR	95% CI	P*
	n	%	n	%			
Gender male	313	51.9	502	43.3	1.41	1.16–1.72	0.001
Born in a non-English speaking country	204	34.0	311	27.1	1.38	1.11–1.72	0.004
Preferred language other than English	85	14.1	136	11.7	1.24	0.93–1.65	0.19
Interpreter required	64	10.7	107	9.2	1.17	0.85–1.63	0.42
Type of subacute care admission							
Geriatric evaluation and management	259	43.1	487	42.0	1.04	0.86–1.27	0.76
Rehabilitation	342	56.9	671	57.8			
LOMT orders	368	61.0	683	58.9	1.09	0.89–1.34	0.29
Medical power of attorney	107	17.7	210	18.1	0.97	0.75–1.26	0.79
Advance directives about transfer	112	18.6	180	15.5	1.24	0.96–1.61	0.16
	Mdn	IQR	Mdn	IQR	AOR	95% CI	P**
Age (years)	80.0	70–86	80	72–87	0.99	0.99–1.00	0.90
Charlson comorbidity index	3.0	2.0–5.0	3.0	1.0–4.0	1.16	1.11–1.21	0.69
FIM on admission to subacute care	65.0	45–82	71	54–88	0.99	0.98–0.99	<0.001

AOR, adjusted odds ratio (adjusted by health service).

*CMH = Cochran–Mantel–Haenszel test.

**Bivariate logistic regression adjusted for health service.

Table 2 Admission characteristics at T0 and T1

	T0							T1						
	Cases (n = 576)		Controls (n = 1057)		AOR	95% CI	P*	Cases (n = 603)		Controls (n = 1160)		AOR	95% CI	P*
	n	%	n	%				n	%	n	%			
Type of acute care admission														
Emergency	468	81.3	845	79.9	1.08	0.82–1.43	0.53							
Elective	108	18.8	212	20.1										
Acute care admitting unit														
Medical	363	63.0	663	62.7	1.01	0.82–1.25	0.92							
Surgical	212	36.8	393	37.2										
LOMT orders	89	15.5	126	11.9	1.42	1.06–1.90	0.003	281	46.6	573	49.4	0.89	0.73–1.09	0.16
Care plan frequency of vital sign assessment in last 24 h of care														
Daily	2	0.3	8	0.8	0.45	0.09–2.13	0.31	58	9.8	263	22.7	0.30	0.22–0.42	<0.001
Twice daily	12	2.1	26	2.5	0.83	0.41–1.67	0.59	115	19.4	338	29.1	0.53	0.41–0.69	<0.001
Three times daily	83	14.4	165	15.6	0.88	0.65–1.84	0.39	192	32.2	299	25.8	1.34	1.07–1.67	0.010
Four times daily	233	40.5	434	41.1	0.94	0.74–1.19	0.61	80	13.5	54	4.7	3.19	2.22–4.59	<0.001
Four hourly	68	11.8	87	8.2	1.59	1.12–2.26	0.009	19	3.2	7	0.6	5.54	2.31–13.26	<0.001
Hourly	0	0.0	2	0.2	N/A	N/A	N/A	1	0.2	0	0.0	N/A	N/A	N/A
Other/not stated	168	29.2	312	29.5	0.99	0.71–1.37	0.93	132	22.1	191	16.5	1.68	1.26–2.29	0.001
Serious adverse events during admission														
Unplanned ICU admission (T0 n = 145)	66	11.5	79	7.5	1.60	1.13–2.26	0.008							
Cardiac arrest team call (T0 n = 20; T1 n = 40)	14	2.4	6	0.6	4.33	1.66–11.33	0.003	29	4.9	11	1.0	5.44	2.69–11.02	<0.001
Rapid response team call (T0 n = 244; T1 n = 298)	115	20.0	129	12.2	1.84	1.39–2.44	<0.001	191	31.7	107	9.3	5.30	4.00–7.03	<0.001
	Mdn	IQR	Mdn	IQR			P**	Mdn	IQR	Mdn	IQR			P**
Admission time								14:01	12:00–16:15	14:04	11:52–16:19	1.00	1.00–1.00	0.52
Hospital LOS	10.0	6–17	8.0	5–12	1.02	1.01–1.03	<0.001							

LOMT, limitation of medical treatment order; ICU, intensive care unit.
AOR = adjusted odds ratio (adjusted by health service).
*CHM = Cochran–Mantel–Haenszel test.
**Bivariate logistic regression stratified by health service.

were discharged back to subacute care, 12.3% of patients went home, and 4.5% were discharged to nursing homes or transition care (Table 3).

Table 3 Transfer characteristics (n = 603)

	n	%
Health service		
Health service 1	86	17.6
Health service 2	93	19.0
Health service 3	104	21.3
Health service 4	84	17.2
Health service 5	122	24.9
Overnight transfer (2200–0759)	101	17.8
Day of week of transfer		
Monday	78	12.9
Tuesday	110	18.2
Wednesday	89	14.8
Thursday	94	15.6
Friday	96	16.9
Saturday	64	10.6
Sunday	59	9.8
Mode of transfer		
Emergency ambulance	448	74.3
Private ambulance	136	22.6
Other	7	1.2
Missing	12	2.0
First contact in acute care		
Emergency department	460	76.3
Direct admission to ward	114	18.9
Direct admission to intensive or coronary care units	1	0.2
Outpatients	7	1.2
Other	21	3.5
Triage category if admitted via the ED (n = 461)		
ATS 1 (immediate emergency care)	22	4.8
ATS 2 (emergency care <10 min)	90	14.9
ATS 3 (emergency care <30 min)	175	29.0
ATS 4 (emergency care <60 min)	79	13.1
ATS 5 (emergency care <120 min)	4	0.7
Triage data not available	91	19.4
ED LOS ≤4 h (n = 422)	136	22.6
Transfer outcome (n = 603 transfers)		
Died in ED	8	1.3
Hospital admission: ward or short stay unit	473	78.4
Hospital admission: intensive or coronary care unit	16	2.7
Transfer to another hospital	4	0.7
Transfer to palliative care	2	0.3
Return to subacute care	71	11.8
Missing	29	4.8
Acute care admission outcomes (n = 489)		
Transfer to subacute care	327	66.9
Home or usual residence (including three with additional services)	60	12.3
Death (excluding deaths in ED)	50	10.2
Nursing home	12	2.5
Transition care programme	10	2.0
Palliative care	8	1.6
Transfer to another hospital	6	1.2
Other/missing	16	3.3
	Mdn	IQR
Subacute care LOS prior to transfer (days)	11.0	4–24.3
ED LOS (h) (n = 422)	6.0	4–11
Acute care length stay if admitted (days) (n = 489)	8.0	4–14

ATS, Australasian Triage Scale.

T3: patient outcomes

When adjusted for health service, cases had more unplanned ICU admission(s) (4.3% vs 0.5%, P < 0.001) and RRT call(s) (20.4% vs 7.5%, P < 0.001) during their entire health service stay (Supplemental Data Table S2). For mortality analyses, patients who featured as both cases and controls were counted only once as a case (n = 79). For patients with multiple transfers (n = 43), only the last transfer was included. When adjusted for health service, cases had significantly higher mortality than controls (14.9% vs 2.3%, P < 0.001), even when patients with an LOMT order were excluded (7.6% vs 0.4%, P < 0.001) (Supplemental Data Table S2).

Predictors of emergency interhospital transfers from subacute to acute care

To establish the factors associated with emergency interhospital transfers from subacute to acute care, multivariable logistic regression was performed using statistically significant variables from bivariate analysis (Table 4). FIM score was categorized as <54 (severe deficit), 55–90 (moderate deficit) and >90 (little or no deficit) [22]. Using emergency interhospital transfer as the dependent variable, a test of the full model with 985 episodes against a constant only model was statistically reliable (Omnibus χ^2 = 164.425, P < 0.001, Hosmer Lemeshow χ^2 = 2.719, P = 0.951) and correctly classified 72.5% of cases. After adjusting for age and health service, the risk-adjusted odds ratios (AOR) for emergency transfer were highest for patients with SAEs during subacute care admission (AOR = 4.80, 95% CI 3.20–7.26, P < 0.001) (Table 4). The AUROC was 73.7%.

Internal validation analyses of the predictive model (Table 4) are reported in Table 5. The P-values from the Hosmer–Lemeshow

Table 4 Factors associated with increased risk of emergency interhospital transfer from subacute to acute care

	AOR	95% CI	P*
T1 Serious adverse event[a] during subacute care admission	4.80	3.20–7.26	<0.001
T1 care plan recommends vital sign assessments ≥3 times per day in 24-h preceding transfer time	2.91	2.14–3.94	<0.001
T0 care plan recommends vital sign assessments ≥4-hourly during last 24 h of first acute care admission	1.63	1.07–2.48	0.02
FIM score on subacute care admission			
>91	Reference		
55–90	1.56	1.02–2.37	0.04
<54	1.94	1.20–3.14	0.007
Born in a non-English speaking country	1.56	1.12–2.17	0.008
T0 serious adverse event[a] during first acute care admission	1.50	1.03–2.19	0.04
Male gender	1.29	0.96–1.73	0.09
Health service			
Health service 1	Reference		
Health service 2	0.59	0.37–0.96	0.03
Health service 3	0.37	0.22–0.63	<0.001
Health service 4	0.91	0.57–1.45	0.69
Health service 5	0.25	0.07–0.88	0.03
Patient age (years)	0.99	0.99–1.01	0.84

*Binary logistic regression.

[a]Serious adverse event = cardiac arrest team call, unplanned intensive care unit admission or rapid response team call.

Table 5 Internal validity of proposed risk predictive model for emergency interhospital transfer from subacute to acute care using 10-fold cross-validation

	N^a	RMSE	MAE	P-value[b]	AUC	AIC	BIC
Median	102	0.44	0.39	0.24	0.77	119.80	146.19
Minimum	84	0.42	0.34	0.06	0.72	106.66	130.96
Maximum	111	0.49	0.44	0.51	0.81	144.47	171.57

[a]Sample size used for model fitting.
[b]*P*-value for Hosmer–Lemeshow goodness-of-fit test.

goodness-of-fit test ranged from 0.06 to 0.51 indicating good model fit (>0.05). Both AIC and BIC indicate that the selected variables were appropriate. The median AUROC was 0.77 (range 0.72–0.81) suggesting a strong effect size [23]. RMSE and MAE values of 0.44 and 0.39, respectively, are equivalent to moderate accuracy [21].

The first acute care admission diagnosis was not included in the above regression analysis as there was no clear reference group; however an exploratory subanalysis of major diagnostic groups (neurological/neurosurgical; cardio-respiratory; musculoskeletal and other) is presented in Supplementary Table 3. After adjusting for age and health service, patients who were initially admitted to acute care with cardio-respiratory issues were at highest risk of emergency transfer (AOR = 1.57, 95% CI = 1.13–2.19, $P = 0.007$) and transfer risk was lowest in patients admitted to acute care with musculoskeletal problems (AOR = 0.69, 95% CI 0.53–0.90, $P = 0.006$) when compared to all other diagnostic groups (Supplementary Table 3).

Discussion

After adjusting for age and health service, the factors associated with increased risk of emergency interhospital transfer from subacute to acute hospital care were SAEs during the first acute or subacute care admissions, frequent vital sign assessments during the last 24 h of the first acute care admission or the 24-h preceding transfer, born in a non-English speaking country, and lower FIM. Those risk factors available at the end of the first acute care admission may be used to inform assessment of readiness for patient movement to subacute care or to inform care planning and patient surveillance in subacute care. Further, SAEs or increases in the frequency of patient assessment in subacute care may serve as a prompt to reassess the risk of deterioration and revise the plan of care with the view to avoiding emergency interhospital transfer to acute care.

Patients at highest risk of emergency interhospital transfer were those experiencing SAEs. SAEs may be considered an indicator of physiological instability and there is a clear relationship between SAEs and increased risk of in-hospital death [24–26]. However, little is known about the epidemiology of clinical deterioration across sectors of care, and specifically the relationship between clinical deterioration in acute and subacute care. Patients in whom frequent vital sign assessments recommended were at increased risk of emergency transfer (AORs 1.63 (acute care) and 2.91 (subacute care)). These results suggest increased staff vigilance that we propose was driven by concerns for patient safety. Policies at the study sites recommend at least 6-hourly to 8-hourly vital sign assessment in acute care, therefore ≥4-hourly vital signs exceeded organizational requirements. Policy recommendations for vital sign assessment in subacute care ranged from 8-hourly for all patients, 8-hourly for the first 3 days then daily, daily or at clinician discretion [12] so vital signs ≥3 times per day also exceeded policy requirements. These findings highlight the importance of nurses' decision-making [12] and the validity of nurse concern as an indicator of clinical deterioration which is well supported by research [27, 28]. These findings also highlight the importance of multidisciplinary involvement in decision-making relating to patient readiness for transfer.

Decreasing FIM was also associated with increased risk of emergency interhospital transfer. FIM scores, calculated on rehabilitation unit admission and discharge, are used for national benchmarking of Australian rehabilitation units [18]. The relationship between FIM score and emergency interhospital transfers raises questions about whether the FIM score should routinely be calculated prior to leaving acute care to inform decisions about readiness for transfer.

The age and gender of our sample were reflective of 2016 Victorian data showing that patients transferred from subacute to acute care had a median age of 75–79 years and 50.0% were males [5]. Birth in a non-English speaking country was statistically significant risk factor for emergency transfer, however, a preferred language other than English was not significant in bivariate analyses. Many patients born in non-English speaking countries speak English, however, their English proficiency may not be adequate for communication of complex health care needs. English proficiency may also be reduced with cognitive impairment as a consequence of acute illness or delirium. There is clear evidence that patients whose primary language is different to that of their carers are at higher risk of adverse events in healthcare [29]. Language barriers result in suboptimal care [30] and patients with communication problems are at significantly higher risk of preventable adverse events such as medication errors or errors in clinical care (46% vs 20%; $P = 0.05$) [31].

The median subacute care LOS before transfer was 11 days: 8.9% ($n = 54$) of transfers occurred within 1 day of admission to subacute care. This finding is different to that of Considine *et al.* [6] who showed a median subacute care LOS of 43 h before transfer [6]. One possible reason for the LOS differences is that national standards, and therefore organizational systems and policies, for recognizing and responding to deteriorating patients were implemented in 2012 [32], thus resulting in greater awareness and more aggressive management of clinical deterioration. Emergency ambulances were used in 74.3% of transfers prompting questions about care disruption and cost. In Melbourne, ambulance transport costs $1204 AUD [33]. ED care was commonly required and triage data suggested high levels of clinical urgency. Acute care hospital admission occurred for 81.1% of patients and the median acute care LOS was 8 days, suggesting that the transfer was warranted and higher level of care than could be provided in subacute care was needed. Return to subacute care from ED occurred in 11.8% of transfers. Detailed analysis of these transfers is warranted to understand whether patient transfer was necessary or whether the services required could be made available within in a subacute care environment.

When patient outcomes for their entire health service stay were examined, cases had significantly higher mortality (14.9% vs 2.3%, $P < 0.001$), unplanned ICU admission(s) (4.3% vs 0.5%, $P < 0.001$) and RRT call(s) (20.4% vs 7.5%, $P < 0.001$). These outcomes are different to Victorian data that report 1.0% ($n = 624/60\,889$) of transfers from subacute to acute hospital care ended in patient death [5]. The reason for this difference is unclear. Our study deliberately examined emergency interhospital transfers that appeared to be largely the result of clinical deterioration. It is possible that Victorian data may include planned transfers for appointments and investigations so are therefore a more stable population. The poor outcomes of the transfer group in our study warrant further investigation to understand whether they are a consequence of clinical complexity or whether fragmentation of care was a factor.

A strength of this study is that cases and controls were from the same ward on the same day, so the impact from variations in care delivery is minimized by time matching. The following should be considered when interpreting our findings. First, reliance on organizational record data raised the potential for data error and missing data but was mitigated by the large sample size and prospective approach. Further, there was wide variation in admission diagnoses and reasons for transfer, so the diagnostic categories were based on the major issue and it was not possible to account for multiple issues in the same patient. Therefore, the results related to diagnostic groups should be interpreted with caution and how to best use diagnostic data should be a focus of further work. Second, the use of a case-time-control design means that only relative risk can be estimated. Third, details of the first acute care admission were not available in patients who were admitted to subacute care from a health service not included in the study. Similarly, if the emergency transfer was to another health service, second acute care admission and outcome data were not available for those cases. The study was conducted in Victoria, Australia, so the generalizability of the study findings may be limited.

Conclusion

Patients who require an emergency interhospital transfer from subacute to acute hospital care have high rates of hospital admission and in-hospital mortality. SAEs during the first acute care admission and increased nursing surveillance prior to subacute care admission may be indicators that a patient is not sufficiently stable to leave acute care. If transfer from an acute care to a subacute care is vital for patients' recovery, then admission to a subacute care facility co-located within an acute care hospital may be a safer option for less stable patients. An acceptable internally validated predictive model was developed from the study data, however, practical implementation of the model warrants further development and testing.

Supplementary material

Supplementary material is available at *International Journal for Quality in Health Care* online.

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Conflict of interest

There are no conflicts of interest to declare. No author had any financial or professional relationships which may pose a competing interest to the study or decision to submit the manuscript for publication.

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