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ORIGINAL ARTICLE

Risk factors associated with 30-day all-cause unplanned hospital readmissions at a tertiary children's hospital in Western Australia

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Aim: To identify risk factors associated with 30-day all-cause unplanned hospital readmission at a tertiary children's hospital in Western Australia.

Methods: An administrative paediatric inpatient dataset was analysed retrospectively. Patients of all ages discharged between 1 January 2010 and 31 December 2014 were included. Demographic and clinical information at the index admission was examined using multivariate logistic regression analysis.

Results: A total of 3330 patients (4.55%) experienced at least one unplanned readmission after discharge. Readmission was more likely to occur in patients who were either older than 16 years (odds ratio (OR) = 1.46; 95% confidence interval (CI) 1.07–1.98), utilising private insurance as an inpatient (OR = 1.16; 95% CI 1.00–1.34), with greater socio-economic advantage (OR = 1.20; 95% CI 1.02–1.41), admitted on Friday (OR = 1.21; 95% CI 1.05–1.39), discharged on Friday/Saturday/Sunday (OR = 1.26, 95% CI 1.10–1.44; OR = 1.34, 95% CI 1.15–1.57; OR = 1.24, 95% CI 1.05–1.47, respectively), with four or more diagnoses at the index admission (OR = 2.41; 95% CI 2.08–2.80) or hospitalised for 15 days or longer (OR = 2.39; 95% CI 1.88–2.98). Area under receiver operating characteristic curve of the predictive model is 0.645.

Conclusions: A moderate discriminative ability predictive model for 30-day all-cause same hospital readmission was developed. A structured discharge plan is suggested to be commenced from admission to ensure continuity of care for patients identified as being at higher risk of readmission. A recommendation is made that a designated staff member be assigned to co-ordinate the plan, including assessment of patients' and primary carers' readiness for discharge. Further research is required to establish comprehensive paediatric readmission rates by accessing linkage data to capture different hospital readmissions.

Key words: 30-day; all-cause unplanned hospital readmission; paediatric; risk factor.

What is already known on this topic

- Follow-up periods for published studies on risk factors associated with all-cause paediatric unplanned readmissions are either 30 days or 1– 2 years.
- Published studies on risk factors for 30-day all-cause paediatric unplanned readmissions have mainly been conducted in the USA, UK or Canada.
- The frequently cited significant risk factors associated with readmission include comorbidity, type of health insurance and illness severity.

What this paper adds

- This is the first published Australian study that developed a moderate discriminative ability predictive model for all-cause paediatric unplanned hospital readmissions using an administrative inpatient dataset.
- Patients who were admitted on Friday or discharged on Friday, Saturday or Sunday or experienced a longer length of hospital stay are at higher risk of being readmitted.
- Requiring a general anaesthetic during the index admission or patients transferred to hospital via an aeromedical service are factors associated with decreased risk of readmissions.

Unplanned hospital readmission rate has been widely accepted as a service performance indicator to evaluate the quality of health-care delivery.[1] A recent systematic review[2] examined research evidence on paediatric unplanned hospital readmissions from 2000 to 2017. Some American studies used 365 days to measure the all-cause unplanned readmissions, and the prevalence was from 16.7[3] to 21.8%.[4] Other studies examined all-cause 30-day unplanned readmissions, and the rates were reported to be 3.8–18.7% (USA),[5–8] 8.8 (UK)[9] and 3.4% (Canada).[10] Unexpected readmissions not only increase the costs of health-care delivery but also result in bed shortages and inefficient use of health-care resources. Families or carers of readmitted children also experience unexpected interruptions of their daily activities.

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As a result, paediatric patients waiting for a hospital bed for elective procedures or children requiring admission via emergency departments may experience cancellation and/or a long waiting period before admission as an inpatient.[1,11]

There has been increased emphasis in recent literature related to the identification of paediatric patients who are at higher risk of being readmitted following initial hospitalisation.[5–10,12] Improvement of transitions of care following discharge targeting those patients will assist in reducing unplanned readmissions.[13] The reported significant risk factors associated with all-cause readmissions include comorbidity, type of health insurance, illness severity, age, gender, ethnicity and day of admission.[5–10]

In Australia, approximately 1.2% of patients, including both adults and children, experienced a 28-day unplanned readmission following elective surgeries in a public hospital. Readmission rates range from 3.6% for tonsillectomy and adenoidectomy, 3.2% following hysterectomy, 2.8% for prostatectomy and 0.3% for cataract extraction.[11]

In Western Australia (WA), the prevalence of 28-day all-cause readmissions to the same hospital across all metropolitan public health services has increased from 2.1% (2010–2011) to 3.9% (2014–2015).[14] Studies conducted in Australia examining risk factors associated with paediatric readmissions have focused on specific health conditions, such as asthma[15,16] and mental health conditions.[17] This study aimed to identify risk factors associated with 30-day all-cause unplanned hospital readmission based on an electronic administrative dataset at a tertiary children's hospital in Western Australia. Australia uses 28 days to measure the all-cause unplanned readmission. However, the 30-day measurement is commonly used in the literature. The selection of the 30-day measurement for this study is to allow international comparison.[18]

Methods

Study design

A retrospective cohort study was conducted using an electronic administrative inpatient dataset extracted from the WA Hospital Morbidity Data Collection for all patients discharged from Princess Margaret Hospital for Children (PMH, which was relocated and renamed Perth Children's Hospital on 10 June 2018). Princess Margaret Hospital was a 220-bed tertiary paediatric facility in WA providing care for children, adolescents and young adults. Inpatient and outpatient visits totalled approximately 250 000 each year.[19] This study was approved by the Human Ethics Research Committee of PMH, Department of Health, WA and Curtin University.

Population

This study defined a cohort of patients of all ages with at least one discharge from PMH between 1 January 2010 and 31 December 2014. Transfers to other hospitals, deaths and discharges against medical advice were excluded due to incomplete hospitalisation and variances in the discharge process. Discharges of mothers attached to neonatal patients who were transferred to PMH from a maternity hospital were also excluded from this study.

Outcome measures/response variable

The 30-day unplanned hospital readmission is the response variable for this study. Index admission is the initial hospitalisation for a specific clinical condition, whereas unplanned hospital readmission is the subsequent unexpected hospitalisation related to the index admission within 30 days of discharge from the initial admission. The identification of unplanned readmissions in this study was based on hospital admission type (unplanned/emergency/non-elective) and the diagnosis of subsequent same-hospital admission related to the index admission. Admissions were considered new index admissions when they occurred more than 30 days following the previous index admission.[20] Only the first index admission was selected for this study for patients who had more than one index admission within the 5-year study period.

Covariates of interest/extracted variables

A total of 16 variables were extracted from the administrative database of Hospital Morbidity Data Collection, including patients' age at admission, gender, residential postcode, admission status, funding source as inpatients, insurance status, source of referral transport, state of residence, care type, interpreter service requirement, intensive care unit stay, general anaesthetic, length of stay, date of admission, date of discharge and number of co-diagnoses.

Age was recoded into six groups as follows: Infants (<12 months), pre-school children (1–4 years), primary school children (5–8 years), late primary school children (9–12 years), lower secondary school children (13–15 years) and upper secondary school children and young adults (≥16 years). The age limit to be admitted at PMH is 15 years unless special permission is granted by the hospital executives for patients with pre-existing medical conditions.[19] A patient's residential postcode was converted into Socio-Economic Indexes for Areas, which represents people's accessibility to material and social resources and participation in society. The Index of Relative Social-Economic Advantage and Disadvantage, with a score of 0–100%, was used in this study. The lower percentage relates to those households with a greater socio-economic disadvantage.[21] Insurance status for this study was coded as either privately insured or no private health insurance. In terms of funding source for hospital inpatients, there is a unique health insurance arrangement in Western Australia, where a patient with private health insurance can choose to be admitted to a public hospital as: (i) a public patient (government funded), and therefore, private health insurance funds are not used or (ii) a private patient using private health insurance funds. Date of admission and discharge was coded as weekdays compared with weekend and designated public holidays from 2010 to 2014.

Data analysis

Statistical Package for the Social Sciences version 23.0 was used to analyse the data. Covariates/extracted variables of patients who experienced 30-day all-cause unplanned same hospital readmission (with-readmission group – coded as 1) were compared with patients who had non-readmission (without-

readmission group – coded as 0) to identify readmission risk factors. Characteristics of the patients were described using mean ± standard deviation for continuous variables, while counts and percentages were used for categorical variables.

Univariate analysis was used to test for the presence of any difference in the 16 covariates/extracted variables between the groups. The χ^2 test was used for categorical variables, and the independent sample t-test was used to investigate associations between the extracted variables and unplanned hospital readmissions. All significant variables that emerged from the univariate analysis were included in the development of the multivariate logistic regression model. Forward elimination was used to remove variables not statistically significant. The effects of all variables were expressed as odds ratios (OR) and associated 95% confidence intervals (CI). A *P* value of less than 0.05 was considered to be statistically significant. The final multivariate logistic model consisted of the least statistically significant predictors.

Sensitivity and specificity were calculated to distinguish patients who experience unplanned readmission. Sensitivity measures the percentage of patients with readmission during the 5-year study period and those who are correctly identified by the model. Conversely, specificity is defined as the proportion of patients who did not experience readmission and who were correctly identified. The area under the receiver operating characteristic (ROC) curve was also generated to demonstrate the discriminative ability of the model. The ROC shows the trade-off between true positives (sensitivity) and false negatives (1-specificity) at all possible thresholds.

Results

The initial extracted administrative inpatient dataset consisted of 137 621 discharges from PMH during the 5-year study period. Following exclusion of patients who were either deceased (*n* = 192), had left against medical advice (*n* = 136), were transferred to other hospitals (*n* = 2264) or were mothers attached to neonatal patients (*n* = 715), a total of 134 314 discharges from 73 132 patients were included in the final analysis. The mean age of all patients was 5.74 ± 4.97 years. One-third of patients (32.3%) were aged from 1 to 4 years compared to 14.1% of patients who were older than 13 years. There were more male (58%) than female patients (42%).

Of the 73 132 patients, 3330 (4.55%) experienced at least one 30-day unplanned hospital readmission. Table 1 summarises patients' characteristics based on 16 covariates/extracted variables of the with-readmission group and without-readmission group. The mean age of the with-readmission group (6.3 ± 5.4 years) was older in comparison to the without-readmissions group (5.7 ± 4.9 years). There were more male than female patients in both groups. The length of the index hospital admission was almost twice as long in the with-readmission group compared to the without-readmission group (4.7 ± 14.1 vs. 2.4 ± 6.6 days).

Univariate analysis identified 12 of the 16 covariates/extracted variables as being significantly associated with unplanned readmission (Table 2); however, there was no difference between the with- and without-readmission group in terms of the patient's type of health insurance, the Australian state of residence, hospital care type and usage of interpreter service. Forward stepwise multivariable logistic regression analysis identified

Table 1 Patients' characteristics based on 16 covariates/extracted variables of the with-readmission group and without-readmission group

Covariates/Extracted variables	With-30 UHRs (*n* = 3330), *n* (%)	Without UHRs (*n* = 69 802), *n* (%)
Age, year		
Mean ± SD	6.3 ± 5.374	5.71 ± 4.946
<1	610 (4.8)	12 050 (95.2)
1–4	938 (4)	22 727 (96)
5–8	578 (4)	13 862 (96)
9–12	543 (4.5)	11 504 (95.5)
13–15	581 (6.3)	8671 (93.7)
≥16	80 (7.5)	988 (92.5)
Gender		
Male	1850 (4.4)	40 571 (95.6)
Female	1480 (4.8)	29 231 (95.2)
Index admission status		
Elective	856 (3.9)	20 982 (96.1)
Emergency	2474 (4.8)	48 820 (95.2)
Funding source for inpatients		
Australian health-care agreements	2976 (4.5)	63 883 (95.5)
Private health insurance	294 (6.4)	4314 (93.6)
Others	60 (3.6)	1605 (96.4)
Type of health insurance		
Privately insured	1432 (4.7)	29 310 (95.3)
No private health insurance	1898 (4.5)	4, 0492 (95.5)
Source of referral transport		
Private/Public transport	2363 (4.6)	48 774 (95.4)
Ambulance	467 (5.5)	8676 (94.5)
Aeromedical service	25 (3)	810 (97)
State/Territory of residence		
WA	3312 (4.6)	69 376 (95.4)
Non-WA	18 (4.1)	426 (95.9)
Care type provided		
Acute care	3256 (4.5)	68 325 (95.5)
Other types	72 (4.8)	1551 (95.2)
IRSAD, %		
Mean ± SD	62.77 ± 27.214	61.04 ± 27.555
0–10	51 (3.7)	1320 (96.3)
11–20	264 (4.1)	6227 (95.9)
21–30	226 (4.3)	4972 (95.7)
31–40	352 (4.4)	7570 (95.6)
41–50	400 (4.6)	8214 (95.4)
51–60	253 (4.2)	5843 (95.8)
61–70	304 (4.5)	6391 (95.5)
71–80	227 (4.8)	4509 (95.2)
81–90	566 (4.6)	11 678 (95.4)
91–100	687 (5)	13 078 (95)
Interpreter service		
Required	9 (2.8)	308 (97.2)
Not required	3321 (4.6)	69 494 (95.4)
GA at index admission		
No	1960 (5.2)	35 420 (94.8)
Yes	1370 (3.8)	34 382 (96.2)
ICU stay at index admission		
No	3255 (4.5)	68 887 (95.5)
Yes	75 (7.6)	915 (92.4)

(*Continues*)

Table 1 (Continued)

Covariates/Extracted variables	With-30 UHRs (*n* = 3330), *n* (%)	Without UHRs (*n* = 69 802), *n* (%)
LOS at index admission, day		
Mean ± SD	4.65 ± 14.146	2.42 ± 6.634
1	1747 (3.5)	48 560 (96.5)
2–7	1178 (6.1)	18 030 (93.9)
8–14	219 (10.2)	1916 (89.8)
≥15	186 (12.6)	1296 (87.4)
Day of index admission date		
Monday	507 (4.5)	10 706 (95.5)
Tuesday	487 (4)	11 781 (96)
Wednesday	588 (4.9)	11 510 (95.1)
Thursday	530 (4.4)	11 491 (95.6)
Friday	565 (5.1)	10 584 (94.9)
Saturday	307 (4.3)	6786 (95.7)
Sunday	346 (4.7)	6944 (95.3)
Weekdays	2619 (4.6)	54 761 (95.4)
Weekend and public holiday	711 (4.5)	15 041 (95.5)
Day of discharge from index admission		
Monday	446 (4.2)	10 113 (95.8)
Tuesday	477 (4.2)	10 975 (95.8)
Wednesday	511 (4.2)	11 608 (95.8)
Thursday	521 (4.2)	11 952 (95.8)
Friday	655 (5.2)	11 937 (94.8)
Saturday	406 (5.4)	7134 (94.6)
Sunday	314 (4.9)	6083 (95.1)
Weekdays	2551 (4.4)	55 391 (95.6)
Weekend and public holiday	779 (5.5)	14 411 (94.5)
Number of co-diagnoses		
0	1162 (3.2)	35 564 (96.8)
1	936 (4.4)	20 278 (95.6)
2	497 (6.4)	7234 (93.6)
3	263 (8.1)	2982 (91.9)
≥4	329 (9.1)	3744 (91.9)

GA, general anaesthetics; ICU, intensive care unit; IRSAD, Index of Relative Social-Economic Advantage and Disadvantage; LOS, length of stay; SD, standard deviation; UHRs, unplanned hospital readmissions; WA, Western Australia.

nine factors that were associated with unplanned hospital readmission within 30 days after discharge (Table 2).

Readmissions were more likely in patients who were 13–15 years of age (OR = 1.30; 95% CI 1.14–1.48) or older than 16 years of age (OR = 1.46; 95% CI 1.07–1.98), utilising private health insurance as an inpatient at a public hospital (OR = 1.16; 95% CI 1.00–1.34) or with a high Index of Relative Social-Economic Advantage and Disadvantage of 90–100% (OR = 1.20; 95% CI 1.02–1.41). Patients admitted on Friday (OR = 1.21; 95% CI 1.05–1.39) or discharged on Friday/Saturday/Sunday are significantly associated with increased risk of readmission (OR = 1.26; 95% CI 1.10–1.44; OR = 1.34; 95% CI 1.15–1.57; OR = 1.24; 95% CI 1.05–1.47, respectively). The likelihood of being readmitted also increased when patients had more than one diagnosis (OR = 2.41; 95% CI 2.08–2.80) or longer than a 24-h hospital stay (OR = 2.39; 95% CI 1.88–2.98). Unplanned readmission was less likely in patients who were transferred to hospital via an aeromedical service (OR = 0.47; 95% CI 0.31–0.71) or had a procedure under general anaesthetics (GA) during the index admission (OR = 0.67; 95% 0.64–0.76).

The ROC curve was generated to illustrate the discriminative ability of the 30-day unplanned hospital readmission predictive model with an area under the ROC curve of 0.645 ± 0.011 (Fig. 1). The sensitivity of the model is represented through the vertical axis, which identifies patients who are likely to be readmitted. Identification of patients who are not likely to be readmitted is represented via the horizontal axis. For a sensitivity of 80%, the model achieved 62% specificity. For a sensitivity of 70%, the model has 50.5% specificity.

Discussion

This is the first published study in WA that developed a multivariate logistic regression model for 30-day all-cause paediatric unplanned hospital readmission using a recent administrative inpatient dataset. Overall, 4.55% of patients discharged from PMH were readmitted to the same hospital. The 30-day same-hospital readmission rate in this study was comparatively lower than rates reported in three hospitals in the USA (6.5–18.7%).[5,7,8] It was, however, higher than the Australian prevalence of 28-day all-cause readmissions across all metropolitan public health services (2.1–3.9%) from 2010 to 2014.[14]

The predictive model developed in this study consists of seven risk factors and two protective factors, and the model had a moderate discriminative ability to predict readmissions. Results from this study confirmed earlier research conducted in Canada[10] – that readmissions are more likely to occur in patients with more than one diagnosis at the index admission. Length of stay associated with index admission was not significantly associated with readmission in two US studies[6,7] compared to the findings of this study – that patients with a longer hospital stay were at a higher risk of being readmitted.

Patients aged between 15 and 18 years were found to be significantly associated with readmission in a study conducted in the USA.[8] This is similar to findings from this study, which identified that patients older than 13 years were nearly 1.5 times more likely to be readmitted compared with younger patients. This may be related to adolescents and young adults with underlying chronic health conditions[3,4,9,22] Further research is recommended[2] to examine whether, potentially, some unplanned hospital readmissions may be unavoidable due to medical complexity.[23]

The association between weekend admission/discharge and unplanned readmission was examined using a single children's hospital administrative dataset.[7] Findings from this study identified that readmissions were more likely to occur when patients were admitted on weekends (OR = 1.09; 95% CI 1.004–1.18). Our study found that not only Friday admissions but also Friday and weekend discharges were associated with higher risks of unplanned readmission. The 'weekend effect' on unplanned hospital readmission for both adults and paediatric patients has been confirmed.[7,24] Care provided over the weekend may be different from weekdays due to limitations in the availability of clinical

Table 2 Univariate and multivariate analyses: Association of 16 covariates/extracted data with unplanned hospital readmission of paediatric patients at Princess Margaret Hospital for Children (2010–2014)

Variables	Univariate OR (upper and lower 95% CI)	*P* value	Multivariate OR (upper and lower 95% CI)	*P* value
Age, year†				
Overall		0.000*		0.000*
5–8	Reference			
<1	1.21 (1.08–1.36)	0.001*		
1–4	0.99 (0.89–1.10)	0.850		
9–12	1.13 (1.00–1.28)	0.042*		
13–15	1.61 (1.43–1.81)	0.000*	1.30 (1.14–1.48)	0.000*
≥16	1.94 (1.52–2.48)	0.000*	1.46 (1.07–1.98)	0.016*
Gender				
Male	Reference			
Female	1.11 (1.04–1.19)	0.003*		
Admission status				
Elective	Reference			
Emergency	1.24 (1.15–1.35)	0.000*		
Funding source as inpatients†				
Overall		0.000*		
Australian health care agreements	Reference			
Private health insurance	1.46 (1.29–1.66)	0.000*	1.16 (1.00–1.34)	0.049*
Others	0.80 (0.61–1.04)	0.098		
Type of health insurance				
Privately insured	Reference			
No private health insurance	1.04 (0.97–1.12)	0.247		
Source of referral transport†				
Overall		0.009*		0.001*
Private/Public transport	Reference			
Ambulance	1.11 (1.00–1.23)	0.043*		
Aeromedical service	0.64 (0.43–0.95)	0.027*	0.47 (0.31–0.71)	0.000*
State/Territory of residence				
WA	Reference			
Non-WA	1.13 (0.70–1.81)	0.613		
Care type provided				
Overall		0.917		
Other types of care	Reference			
Acute care	0.977 (0.24–4.01)	0.974		
IRSAD (%)†				
Overall		0.042*		0.008*
51–60	Reference			
0–10	0.77 (0.53–1.12)	0.171		
11–20	0.98 (0.82–1.17)	0.814		
21–30	1.05 (0.87–1.26)	0.604		
31–40	1.07 (0.91–1.27)	0.397		
41–50	1.13 (0.96–1.32)	0.153		
61–70	1.10 (0.93–1.30)	0.28		
71–80	1.16 (0.97–1.40)	0.107		
81–90	1.12 (0.96–1.30)	0.145		
91–100	1.21 (1.05–1.41)	0.010*	1.20 (1.02–1.41)	0.024*
Interpreter service				
Not required	Reference			
Required	0.61 (0.32–1.19)	0.146		
ICU stay at index admission				
No	Reference			
Yes	1.74 (1.37–2.10)	0.000*		
Had GA at index admission†				
No	Reference			
Yes	0.72 (0.67–0.77)	0.000*	0.67 (0.64–0.76)	0.000*

(*Continues*)

Table 2 (Continued)

Variables	Univariate OR (upper and lower 95% CI)	*P* value	Multivariate OR (upper and lower 95% CI)	*P* value
LOS at index admission, day†				
Overall		0.000*		0.000*
1	Reference			
2–7	1.82 (1.68–1.96)	0.000*	1.42 (1.30–1.55)	0.000*
8–14	3.18 (2.74–3.68)	0.000*	2.35 (1.97–2.82)	0.000*
≥ 15	3.99 (3.40–4.69)	0.000*	2.39 (1.88–2.98)	0.000*
Day of index admission date†				
Overall		0.002*		0.004*
Thursday	Reference			
Monday	1.03 (0.91–1.16)	0.678		
Tuesday	0.90 (0.79–1.02)	0.088		
Wednesday	1.11 (0.98–1.25)	0.096		
Friday	1.16 (1.03–1.31)	0.018*	1.21 (1.05–1.39)	0.007*
Saturday	0.98 (0.85–1.13)	0.792		
Sunday	1.08 (0.94–1.24)	0.275		
Week days	Reference			
Weekend and public holidays	0.99 (0.91–1.08)	0.787		
Day of discharge from index admission†				
Overall		0.000*		0.000*
Thursday	Reference			
Monday	1.01 (0.88–1.14)	0.978		
Tuesday	0.99 (0.87–1.12)	0.844		
Wednesday	0.99 (0.87–1.12)	0.877		
Friday	1.25 (1.11–1.40)	0.000*	1.26 (1.10–1.44)	0.001*
Saturday	1.29 (1.13–1.48)	0.000*	1.34 (1.15–1.57)	0.000*
Sunday	1.17 (1.02–1.35)	0.03*	1.24 (1.05–1.47)	0.012*
Weekdays	Reference			
Weekend and public holidays	1.18 (1.08–1.27)	0.000*		
Number of Co-diagnoses†				
Overall		0.000*		0.000*
0	Reference			
1	1.41 (1.29–1.54)	0.000*	1.28 (1.16–1.41)	0.000*
2	2.10 (1.89–2.34)	0.000*	1.73 (1.53–1.95)	0.000*
3	2.70 (2.35–3.10)	0.000*	2.10 (1.80–2.46)	0.000*
≥4	3.86 (3.45–4.32)	0.000*	2.41 (2.08–2.80)	0.000*

*$P < 0.05$ (statistically significant results). †Indicates variables were included in the multivariate analysis. CI, confidence interval; GA, general anaesthetics; ICU, intensive care unit; IRSAD, Index of Relative Social-Economic Advantage and Disadvantage; LOS, length of stay; OR, odds ratio; WA, Western Australia.

services, including allied health providers and discharge liaison nurse, and variations in the skills of nursing staff. These limitations may result in incomplete discharge processes and early/immature discharge. This study has shown that the highest percentage of unplanned readmissions is related to Friday admission and Friday discharge (refer to Table 1). With the comparatively large number of discharges on Friday, parents may not receive comprehensive discharge information, impacting the continuity of care following discharge from the hospital.[25] Friday discharge may also be related to parental wishes of having their child at home over the weekend when the patient was not clinically ready to be discharged.

A recent study[9] conducted in the UK identified that patients at a socio-economic disadvantage were more likely to be readmitted. In comparison, this study found that patients residing in areas of greater socio-economic advantage were significantly associated with readmission. In addition, patients utilising private health insurance when admitted to a public hospital were identified as a risk predictor for readmission. Inconsistent findings were reported by two US studies examining the type of health insurance. One study[6] cited having private insurance (OR = 1.14; 95% CI 1.04–1.24) as a significant predictor, but the other study[5] reported that patients who only have public insurance were at a higher risk of readmission (OR = 1.48; 95% CI 1.20–1.83). Coller[8] commented that unplanned hospital readmission is not only an indicator of the quality of health care but also a measure of health service accessibility. In this study, paediatric patients with private health insurance or with advantaged socio-economic status were more likely to re-present to PMH as the first choice rather

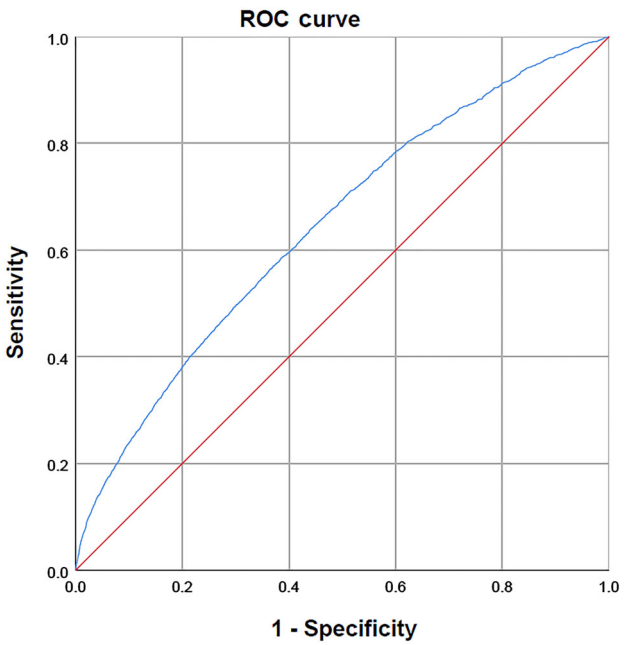

Fig. 1 A receiver operating characteristic (ROC) curve of the risk predictive model with 30-day all-cause unplanned same-hospital readmissions.

than attend a peripheral hospital. Families with greater socioeconomic advantage have fewer financial considerations; therefore, they are more likely to return to the same hospital as the index admission regardless of travel distance.

The findings from this study also identified two factors that reduced the likelihood of readmission. These included patients transferred to PMH by aeromedical services and those who experienced a GA during the index admission. Due to the geographical features of WA, patients admitted to PMH via aeromedical services are normally from country or rural areas. Therefore, those patients might present at the regional hospital to seek medical assistance following discharge rather than returning to the Perth metropolitan area. Our study examined all discharges from PMH during the 5-year study period, including patients who had elective surgery under GA as a day surgery procedure and were discharged within 24 h. These patients were screened and selected using a set of criteria, which may have contributed to the result of fewer readmissions.

The area under the ROC of this study is 0.645 for 30-day all-cause readmission. One US study[3] reported a discriminative model ability of area under the ROC of 0.81. However, the model was for 365-day all-cause paediatric readmissions. These two studies are not comparable due to differences in the follow-up measurement of unplanned hospital readmissions.

Conclusions

The results of this study suggests health-care providers need to recognise and develop specific management plans for patients at a higher risk of readmission based on age (≥13 years), number of admitting diagnosis (>1), day of admission (Friday), day of discharge (Friday and Weekends) and length of hospitalisation (>1). For patients at a higher risk of readmission, a structured discharge plan is recommended to be commenced at the time of admission as this will ensure the continuity of care. The discharge plan should be co-ordinated by a designated staff member throughout the course of hospitalisation until the follow-up appointment. Research evidence suggests that readmission might be caused by early/premature discharge. Therefore, it is critical to assess patients' and their primary carers' readiness for discharge in reducing and preventing unplanned readmissions.[26] A further study focusing on adolescents and younger adults with readmissions will assist in understanding reasons and risk factors.

This study has certain limitations. Although PMH is the only tertiary paediatric hospital in WA, there are several general hospitals with paediatric wards. The readmission rate may be underestimated as the study was not designed to detect readmissions to different hospital.[6] The specific instances include (i) patients who had index admissions at PMH were then readmitted to paediatric wards in different hospitals; (ii) paediatric patients who were initially admitted to other hospitals and then readmitted to the same hospital or (iii) patients initially admitted to other hospitals but then readmitted to PMH.

Currently, readmissions are recorded in the inpatient dataset of PMH as an initial admission. A further study accessing WA linkage data to capture the true paediatric unplanned readmission rates in WA is needed. This study accessed administrative inpatient information as electronic medical record keeping has not been implemented at PMH. The covariates/extracted variables in this study, in comparison to some studies,[27,28] lack patients' specific clinical information, for example, laboratory and imaging results, medication usage, inpatient complications and written discharge information. In conjunction with the administrative inpatient information, a future study is required to examine additional clinical information by reviewing medical records at PMH.

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