

Nationwide study of the characteristics of frequent attenders with multiple emergency department attendance patterns

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ABSTRACT

Introduction: The burden of frequent attenders (FAs) of emergency departments (EDs) on healthcare resources is underestimated when single-centre analyses do not account for utilisation of multiple EDs by FAs. We aimed to quantify the extent of multiple ED use by FAs and to characterise FAs.

Methods: We reviewed nationwide ED attendance in Singapore data from 1 January 2006 to 31 December 2018 (13 years). FAs were defined as patients with ≥ 4 ED visits in any calendar year. Single ED FAs and multiple ED FAs were patients who attended a single ED exclusively and ≥ 2 distinct EDs within the year, respectively. Mixed ED FAs were patients who attended a mix of a single ED and multiple EDs in different calendar years. We compared the characteristics of FAs using multivariable logistic regression.

Results: We identified 200,130 (6.3%) FAs who contributed to 1,865,704 visits (19.6%) and 2,959,935 (93.7%) non-FAs who contributed to 7,671,097 visits (80.4%). After missing data were excluded, the study population consisted of 199,283 unique FAs. Nationwide-linked data identified an additional 15.5% FAs and 29.7% FA visits, in addition to data from single centres. Multiple ED FAs and mixed ED FAs were associated with male sex, younger age, Malay or Indian ethnicity, multiple comorbidities, median triage class of higher severity, and a higher frequency of ED use.

Conclusion: A nationwide approach is needed to quantify the national FA burden. The multiple comorbidities and higher frequency of ED use associated with FAs who visited multiple EDs and mixed EDs, compared to those who visited a single ED, suggested a higher level of ED burden in these subgroups of patients. The distinct characteristics and needs of each FA subgroup should be considered in future healthcare interventions to reduce FA burden.

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INTRODUCTION

Emergency department (ED) overcrowding is a growing issue that threatens public health in various parts of the world,¹ including the US,² UK,³ Australia,⁴ Japan⁵ and Taiwan.⁶

Individuals who visit the ED repeatedly, known as frequent attenders (FAs), have been identified as a possible driver of ED overcrowding. While the definition

of a FA varies in the literature, a commonly used threshold is ≥ 4 ED presentations within a year.⁷⁻¹⁰ FAs represent a small proportion of ED patients but contribute a disproportionate number of ED visits, exerting an excessive strain on ED resources⁹ as well as related medical services.¹¹

FAs may exacerbate the problem of poor quality of care, prolonged waiting times, insufficient admission

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CLINICAL IMPACT

What is New

- To the best of our knowledge, this is the first study in Singapore to compare characteristics associated with frequent attenders (FAs) who visited single emergency departments (EDs), multiple EDs and mixed EDs.
- Multiple ED FAs and mixed ED FAs were associated with ≥ 2 comorbidities, median triage class of higher severity (P2) and a higher frequency of ED use (>7 visits per year).

Clinical Implications

- Targeted healthcare interventions are needed to address the distinct characteristics of FA subgroups to reduce the burden of FA on healthcare resources.

beds and delayed care,¹² thereby leading to detrimental health outcomes. Moreover, studies have reported that FAs may not be using the ED appropriately.^{9,10,13–15}

Most studies on repeated ED use by FAs have focused on single centres with limited multicentre assessment of ED use.⁷ In the US, limited statewide studies reported 58% FAs in Massachusetts¹⁶ and 62% FAs in Utah¹⁷ visiting multiple EDs (≥ 2 different EDs). To the best of our knowledge, few studies on FAs have been conducted on a national level.^{9,18–20} Without national data, the burden of FAs is likely to be underestimated when FAs visit multiple EDs within a country.²⁰ Furthermore, use of multiple EDs is associated with problems such as over-treating,²¹ drug misuse,^{22,23} and discontinuity of care.²⁴

Consistent with global trends, Singapore faces an increase in ED attendances over the years^{25,26} and ED overcrowding remains a chronic problem.²⁷ Currently, there are 10 public hospitals in Singapore (8 general hospitals and 2 specialised hospitals) with 24-hour emergency services that are easily accessible.

In the present study, data of nationwide ED attendance over a 13-year period across all public hospitals in Singapore were analysed to quantify the degree to which FAs sought care at EDs. Single hospital analyses were compared with nationwide data. We sought to determine how characteristics associated with ED attendance behaviour differed in (1) FAs who visited a single ED only; (2) FAs who visited multiple EDs; and (3) FAs who attended a mix of a single ED and multiple EDs in different calendar years.

METHODS

Study design and population

This was a retrospective review of ED attendance records from all public hospitals in Singapore from 1 January 2006 to 31 December 2018. The public healthcare system in Singapore comprises 3 integrated healthcare clusters—Singapore Health Services, National Healthcare Group, and National University Health System—with 8 public general hospitals under the clusters. In 2011, the National Electronic Health Record (NEHR) system, which consolidates all patients' electronic medical records across public (mandatory data contribution) and private (voluntary data contribution) healthcare institutions on a single secure platform, was implemented. Medical records on NEHR were anonymised to form Ministry of Health, Singapore's Omnibus database. In our study, we utilised nationwide ED de-identified electronic health data from Omnibus. Although patient identification was masked, repeated visits for the same patient could be tracked through a study identifier. Visits to specialised hospitals (a women's and children's hospital, and a psychiatric hospital) and visits with missing study identifiers were excluded from the analysis.

FAs were identified as patients with ≥ 4 ED visits in any calendar year, which was consistent with commonly reported definitions in FA studies.^{9,10} FAs of a single ED (single ED FAs) were identified as FAs who sought care from 1 ED in any calendar year exclusively throughout the study period. FAs of multiple EDs (multiple ED FAs) referred to FAs who sought care in ≥ 2 distinct EDs in any calendar year exclusively throughout the study period. FAs who attended a mix of a single ED and multiple EDs in different calendar years of the study period were referred to as mixed ED FAs in this study. Institutional review board exemption was obtained for the study.

Data variables

Patient demographics (age, sex and ethnicity), ED attendance characteristics, and variables that were found in the literature to be associated with frequent ED visits^{2,4–7,16,17,28} were included in our analysis. The age of patients at their first ED visit was categorised into 5 age groups (≤ 25 , 26–45, 45–65, 66–85, >85 years old). Ethnicity was categorised into the 4 main ethnic groups in Singapore as Chinese, Malay, Indian and others. ED attendance characteristics included triage class (based on patient acuity category scale), number of comorbidities, admission rate, frequency of ED use, and final diagnosis that was based on World Health

Organization International Classification of Diseases Ninth Revision (ICD-9), Tenth Revision (ICD-10) and Australian Modification (ICD-10-AM).

For each patient, we computed the median triage category over all ED visits and the proportion of ED visits that resulted in hospital admission. Highly frequent use of ED was taken to be >7 ED visits within a calendar year.²⁹ The most common final diagnosis was identified for each patient and categorised into broad groups of conditions under each relevant ICD-9 chapter heading.³⁰

Statistical analysis

We compared the demographics of FAs and their ED attendance characteristics using chi-square tests for categorical data and Mann-Whitney U test for continuous variables.

Multivariable logistic regression modelling, with unique individuals as the unit of analysis, was performed to determine characteristics associated with multiple and mixed ED use in FAs. Factors found significant in univariable analyses were included in the multivariable logistic regression model. A two-tailed *P* value of <0.05 was considered statistically significant. Odds ratios (OR) and corresponding 95% confidence intervals (CI) were reported as applicable. All data analyses were performed using STATA version 15.1 (StataCorp, College Station, US).

RESULTS

From 1 January 2006 to 31 December 2018, a total of 11,641,406 ED visits were recorded. We excluded 17.5% of visits to specialised hospitals and 0.51% visits with missing study identifiers (Fig. 1). We identified 200,130 (6.3%) patients as FAs who contributed to 1,865,704 ED visits (19.6%), and 2,959,935 (93.7%) non-FAs who contributed to 7,671,097 (80.4%) ED visits. After excluding missing data, the final study population consisted of 199,283 unique FAs.

Fig. 2 shows the yearly trend of the total number of ED patients and corresponding ED visits. We observed an increase in the number of ED patients and ED visits by 39.7% and 34.8%, respectively, from 2006 to 2018. Consistent with this increasing trend, the number of FAs and their corresponding ED visits were also found to have increased over the study period by 24.9% and 16.4%, respectively.

Compared to 173,329 FAs identified from aggregating the numbers from all individual hospitals, nationwide linked data identified 200,130 FAs, which was an additional 15.5% of FAs identified (Table 1).

Table 2 shows the demographics and ED attendance characteristics of the FA population.

FAs of multiple EDs and mixed EDs were characterised by younger age, with a median age of 33 years (IQR [interquartile range] 21–62) and 47 years (IQR 22–67), respectively, compared to 52 years (IQR 23–73) for FAs of a single ED. A higher proportion of FAs who visited multiple EDs (72.4%) were males compared to those who visited single EDs (62.6%) and mixed EDs (67.2%). FAs of Chinese (59.5%) and other (14.3%) ethnicities tended to visit a single ED, while FAs of Malay (19.5%) and Indian (19.1%) ethnicities showed mixed ED attendance behaviour.

The majority of all FAs (59.5–69.6%) had 1 comorbid condition, with a higher proportion of mixed ED FAs (38.8%) having ≥ 2 comorbidities compared to FAs who visited single (25.6%) and multiple EDs (27.9%). The majority of FAs who visited multiple EDs had a median triage class of lowest severity, i.e. P3/P4 (58.8%), while the majority of mixed ED FAs had a median triage class of higher severity, i.e. P2 (51.0%). A higher proportion of mixed ED FAs (25.6%) had symptoms, signs and ill-defined conditions as the final diagnoses compared to FAs who visited a single ED (19.2%) and multiple EDs (20.2%).

Multivariable analysis showed that FAs who visited multiple EDs and mixed EDs were associated with male sex, younger age, Malay or Indian ethnicity, multiple comorbid conditions, median triage class of higher severity, and a higher frequency of ED use (Table 3).

Compared to FAs who were ≤ 25 years of age, the adjusted odds of multiple ED and mixed ED use were 0.33 time (95% CI 0.31–0.35) and 0.36 time (95% CI 0.33–0.39) lower, respectively, in FAs >85 years old. The odds of multiple ED and mixed ED use were 1.25 (95% CI 1.22–1.28) and 1.04 (95% CI 1.01–1.07) times higher, respectively, in male FAs compared to female FAs. FAs of Malay or Indian ethnicity had 1.06 (95% CI 1.03–1.09) and 1.17 times (95% CI 1.13–1.20) increased odds of visiting multiple EDs, respectively, compared to FAs who were Chinese. Similarly, FAs of Malay or Indian ethnicity had 1.40 (95% CI 1.34–1.45) and 1.74 times (95% CI 1.67–1.82) increased odds of visiting mixed EDs than FAs who were Chinese.

A highly frequent ED use of >7 visits per year was found to be most strongly associated with multiple ED (OR 2.15, 95% CI 2.09–2.22) and mixed ED (OR 4.61, 95% CI 4.45–4.79) use in FAs. The odds of multiple ED (OR 0.93, 95% CI 0.88–0.99) and mixed ED (OR 0.87, 95% CI 0.80–0.95) use were lower for FAs with a median triage class of P3/P4 (lowest severity), when

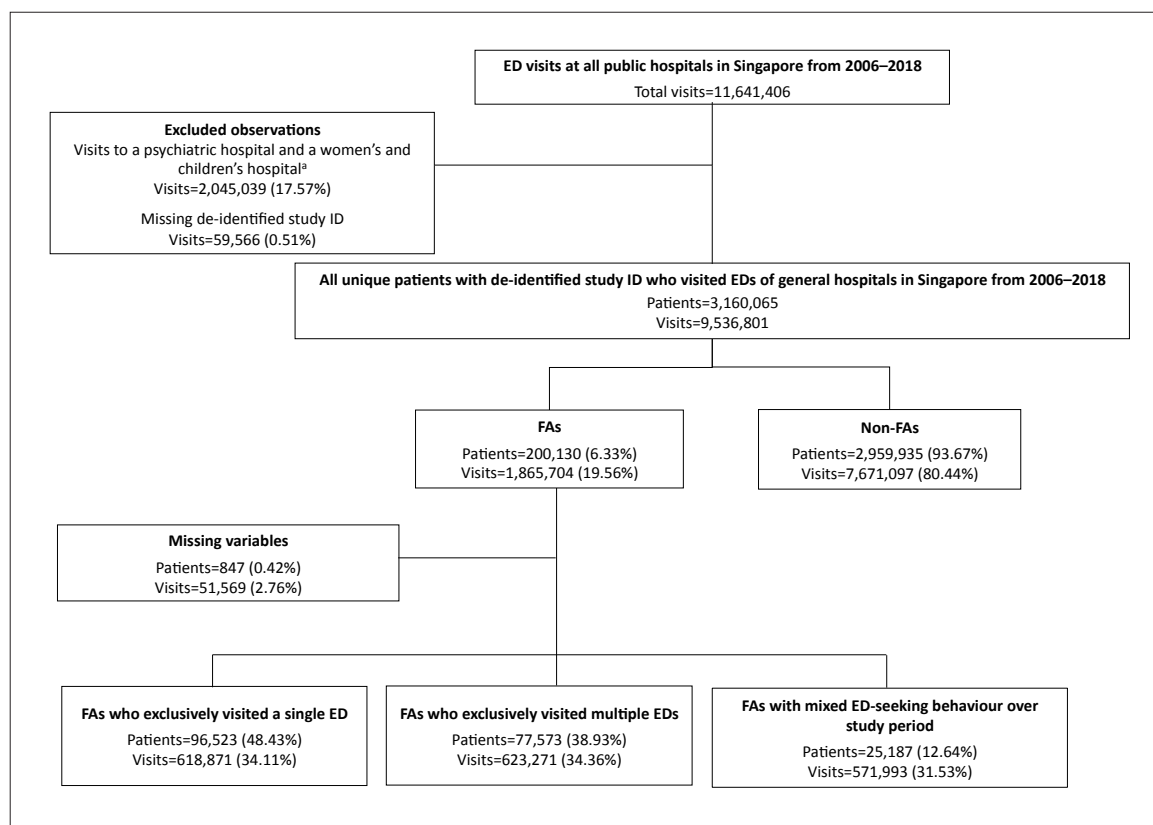


Fig. 1. Study population flowchart

ED: emergency department; FA: frequent attendee; ID: identifier

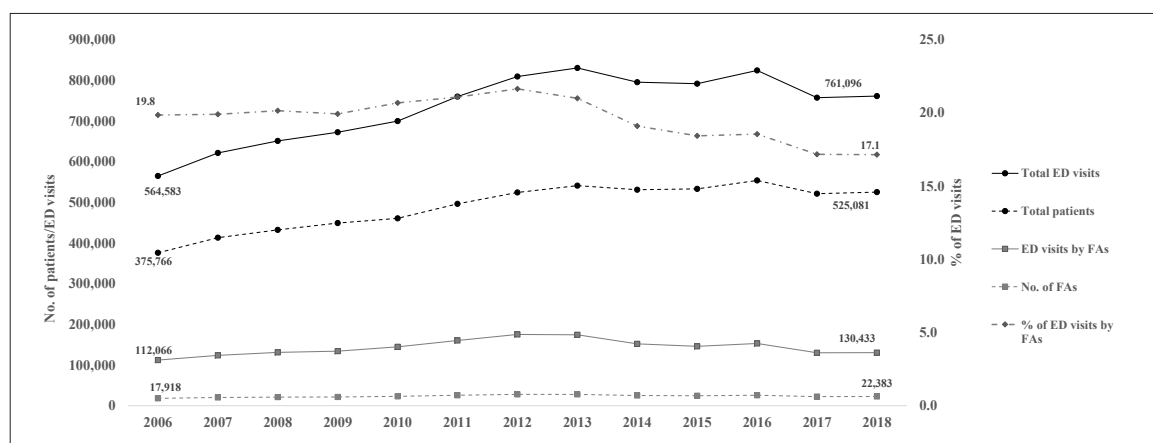
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Fig. 2. Number of emergency department patients and emergency department visits at all public general hospitals in Singapore by calendar year from 2006 to 2018.

ED: emergency department; FA: frequent attendee

compared to FAs with median triage class of P1 (highest severity), while the association between admission rate and multiple ED ($P=0.92$) and mixed ED ($P=0.08$) use in FAs became attenuated.

FAs who had ≥ 2 comorbidities had 1.07 times (95% CI 1.02–1.13) and 3.39 times (95% CI 3.05–3.76)

increased odds of visiting multiple EDs and mixed EDs, respectively, than FAs without any comorbidities. Compared with infectious diseases as the reference category, the top 3 most common final diagnoses associated with FAs of multiple EDs were mental disorders (OR 1.87, 95% CI 1.71–2.04); injuries and

Table 1. Frequent attenders in Singapore and their attributable ED visits nationwide and at individual hospitals, 2006–2018

Hospital	No. of FAs	Total patients	Proportion of total patients (%)	No. of ED visits by FAs	Total ED visits	Proportion of total ED visits (%)
Nationwide	200,130 ^a	3,160,065	6.33	1,865,704	9,536,801	19.56
Hospital A	28,662	821,017	3.49	237,483	1,764,082	13.46
Hospital B	36,834	759,458	4.85	328,765	1,905,645	17.25
Hospital C	37,554	900,773	4.17	315,071	2,056,402	15.32
Hospital D	22,751	506,410	4.49	196,303	1,124,899	17.45
Hospital E	30,703	813,569	3.77	231,344	1,777,142	13.02
Hospital F	11,341	279,943	4.05	92,648	563,521	16.44
Hospital G ^b	5,352	199,845	2.68	36,108	317,740	11.36
Hospital H ^b	132	23,855	0.55	684	27,370	2.50

ED: emergency department; FA: frequent attendee

^a Nationwide linked data identified 200,130 FAs, which was an additional 15.5% of FAs when compared to 173,329 FAs identified if the numbers from all individual hospitals were aggregated^b Limited data available as operations of these hospitals commenced officially in 2015 (G) and 2018 (H)

Table 2. Characteristics of frequent attenders in Singapore who visited a single emergency department versus multiple emergency departments versus mix of single and multiple emergency departments, 2006–2018

Characteristics	Overall, no. (%) N=199,283	FAs of single ED, no. (%) n=96,523	FAs of multiple EDs, no. (%) n=77,573	FAs of single and multiple EDs (mixed EDs), no. (%) n=25,187	P value
Demographic characteristics					
Age, median (IQR), years	44 (22–69)	52 (23–73)	33 (21–62)	47 (22–67)	<0.001
Age groups, years					
≤25	67,923 (34.1)	27,459 (28.5)	32,361 (41.7)	8,103 (32.2)	<0.001
26–45	33,988 (17.1)	16,086 (16.7)	13,755 (17.7)	4,147 (16.5)	
46–65	40,500 (20.3)	19,392 (20.1)	14,812 (19.1)	6,296 (25.0)	
66–85	46,751 (23.5)	26,876 (27.8)	14,020 (18.1)	5,855 (23.3)	
>85	10,121 (5.1)	6,710 (7.0)	2,625 (3.4)	786 (3.1)	
Male	133,593 (67.0)	60,466 (62.6)	56,193 (72.4)	16,934 (67.2)	<0.001
Ethnicity					
Chinese	113,617 (57.0)	57,418 (59.5)	43,522 (56.1)	12,677 (50.3)	<0.001
Malay	31,749 (15.9)	14,149 (14.7)	12,803 (16.5)	4,922 (19.5)	
Indian	27,405 (13.8)	11,125 (11.5)	11,358 (14.6)	4,797 (19.1)	
Others	26,512 (13.3)	13,831 (14.3)	9,890 (12.8)	2,791 (11.1)	
Attendance characteristics					
Median triage class					
P1	8,231 (4.1)	4,852 (5.0)	2,529 (3.3)	850 (3.4)	<0.001
P2	85,453 (42.9)	43,152 (44.7)	29,455 (38.0)	12,846 (51.0)	
P3/P4	105,599 (53.0)	48,519 (50.3)	45,589 (58.8)	11,491 (45.6)	

Table 2. Characteristics of frequent attenders in Singapore who visited a single emergency department versus multiple emergency departments versus mix of single and multiple emergency departments, 2006–2018 (Cont'd)

Characteristics	Overall, no. (%) N=199,283	FAs of single ED, no. (%) n=96,523	FAs of multiple EDs, no. (%) n=77,573	FAs of single and multiple EDs (mixed EDs), no. (%) n=25,187	P value
No. of comorbidities					
0	8,332 (4.2)	4,620 (4.8)	3,302 (4.3)	410 (1.6)	<0.001
1	134,812 (67.7)	67,191 (69.6)	52,626 (67.8)	14,995 (59.5)	
≥2	56,139 (28.2)	24,712 (25.6)	21,645 (27.9)	9,782 (38.8)	
Admission rate					
<0.5	118,189 (59.3)	52,869 (54.8)	50,883 (65.6)	14,437 (57.3)	<0.001
≥0.5	81,094 (40.7)	43,654 (45.2)	26,690 (34.4)	10,750 (42.7)	
Frequency of ED use					
4–7 visits per year	169,116 (84.9)	90,056 (93.3)	65,277 (84.2)	17,244 (68.5)	<0.001
>7 visits per year	30,167 (15.1)	6,467 (6.7)	12,296 (15.9)	7,943 (31.5)	
Most common final diagnosis related to					
Infectious diseases	19,261 (9.7)	10,736 (11.1)	7,195 (9.3)	1,330 (5.3)	<0.001
Neoplasms	3,513 (1.8)	1,890 (2.0)	1,531 (2.0)	92 (0.4)	
Endocrine, nutritional and related diseases	8,295 (4.2)	4,260 (4.4)	2,791 (3.6)	1,244 (4.9)	
Mental disorders	2,846 (1.4)	1,093 (1.1)	1,399 (1.8)	354 (1.4)	
Nervous system and sense organs	7,528 (3.8)	3,297 (3.4)	3,604 (4.7)	627 (2.5)	
Circulatory system	14,032 (7.0)	7,300 (7.6)	4,880 (6.3)	1,852 (7.4)	
Respiratory system	44,640 (22.4)	21,592 (22.4)	16,440 (21.2)	6,608 (26.2)	
Digestive system	13,884 (7.0)	7,103 (7.4)	5,322 (6.9)	1,459 (5.8)	
Genitourinary system	7,161 (3.6)	4,112 (4.3)	2,185 (2.8)	864 (3.4)	
Skin and subcutaneous tissue	6,220 (3.6)	3,275 (3.4)	2,189 (2.8)	756 (3.0)	
Musculoskeletal system and connective tissue	9,134 (3.1)	4,212 (4.4)	3,828 (4.9)	1,094 (4.3)	
Symptoms, signs and ill-defined conditions	40,635 (20.4)	18,490 (19.2)	15,696 (20.2)	6,449 (25.6)	
Injury and poisoning	20,287 (10.2)	8,101 (8.4)	9,893 (12.8)	2,293 (9.1)	
Others	1,846 (0.9)	1,062 (1.1)	620 (0.8)	164 (0.7)	

ED: emergency department; FA: frequent attender; IQR: interquartile range

poisoning (OR 1.61, 95% CI 1.54–1.68); and neoplasms (OR 1.55, 95% CI 1.44–1.68). For mixed FAs, they were symptoms, signs and ill-defined conditions (OR 2.37, 95% CI 2.22–2.53); endocrine, nutritional and related diseases (OR 2.14, 95% CI 1.96–2.34); and injury and poisoning (OR 2.11, 95% CI 1.96–2.28).

DISCUSSION

Our study provided a comprehensive perspective on FAs using nationwide, longitudinal ED attendance data

and highlighted the heterogeneity among FAs with different ED attendance patterns. It affirmed single-centre studies^{9,18,19} that FAs account for a disproportionately large share of ED attendances and the magnitude was previously underestimated when comparing nationwide data and data aggregated from individual hospitals. Addition of the number of FAs from the ED of each hospital underestimated the actual FA use of EDs.

FAs who visited multiple EDs and mixed EDs were not captured in hospital-specific data but could be

Table 3. Univariable and multivariable analysis of factors associated with frequent attenders in Singapore who visited multiple emergency departments and a mix of single and multiple emergency departments (versus a single emergency department)

Parameters	Univariable, OR (95% CI)		Multivariable adjusted, OR (95% CI) ^a	
	FAs of multiple EDs	FAs of single and multiple EDs (mixed EDs)	FAs of multiple EDs	FAs of single and multiple EDs (mixed EDs)
Age groups, years				
≤25 (reference)	1.00	1.00	1.00	1.00
26–45	0.73 (0.71–0.75)	0.87 (0.84–0.91)	0.76 (0.74–0.79)	0.94 (0.90–0.99)
46–65	0.65 (0.63–0.67)	1.10 (1.06–1.14)	0.60 (0.58–0.62)	0.92 (0.88–0.97)
66–85	0.44 (0.43–0.45)	0.74 (0.71–0.77)	0.42 (0.40–0.43)	0.64 (0.60–0.67)
>85	0.33 (0.32–0.35)	0.40 (0.32–0.35)	0.33 (0.31–0.35)	0.36 (0.33–0.39)
Sex				
Female (reference)	1.00	1.00	1.00	1.00
Male	1.57 (1.54–1.60)	1.22 (1.19–1.26)	1.25 (1.22–1.28)	1.04 (1.01–1.07)
Ethnicity				
Chinese (reference)	1.00	1.00	1.00	1.00
Malay	1.19 (1.16–1.23)	1.54 (1.48–1.60)	1.06 (1.03–1.09)	1.40 (1.34–1.45)
Indian	1.35 (1.31–1.39)	2.00 (1.93–2.08)	1.17 (1.13–1.20)	1.74 (1.67–1.82)
Others	0.94 (0.92–0.97)	0.91 (0.87–0.96)	0.78 (0.76–0.81)	0.91 (0.87–0.96)
Median triage class				
P1 (reference)	1.00	1.00	1.00	1.00
P2	1.31 (1.25–1.38)	1.70 (1.58–1.83)	1.15 (1.09–1.21)	1.62 (1.50–1.76)
P3/P4	1.80 (1.72–1.89)	1.35 (1.25–1.46)	0.93 (0.88–0.99)	0.87 (0.80–0.95)
No. of comorbidities				
None (reference)	1.00	1.00	1.00	1.00
1	1.10 (1.05–1.15)	2.51 (2.27–2.79)	1.05 (1.00–1.10)	2.24 (2.02–2.48)
≥2	1.23 (1.17–1.29)	4.46 (4.02–4.95)	1.07 (1.02–1.13)	3.39 (3.05–3.76)
Admission rate				
<0.5 (reference)	1.00	1.00	1.00	1.00
≥0.5	0.64 (0.62–0.65)	0.90 (0.88–0.93)	1.00 (0.97–1.03)	1.04 (0.99–1.09)
Frequency of ED use				
4–7 visits per year (reference)	1.00	1.00	1.00	1.00
>7 visits per year	2.54 (2.47–2.62)	5.17 (4.99–5.35)	2.15 (2.09–2.22)	4.61 (4.45–4.79)
Most common final diagnosis related to				
Infectious diseases (reference)	1.00	1.00	1.00	1.00
Neoplasms	1.21 (1.12–1.30)	0.39 (0.31–0.49)	1.55 (1.44–1.68)	0.36 (0.29–0.45)
Endocrine, nutritional and related diseases	0.98 (0.92–1.03)	2.36 (2.17–2.57)	1.30 (1.22–1.38)	2.14 (1.96–2.34)
Mental disorders	1.91 (1.76–2.08)	2.61 (2.28–2.99)	1.87 (1.71–2.04)	1.93 (1.68–2.22)
Nervous system and sense organs	1.63 (1.54–1.72)	1.54 (1.39–1.70)	1.50 (1.41–1.58)	1.47 (1.32–1.63)

Table 3. Univariable and multivariable analysis of factors associated with frequent attenders in Singapore who visited multiple emergency departments and a mix of single and multiple emergency departments (versus a single emergency department) (Cont'd)

Parameters	Univariable, OR (95% CI)		Multivariable adjusted, OR (95% CI) ^a	
	FAs of multiple EDs	FAs of single and multiple EDs (mixed EDs)	FAs of multiple EDs	FAs of single and multiple EDs (mixed EDs)
Circulatory system	1.00 (0.95–1.05)	2.05 (1.90–2.21)	1.33 (1.27–1.40)	1.89 (1.74–2.05)
Respiratory system	1.14 (1.10–1.18)	2.47 (2.32–2.63)	0.95 (0.92–0.99)	2.06 (1.93–2.20)
Digestive system	1.11 (1.07–1.17)	1.66 (1.53–1.80)	1.17 (1.12–1.23)	1.53 (1.40–1.66)
Genitourinary system	0.79 (0.75–0.84)	1.70 (1.55–1.86)	0.96 (0.91–1.02)	1.58 (1.44–1.74)
Skin and subcutaneous tissue	1.00 (0.94–1.06)	1.86 (1.69–2.05)	1.07 (1.01–1.14)	1.86 (1.68–2.06)
Musculoskeletal system and connective tissue	1.36 (1.29–1.43)	2.10 (1.92–2.29)	1.29 (1.22–1.37)	1.96 (1.79–2.14)
Symptoms, signs and ill-defined conditions	1.27 (1.22–1.31)	2.82 (2.64–3.00)	1.39 (1.33–1.44)	2.37 (2.22–2.53)
Injury and poisoning	1.82 (1.75–1.90)	2.28 (2.12–2.46)	1.61 (1.54–1.68)	2.11 (1.96–2.28)
Others	0.87 (0.79–0.97)	1.25 (1.05–1.48)	1.00 (0.90–1.11)	1.19 (1.00–1.42)

CI: confidence interval; FA: frequent attender; OR: odds ratio

^a Using stepwise logistic regression controlling for age, sex, ethnicity, median triage class, number of comorbidities, proportion of admissions, frequency of ED use and most common final diagnosis

accounted for using nationwide linked data. Although majority of FAs (48.4%) visited a single ED, half of the FAs (51.6%) visited multiple EDs or had mixed ED attendance behaviour. These findings signified that a substantial number of FAs would not be accounted for if only data at a single hospital were analysed. As such, integrated datasets that include all EDs in a given region or country is important to realise the full extent of the FA burden.

A failure to consider the overlapping pattern of ED use has various implications. The costs of multiple ED utilisation by FAs are higher compared to aggregate costs from a single ED.²⁹ Multiple ED use poses a challenge in settings where ED physicians need to make rapid decisions under stressful conditions despite insufficient knowledge with regards to previous care at EDs. This may result in duplicative, unnecessary or suboptimal patient care.³¹

Our findings showed that younger age (≤ 25 years old) and male sex were associated with FAs who visited multiple EDs and mixed EDs. In contrast, studies based on single-centre assessments of ED use reported FAs as being older adults and >65 years old.^{9,18,19} This suggested that single ED analyses failed to capture a whole FA population, particularly younger aged FAs who may have greater mobility and may visit EDs at multiple locations.³² Our findings corroborated with Chan et al. who observed higher rates of frequent attendance in younger males (16–25 years old) in

Singapore.¹⁸ The authors postulated that this was likely due to the prevalence of conscripted soldiers seeking treatment at the ED. Similarly, a study in 1 tertiary hospital reported that 7% of their annual ED workload was contributed by conscripted soldiers.¹⁹ In Singapore, all males aged ≥ 18 years are required to serve 2 years of mandatory military service. These military personnel can access ED services without fees, which may explain the higher consumption of ED services by this group of FAs.³³

FAs with 2 or more comorbidities tended to visit multiple EDs or mixed EDs (>3 times increased odds) compared to those with no comorbidities, suggesting that these groups of FAs were characterised by more complex medical profiles. Interestingly, only 30–40% FAs of multiple ED and mixed ED attendance had an admission rate of >0.5 , i.e., they were less likely to be admitted as inpatients for further management and this may be related to their younger age. Further research may be needed to determine if these FAs could be better managed in the community.

FAs of multiple EDs and mixed EDs were highly frequent users of EDs compared to FAs of a single ED, with 16% of multiple ED FAs and one third of mixed ED FAs having >7 visits per year. This observation was consistent with existing literature on multiple ED use.³² This tendency could in part be attributed to an increase in random chance of visiting more than 1 ED as the frequency of ED use was increased.²⁹

Importantly, our findings showed a strong association between mental disorders (including alcohol/substance abuse) and the use of multiple EDs by FAs, a finding that was aligned with prior literature on multiple ED use.^{31,32} This suggested that EDs in Singapore could be facing the effects of unavailable or insufficient treatment opportunities for mental disorders. FAs who presented with such diagnoses were likely sent to the ED during times of crisis, and often by third parties (e.g. law enforcement or ambulance). These patients would then be conveyed to the nearest ED, increasing the likelihood of visiting different EDs.³² Stronger infrastructure to address issues of mental health and substance use may be critical to mitigate the use of multiple EDs.³²

For mixed ED FAs, a strong association was found for the final diagnoses of general symptoms/ill-defined conditions (including syncope, nausea and chest pain), which may be related to the higher proportion of individuals with multiple comorbidities seen in this group. Our observation that mixed ED FAs were the heaviest users of EDs with a significant proportion of them visiting the ED >7 times in a year, corroborated previous studies which demonstrated an increased ED/acute care utilisation with increased number of comorbidities.^{34,35} Further studies are needed to elucidate the reasons for ED care seeking instead of primary care for this group of patients.

The FA population was found to be not demographically or clinically homogeneous, with each of the 3 groups of FAs having distinct characteristics and needs.¹⁶ This is an important consideration that should guide the development of future health interventions to reduce FA numbers, improve patient outcomes and encourage the use of finite ED resources more efficiently, especially when ED visits continue to rise. The magnitude of the FA population overlap among EDs suggests that coordination of care across multiple institutions is warranted to address the FA burden.

Future research

The scope for future research includes investigating the persistence of multiple and mixed ED use over time and conducting qualitative studies to explore reasons for ED use in terms of the healthcare system (e.g. ambulance transport policies, accessibility and quality of primary care services) and personal preference factors, so as to better assess the extent to which FA behaviour may be problematic, inappropriate or preventable.²⁹ Future research should also seek to understand and evaluate the impact of multiple and mixed ED use on patient care utilisation and outcomes.³¹

Study limitations

There were several methodological limitations in our study. Firstly, there was a lack of critical variables that may influence ED-seeking behaviour, such as education level, socioeconomic status, employment status, social history and mode of arrival to the ED. Social circumstances such as homelessness or isolation may specifically increase the risk of multiple ED use but these were unavailable in the dataset.

Secondly, the study was subjected to the common limitations of using existing datasets collected for clinical and administrative purposes. These included missing data and a potential misclassification of information, especially when data could be collected under stress conditions at the ED.

Lastly, our findings may not be generalisable to other settings as health-seeking behaviour of FAs are intricately related to factors such as healthcare funding and delivery models, which differ across regions or countries.

CONCLUSION

To our knowledge, this is the first study in Singapore to compare factors associated with FAs who visited single EDs, multiple EDs and mixed EDs. The use of nationwide data provided a comprehensive perspective on FAs. A nationwide approach is needed to quantify the national FA burden, as single hospital studies may greatly underestimate the problem.

The multiple comorbidities and higher frequency of ED use associated with FAs who visited multiple EDs and mixed EDs, compared to those who visited a single ED, suggested a higher level of ED burden in these subgroups of patients. The distinct characteristics and needs of these patients should be considered in future healthcare interventions to reduce FA of EDs.

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