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Here one year, gone the next? Investigating duration and predictors of ongoing frequent emergency department attendance, a retrospective study in Australia.

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Manuscripts

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3 1 **Here one year, gone the next? Investigating duration and predictors of ongoing frequent**
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5 2 **emergency department attendance, a retrospective study in Australia.**
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3 **18 Abstract**
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7 **19 Objectives:** Patients are presenting to Emergency Departments (EDs) with increasing
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20 complexity at rates beyond population growth and ageing. Intervention studies target patients
21 with 12 months or less of frequent attendance (FA). However, since most of these patients do
22 not remain FA, these interventions may not be well targeted. This paper quantifies temporary
23 and ongoing FA and contrasts risk factors for each group.

24 Design: A retrospective population-based study using 10 years of longitudinal data.

25 Setting: An Australian health district including metropolitan, regional and rural EDs.

26 Participants: 332,100 residents visited any ED during the study period, of which 8,577 were
27 FA (seven or more visits within 12 months).

28 Main outcome measure: Logistic regression modelling was used to identify risk factors for
29 temporary (one year) and ongoing FA among adults and children. Ongoing FA were further
30 split into repeat (two years) and persistent (three or more years).

31 Results: Of the 8,577 FA, 80.1% were identified as temporary, and 19.9% as ongoing (12.9%
32 repeat, 7.1% persistent). Among adults, ongoing FA were more likely than temporary FA to
33 be young (age 25 to 44), of Aboriginal or Torres Strait Islander background, have a partner,
34 be from high socio-economic areas, or be admitted following ED presentation. Ongoing FAs
35 had higher-rates of non-injury presentations, in particular substance-related (OR=3.0, 95% CI
36 1.7 to 5.3) and psychiatric illness (OR=3.5, 95% CI 2.5 to 4.9). Among children, ongoing
37 FAs were more likely than temporary FAs to be female, aged 5-15, with higher likelihood of

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3 38 admission (OR=3.0, 95% CI 1.2 to 7.4) and rates of neurological conditions (OR=2.3, 95%
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5 39 CI 1.2 to 4.4).

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9 40 **Conclusions:** This study highlights that most FA are temporary, raising concerns about the
10
11 41 value of intervention studies which target the entire FA cohort. Future intervention studies
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14 42 should focus on ongoing FA or include controls.

17 43 **Article summary**

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20 44 Strengths and limitations of this study:

- 21
22 45 • Our unique, longitudinal study reports on long-term patterns of attendance to all
23
24 46 emergency departments within a single health district by frequent attenders over 10 years.
- 25
26 47 • We considered long-term frequent attendance patterns which allowed for patients
27
28 48 discontinuing frequent attendance and resuming later on.
- 29
30 49 • We contrasted socio-demographic and risk factors for temporary versus ongoing frequent
31
32 50 attendance and for both adults and children.
- 33
34 51 • We included metropolitan, regional and rural EDs in Australia, however findings from one
35
36 52 healthcare setting may not be generalisable to other settings.

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43
44 54 (IHIP) research partnership established between the Illawarra Shoalhaven Local Health
45
46 55 District (ISLHD) and the University of Wollongong, with ISLHD providing funding support
47
48 56 and the data used in this study, and the NSW Ministry of Health who authorised the data
49
50 57 release.

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54
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56
57 59 McAlister, and Niki Cirillo for reviewing the manuscript, and assistance with accessing data
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3 60 and interpretation. Patients and the public were not involved in the design or conduct of this
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5 61 study.
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9 62 **Data statement:** Additional materials are available in the supplementary appendix, the
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11 63 dataset was extracted from the Illawarra Health Information Platform.
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15 64 **Competing interests:** The authors declare that they have no competing interests.
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65 INTRODUCTION

66 Background

67 Emergency Department (ED) frequent attenders (FA) are a complex and vulnerable patient
68 group.¹⁻⁴ Compared to non-frequent ED attenders, they have higher rates of morbidity and
69 mortality,⁵ mental health issues,⁵⁻⁷ substance use problems,^{6,8} and chronic diseases,⁸⁻¹⁰ and are
70 more likely to be homeless¹¹ and of low socio-economic status.¹² By definition, this group
71 accounts for a disproportionate share of ED visits. They are also more likely to attend
72 multiple EDs to address their unmet health needs.⁸

73 Interventions are primarily aimed at reducing ED visits,¹³⁻¹⁷ and improving social and
74 clinical outcomes.^{13,16,18} The most commonly studied intervention is case management.
75 ^{13,10,16,18} Other interventions include establishment of care plans with patient input,¹⁹ and
76 providing case notes from previous ED visits.²⁰ Case management in some cases reduced ED
77 costs and improved social and clinical outcomes, but in many studies had no impact, or
78 increased ED and primary care utilisation.¹³ The limited number of studies with control
79 groups has contributed to a lack of evidence on effective interventions, as before-and-after
80 studies fail to account for the high likelihood of FAs becoming infrequent without
81 intervention.¹

82 Relevance

83 Few studies have investigated long-term use patterns among ED attenders across multiple
84 facilities.²¹ Most studies report data from a single year,²²⁻²⁸ or a small number of years,^{11,16} or
85 from a small number of facilities,^{9,29,30} with ongoing visit patterns given little consideration.¹
86 Multi-site studies of more than 2-3 years are scarce.^{1,21,31,32} The need for research into long-
87 term utilisation patterns among FA has been identified, in particular understanding predictors

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3 88 of ongoing use,²¹ and analysis by age group and frequency of visit, to distinguish meaningful
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5 89 sub-groups for intervention.^{1,33}
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8 90 Research addressing these knowledge gaps will assist with identifying and distinguishing
9
10 91 the characteristics of ongoing FAs from those with temporary frequent ED use. This
11
12 92 information will assist in planning appropriate support or interventions for the temporary and
13
14 93 ongoing subgroups of FA.
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16

17 18 94 **Objectives**

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21 95 The aim of this study was to contrast the attributes and risk factors of temporary FA, with
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23 96 ongoing FA. The ongoing FA were further subdivided into repeat FA, who met the frequent
24
25 97 attendance threshold twice, and persistent FA, who met the threshold in three or more
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27 98 periods.
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31 32 99 **METHODS**

33 34 35 36 100 **Study design and setting**

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38 101 A retrospective population-based study was carried out using longitudinal data from an
39
40 102 Australian regional health service, the Illawarra Shoalhaven Local Health District (ISLHD).
41
42 103 The district services almost 390,000 residents in a 250 kilometre long coastal catchment area,
43
44 104 covering rural, regional and metropolitan areas.³⁴ Five of the eight public hospitals within the
45
46 105 district have an ED, the largest being one of the busiest adult and paediatric emergency
47
48 106 departments in the state of New South Wales.³⁵
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53 54 107 **Selection of participants**

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56 108 This negligible risk study accessed data from the Illawarra Health Information Platform
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58 109 (IHIP). IHIP is a non-identifiable databank established by the ISLHD and the University of
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3 110 Wollongong for research, planning and evaluation purposes. IHIP holds a unique record
4
5 111 number for every person who has accessed any ISLHD service since the late 1980s. Ethical
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7 112 approval was received to establish the IHIP non-identifiable databank and for the associated
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9
10 113 data linkage protocols.

11
12 114 Emergency Department data were analysed for all individuals who attended any of the
13
14 115 district's EDs at least once between 1 July 2005 and 30 June 2015. Non-residents of the
15
16
17 116 district's catchment area were excluded.

20 21 117 **Patient and Public Involvement**

22
23 118 Previous studies by the authors on patient's reasons for attending ED,³⁶ and other literature
24
25 119 on patient perspectives in the ED,³⁷ shaped the research questions, including a focus on
26
27 120 understanding long-term use patterns rather than individual visits. The retrospective study
28
29 121 was designed to inform future interventions and research. While patients weren't directly
30
31 122 involved in the design or conduct of this study, a steering group which includes a patient
32
33 123 advisor will contribute to research translation and dissemination activities. Dissemination to
34
35 124 patients will also occur through the health district's Community Partnership Council and
36
37 125 other established patient advisory committees.

42 43 126 **Outcomes**

44
45 127 Historically, frequent ED use has been defined as three to 12 visits per year,⁵ while highly
46
47 128 frequent use has been defined as four to 20 visits per year.^{7,38} Because of this variation,
48
49 129 Locker et al proposed that more than four ED visits per year was a non-random event, and
50
51 130 suggested this become a standard threshold for defining frequent ED attendance.⁶ This study
52
53 131 uses a more recently proposed definition based on a divergence of patient characteristics,
54
55 132 where non-FA present 1-6 times in a year, and FA 7 or more times in a year.³⁹

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3 133 A 12-month window was used to count ED visits following a first (or index) ED visit, a
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5 134 patient-based timeline not defined by calendar year.^{39,40} Subsequent 12 month windows
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8 135 commenced at the next ED visit after each 12-month window.
9

10 136 Duration of frequent ED attendance was measured by the number of 12-month windows
11
12 137 each patient had frequent ED use. Sub-groups of FAs were identified to provide insight into
13
14 138 the varying needs of this complex and heterogeneous patient group. Temporary FA were
15
16 139 defined as those who met the FA threshold once during the study period, and ongoing FA
17
18 140 were looked at in two groups - repeat FA who met the threshold twice, and persistent FA on
19
20 141 more than two occasions.
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25 142 **Measurements**

26
27 143 Demographic characteristics such as age, sex, preferred language, and marital status were
28
29 144 analysed according to the first ED visit in the study period. Private hospital insurance status
30
31 145 and Aboriginal and Torres Strait Islander status were analysed according to the most recent
32
33 146 visit to the ED,⁴¹ due to a higher proportion of missing data in the early study years. Triage
34
35 147 category was averaged over all visits with an average of 4 to 5 considered low urgency. The
36
37 148 proportion of all ED visits resulting in a hospital admission was calculated for each person.
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39

40
41 149 Socioeconomic status was based on Index of Relative Socio-economic Disadvantage
42
43 150 (IRSD) information.⁴² Each Australian postal area has an ISRD score and ranking. For the
44
45 151 purposes of this study, the rankings which were summarised as deciles were reduced to
46
47 152 quintiles, with low ranks representing the most disadvantaged.
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49

50 153 Patient diagnosis was recorded on discharge from the ED. Between 2009 and 2012 each
51
52 154 ED within the regional health service transitioned from ICD-9-CM diagnosis coding to
53
54 155 SNOMED recording of diagnosis. For this study, diagnoses according to ICD-9-CM coding
55
56 156 and SNOMED were therefore mapped to ICD-10-AM⁴³ and then aggregated to Major
57
58 157 Diagnostic Blocks (MDB) using the Independent Hospital Pricing Authority's Urgency
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3 158 Related Group software v1.4.4.⁴⁴ Frequent ED attenders were primarily analysed according to
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5 159 their most common MDB to reduce the likelihood of bias from with missing data (such as
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7
8 160 during system transition and for patients who did not wait), but also described based on
9
10 161 whether they ever had a diagnosis in each MDB.
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14 162 **Data analysis**

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16 163 Associations between categorical variables were evaluated using Pearson's Chi Square Test.
17
18 164 Multivariate logistic regression models were used to compare characteristics of non-FA with
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20
21 165 FA and subgroups, and results summarised as odds ratios (OR) and 95% confidence intervals
22
23 166 (CI). Demographic, diagnosis (MDB), and visit characteristics were included in regression
24
25 167 models. The proportion of missing data was generally low, ranging from <1% for items such
26
27
28 168 as sex, Aboriginal or Torres Strait Islander status, socioeconomic status and triage category,
29
30 169 to 5.3% for preferred language, 10.8% for hospital insurance and 11.4% for marital status.
31
32 170 Those without an assigned MDB due to; no recorded diagnosis (7.5%), a diagnosis code not
33
34 171 recognised by the grouper (3.9%) or patients who did not wait (3.5%), were excluded from
35
36
37 172 analysis by diagnosis. Planned return visits accounted for 3.1% of all ED visits, and these
38
39 173 were excluded from all analyses. Sensitivity analyses were carried out with an alternative
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41 174 threshold for frequent ED attendance of four visits per year, and including planned return
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44 175 visits. Statistical significance was set at 5%. All statistical analysis was conducted using SAS
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46 176 version 9.4.⁴⁵
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50 177 **RESULTS**

51
52 178 A total of 1,199,633 ED visits by 332,100 individuals were recorded across the 10-year study
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54 179 period (Table 1). Of residents who attended the ED, 2.6% (n=8 577) met the threshold for
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56
57 180 frequent attendance (attended 7 or more times within a 12-month window).
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3 181 Among FA, most (n=6866, 80.1%) met the attendance threshold only once (temporary
4
5 182 FA) (Figure 1). A further 12.9% (n= 1104) met the threshold twice (repeat FA), while only
6
7 183 7.1% (n=607) met the threshold on 3 or more occasions (persistent FA). Over the 10 years,
8
9 184 these 607 persistent FA made 38,338 ED visits. A similar pattern of predominantly temporary
10
11 185 FA was observed in each age group (Figure 1).

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13
14 186 A sensitivity analysis including planned return visits, indicated similar patterns of long
15
16 187 term ED use. For example, 81.4% of FAs were temporary FA when planned return visits
17
18 188 were included. When the threshold of FA was reduced to four visits in 12-months, 75.6% of
19
20 189 individuals were temporary FA.

21 22 23 24 25 190 **Demographic and visit characteristics**

26
27 191 Compared to non-FA, FA were more likely to be: male, older (aged 65 or over), Aboriginal or
28
29 192 Torres Strait Islander, have no partner, from non-English speaking backgrounds, un-insured
30
31 193 (publically insured only patients), and resident in lower socio-economic areas (Table 1).

32
33 194 Compared to the other groups of FA, persistent FA were young to middle aged adults, female,
34
35 195 Aboriginal or Torres Strait Islander, had no partner, were from lower socioeconomic areas,
36
37 196 un-insured (publically insured only patients) and not admitted (Table 1). During the ten year
38
39 197 study period FA had an average of 21.0 ED visits, compared to 3.2 for non-FA, with more FA
40
41 198 admitted to hospital.

42 43 44 45 46 47 199 **Diagnostic profile**

48
49 200 The most common diagnoses among FA were digestive, respiratory, circulatory, single site
50
51 201 major injury and psychiatric illness (Supplementary Material Table 1), however diagnostic
52
53 202 profile differed by age and length of frequent attendance.

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56 203 Among the youngest FA, aged 0-4 years, respiratory illness was the most common
57
58 204 diagnosis across all groups FA (Table 2). Among children aged 5-15 years, injury and
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3 205 digestive system illnesses were the two most common diagnoses in all sub-groups, with injury
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5 206 being the most common diagnosis among temporary FA and digestive system illness among
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7 207 the persistent FA. Children also presented with psychiatric illness, which was the most
8
9 208 common diagnosis for 9.3% of temporary FA, 14.3% of repeat FA and 12.7% of persistent
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11 209 FA.

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14 210 While injury and digestive system illness were also common among older teenagers and
15
16 211 young adults (16-24 and 25-44 years), there were increasing numbers of patients visiting ED
17
18 212 primarily for psychiatric illness, particularly among repeat FA aged 25-44 years and persistent
19
20 213 FA (Table 2).

21
22
23 214 Among adults aged 45-64 years, the most common diagnoses were circulatory, digestive
24
25 215 and respiratory illnesses. Among older adults 65 years and above, circulatory followed by
26
27 216 respiratory system illnesses were most common, with the exception of persistent FA who had
28
29 217 more respiratory illness than circulatory illness. In the older age groups, aged 75 years and
30
31 218 above, digestive system and urological system illness were common among all FA groups.

32
33 219 Analysis of all diagnoses reported in the study period (rather than most common) shows
34
35 220 that from the age of 25 years, ED visits relating to single site major injuries were common
36
37 221 among temporary and repeat FA, while persistent FA had higher proportions of respiratory,
38
39 222 musculoskeletal, neurological and psychiatric visits (Table 2). Among ongoing FA aged 5-15,
40
41 223 16-24 and 25-44, more than half presented with a psychiatric diagnosis at least once during
42
43 224 the study period.

44 45 46 47 48 49 50 225 **Predictors of frequent attendance**

51
52 226 Multivariate logistic regression models were fit to assess the likelihood of being a FA, based
53
54 227 on socio-demographic and visit characteristics and diagnoses for those aged 16 and over
55
56 228 (Table 3) and those aged under 16 (Table 4). Consistent with the findings of the earlier
57
58 229 descriptive analysis, being an adult FA was associated with being: male; older; Aboriginal or
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3 230 Torres Strait Islander; un-insured (publically insured only patients); socio-economically
4
5 231 disadvantaged presenting with higher urgency; and less likely to be admitted or have a
6
7 232 partner (Table 3). Compared to the reference category (single site major injury), FA was
8
9 233 associated with all diagnostic groups, with the highest odds of psychiatric illness (OR=6.7,
10
11 234 95% CI 5.9 to 7.6) and alcohol/drug related disorders (OR=6.7, 95% CI 5.1 to 8.7) (Table 3).

12
13
14 235 Among children aged under 16, FA were more likely to be older (age 5 to 15) and
15
16 236 similarly to adult FA, were more likely to be Aboriginal or Torres Strait Islander, un-insured
17
18 237 (publically insured only patients); socio-economically disadvantaged; and present with higher
19
20 238 urgency (OR=2.5, 95% CI 2.2 to 2.8). However they were not more likely to be male; and
21
22 239 were no less likely to be admitted than non-FA (Table 4).

23
24
25 240 Compared to the reference category (single site major injury), FA children aged under 16
26
27 241 were more likely to present with digestive illness, endocrine, nutritional and metabolic
28
29 242 system illness, neurological system illness, and respiratory illness. As with adults, the highest
30
31 243 risk of FA was presenters with psychiatric illness (OR=7.8, 95% CI 5.9 to 10.2) (Table 4).

32 33 34 35 36 244 **Predictors of frequent attendance by duration**

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38
39 245 Models fitted separately for each FA sub-group (temporary FA, repeat FA and persistent FA
40
41 246 compared to non-FA) led to different demographic risk factors. While temporary and repeat
42
43 247 adult FA were more likely to be male, after adjusting for other characteristics, sex was not a
44
45 248 risk factor for persistent FA (OR=1.0, 95% CI 0.9 to 1.2) (Table 3). Persistent adult FA were
46
47 249 also more likely to be in the middle age groups, aged 25-64 years, whereas those aged 65 and
48
49 250 over were more at risk for temporary and repeat FA. Among those aged under 16, ongoing
50
51 251 FA (repeat and persistent) were more likely to be female and aged 5 to 15, neither of which
52
53 252 were risk factors for temporary FA (Table 4).

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55
56 253 Demographic and clinical risk factors for adult FA were in many cases magnified among
57
58 254 repeat and persistent FA (Table 3). For example, Aboriginal or Torres Strait Islander

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3 255 background was a larger risk factor for those with long periods of FA (temporary FA
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5 256 OR=1.9, 95% CI 1.6 to 2.2 and persistent FA OR=3.1, 95% CI 2.2 to 4.2) and having a
6
7 257 partner was less likely among longer duration FA (temporary FA OR=0.7, 95% CI 0.7 to 0.8
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9 258 and persistent FA OR=0.4, 95% CI 0.3 to 0.5).

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12 259 Alcohol and drug-related disorders were much more prominent among longer-duration
13
14 260 FA (temporary FA OR=5.2, 95% CI 3.8 to 7.1 compared to persistent FA OR=26.5, 95% CI
15
16 261 12.3 to 57.2), as were neurological illness (temporary FA OR=1.7, 95% CI 1.5 to 2.0
17
18 262 compared to persistent FA OR=10.1, 95% CI 5.6 to 18.1), and psychiatric illness (temporary
19
20 263 FA OR=5.0, 95% CI 4.3 to 5.8 compared to persistent FA OR=25.5, 95% CI 14.6 to 44.5)
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22 264 (Table 3).

27 265 **Risk factors for temporary versus ongoing frequent attendance**

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29
30 266 Risk factors for ongoing FA (repeat and persistent) were modelled in comparison to
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32 267 temporary FA, rather than non-FA. This confirmed the earlier findings that ongoing FA are
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34 268 younger (aged 25-64) and more likely to be Aboriginal or Torres Strait Islander, but less
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36 269 likely to have a partner, be admitted, or be from high socio-economic areas (Figure 2, left
37
38 270 image). Substance-related visits, psychiatric illness, endocrine/nutritional/metabolic illness
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40 271 and neurological illness were again more likely for ongoing FA. Among children aged under
41
42 272 16, ongoing FA were more likely than temporary FA to be female, aged 5-15, and present
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44 273 with neurological illness (Figure 2, right image).

45 274 **DISCUSSION**

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48 275 This investigation of 10 years of longitudinal ED data has provided a novel perspective on
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50 276 the risk factors by duration of FA, for both adults and children. Investigation of visits to all
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52 277 EDs in the region found the majority of frequent ED attenders are temporary, and only

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3 278 approximately 20% remain as FA in any of up to nine subsequent years. Persistent FA only
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5 279 accounted for 7.1% of FA.
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8 280 The estimate that 80.1% of FA are temporary is slightly higher than other shorter-term
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10 281 studies carried out in the US,^{1, 33,43,46} Sweden³ and New Zealand,⁴⁷ where estimates varied
11
12 282 between 58 and 72%. Definitions of temporary FA differ slightly across studies, including:
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14 283 the threshold number of visits for FA; whether the period of FA is patient-based (using an
15
16 284 index visit) or calendar based; whether another period of FA immediately follows the first FA
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18 285 period or is during the study period. We considered any periods of FA across the entire study
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20 286 period to be inclusive of patients who re-established frequent attendance patterns.⁴⁸
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22
23 287 Systematic reviews show that internationally, intervention studies have been targeting the
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25 288 entire FA cohort.^{13,14} However, differences in profile and risk factors for ongoing FA
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27 289 compared to temporary FA, and for adults and children, demonstrate a need to consider
28
29 290 different types of interventions. In particular, the cohort of persistent FA may receive more
30
31 291 benefit from case management, and increased continuity of primary care provider⁴⁹ than
32
33 292 temporary FA. Young adults with ongoing FA related to substance disorders and psychiatric
34
35 293 illness may benefit from additional services outside the ED, while among children, older
36
37 294 females with neurological conditions (predominantly seizure-related and headaches) could
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39 295 benefit from pathways which reduce the likelihood of admission and result in reduced length
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41 296 of hospital stay.⁵⁰
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47 297 Our research has shown a complex relationship between ED attendance and hospital
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49 298 admission. Multivariate analysis showed frequent ED attendance was inversely associated
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51 299 with hospital admission, and duration of frequent ED attendance was not associated with
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53 300 hospital admission among adults, suggesting some FA may be treated and/or managed in a
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55 301 different setting.
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302 **Limitations**

303 The inclusion of any patients whose with frequent attendance for any 12 month period during
304 the 10 year study period enabled patients to be grouped according to long-term patterns of
305 frequent attendance, however some temporary and repeat FA may have been classified
306 differently had all participants had equal follow up time.

307 Data quality, data consistency and the amount of missing information (in particular
308 diagnosis) improved over time, which may impact descriptive and modelling results. The
309 effect of missing diagnoses was minimised by modelling a patient's most common diagnostic
310 block over all visits. While hospital insurance and preferred language were imputed using
311 recent data, having a partner was considered more likely to change over the study period so
312 missing cases were excluded from models.

313 Social variables that may increase the risk FA, such as use of primary care services,
314 homelessness or isolation, were not routinely collected. Other factors that may be predictive
315 of FA, such as patient satisfaction with treatment, and having a regular source of care⁵¹ were
316 not collected.

317 We did not link to data on deaths outside hospital and therefore did not explore
318 reasons for patients discontinuing frequent attendance, however this is an area of potential
319 future research. We included metropolitan, regional and rural EDs in Australia, however
320 findings from one healthcare setting may not be generalisable to other settings.

321 **Conclusions**

322 This study has provided a unique, longitudinal perspective on ED FA, contrasting the
323 demographic and diagnostic profile of temporary, repeat and persistent FA. The distinction
324 between temporary and ongoing FA cohorts should be used when describing FA, and to
325 inform appropriate interventions and better direct health resources.

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3 326 **Author contributions**
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5 327 LL carried out analysis, interpretation, and drafted the manuscript, VWW and KL assisted
6
7
8 328 with interpretation of the data and assisted with drafting and reviewing the manuscript, RZ,
9
10 329 JM, TC, and WT contributed to interpretation of the data and reviewed the manuscript, KE
11
12 330 was responsible for the study conception and contributed to interpretation of the data and
13
14 331 reviewed the manuscript.
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Table 1. Characteristics of ED patients, 12-month windows, and visits* by length of frequent attendance

Patients	Frequent Attenders (FA)				Non-frequent ED attenders (N=323,523)	ED attenders (N=332,100)
	Temporary (N=6,866)	Repeat (N=1,104)	Persistent (N=607)	All (N=8,577)		
Age group (%) ††						
0-4	10.4	5.7	2.3	9.2	13.4	13.3
5-15	9.0	8.9	9.1	9.0	12.6	12.5
16-24	11.5	12.5	12.4	11.7	12.6	12.6
25-44	20.2	24.3	34.9	21.8	22.6	22.6
45-64	18.8	21.9	23.7	19.6	20.2	20.2
65-74	12.4	12.6	8.7	12.2	8.6	8.7
75+	17.8	14.1	8.9	16.7	10.1	10.2
Sex (%) †††						
Male	53.8	51.5	46.8	53.0	51.3	51.3
Female	46.2	48.6	53.2	47.0	48.8	48.7
Indigenous (%) ††††						
Aboriginal or Torres Strait Islander origin	7.4	10.6	12.5	8.2	3.3	3.4
Neither Aboriginal nor Torres Strait Islander origin	92.6	89.4	87.5	91.8	96.8	96.6
Partner ††††† (persons aged 16 and over)						
Yes	45.1	39.0	30.2	43.2	53.8	53.5
No	54.9	61.0	69.8	56.8	46.2	46.5
Private hospital insurance (%) †††††						
Yes	17.3	16.1	11.7	16.8	32.0	31.6
No	82.7	83.9	88.3	83.3	68.0	68.4
Preferred language (%) †††††						
English	78.9	82.2	82.1	79.6	87.7	87.5
Other	21.1	17.8	17.9	20.4	12.3	12.5
Socio-economic status †††††						
Quintile 1 (low)	30.0	32.8	34.4	30.7	22.2	22.4
Quintile 2	26.6	24.6	25.0	26.3	22.8	22.9
Quintile 3	32.8	35.6	34.6	33.3	40.4	40.2
Quintile 4	5.7	4.1	4.1	5.4	7.6	7.5
Quintile 5 (high)	4.8	2.9	1.8	4.4	7.0	7.0
Visits	(N=108,858)	(N=32,643)	(N=38,338)	(N=179,839)	(N=1,019,794)	(N=1,199,633)
Visits in study period (mean)	15.9	29.6	63.2	21.0	3.2	3.6
Visits per 12-month window (with 1+ visit) (mean)	4.2	5.8	9.5	5.1	1.7	1.8
Admitted (%) †††††						
Yes	37.0	38.0	33.5	36.4	30.8	31.6
No	63.0	62.0	66.5	63.6	69.2	68.4
Triage category †††††						
1 (highest urgency)	0.5	0.5	0.5	0.5	0.5	0.5
2	7.7	8.3	7.7	7.8	6.7	6.9
3	30.0	30.3	28.8	29.9	28.0	28.3
4	45.1	45.7	46.6	45.8	50.7	49.9
5 (lowest urgency)	16.7	15.3	16.4	16.7	14.2	14.5

* Excludes planned return visits

† As reported at earliest ED visit in study period

‡ χ^2 test for patient type (temporary FA, repeat FA, ongoing FA) by: age $\chi^2_{12} = 164.5$ ($p < .0001$), sex $\chi^2_2 = 12.2$ ($p = 0.002$), Indigenous $\chi^2_2 = 29.1$ ($p < .0001$), Partner $\chi^2_2 = 43.8$ ($p < .0001$), Hospital insurance $\chi^2_2 = 10.8$ ($p = 0.045$) Preferred language $\chi^2_2 = 8.6$ ($p = 0.014$), Socio-economic status $\chi^2_8 = 34.6$ ($p < .0001$), Admitted $\chi^2_2 = 196.7$ ($p < .0001$), Triage category $\chi^2_8 = 76.0$ ($p < .0001$). Excludes unknown, missing, and not-stated.

§ As reported at most recent ED visit in study period. This is the recommended approach for Indigenous status (Randall et al 2013) and was required for hospital insurance due to incomplete early data at two facilities.

** Percentage missing, unknown, not stated - Partner 11.5%, Indigenous status (at last ED visit) 0.9%, Socio-economic status 0.0%, Hospital insurance (at last ED visit) 10.8%, Preferred language 5.3%, Admitted 0.0%, Triage category 0.2%

Table 2. Diagnostic profile of ED frequent attender patients* by duration of frequent attendance and age group

% of patients	Temporary frequent attender (frequent attender in one 12-month period)								Repeat frequent attender (frequent attender in two 12-month periods)								Persistent frequent attender (frequent attender in three or more 12-month periods)							
	Age group†								Age group								Age group							
	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All
N persons	711	615	791	1387	1291	850	1221	6866	63	98	138	268	242	139	156	1104	14	55	75	212	144	53	54	607
Most common Major Diagnostic Block																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.0	1.6	0.0	0.0	0.8	0.0	0.0	‡	2.6	2.9	0.0	0.0	1.4	0.0	0.0	‡	2.8	4.2	‡	0.0	2.3
Circulatory system illness	*	1.3	3.5	5.5	17.5	24.4	23.7	12.2	0.0	5.1	‡	4.5	15.3	25.2	32.7	13.0	0.0	‡	‡	7.6	18.1	28.3	14.8	11.5
Digestive system illness	12.2	18.5	21.4	15.9	14.4	12.0	13.6	15.2	14.3	22.5	26.8	15.7	19.4	13.8	9.6	17.6	‡	36.4	26.7	18.4	16.7	15.1	14.8	19.9
Endocrine, nutritional and metabolic system illness	‡	0.8	0.9	1.1	0.7	1.1	1.2	0.9	‡	‡	‡	‡	2.1	‡	‡	1.4	0.0	‡	‡	‡	‡	0.0	0.0	1.3
Illness of skin, subcutaneous tissue, breast	2.0	4.7	5.6	7.1	5.4	3.3	2.9	4.7	‡	‡	5.1	5.6	2.9	‡	‡	3.4	0.0	‡	‡	4.3	‡	0.0	‡	2.6
Injury, single site, major Musculoskeletal/connective tissue system illness	14.5	31.7	20.0	13.4	6.3	3.9	6.2	12.1	‡	21.4	7.3	12.7	2.1	‡	5.8	7.7	‡	21.8	‡	7.6	3.5	0.0	‡	6.9
Neurological system illness	0.7	2.9	3.0	6.0	5.3	5.4	4.2	4.3	0.0	‡	5.1	9.3	6.6	5.0	‡	5.3	0.0	‡	8.0	9.4	5.6	0.0	‡	6.1
Psychiatric illness	4.6	3.6	3.5	5.6	5.3	5.9	7.0	5.3	9.5	7.1	5.1	6.3	8.7	5.8	3.9	6.5	‡	9.1	8.0	11.3	13.2	‡	11.1	10.4
Respiratory system illness	0.0	9.3	11.3	13.1	5.9	1.4	1.0	6.2	‡	14.3	21.0	25.0	10.7	‡	‡	12.9	0.0	12.7	29.3	26.4	10.4	‡	0.0	16.6
Urological system illness	44.0	6.0	4.6	4.0	14.3	18.4	17.1	14.4	47.6	‡	5.1	4.9	14.5	21.6	19.9	13.6	0.0	0.0	‡	2.4	16.7	34.0	22.2	11.2
Other MDBs	1.1	1.3	2.5	2.5	4.7	10.6	13.3	5.6	0.0	6.1	‡	‡	3.3	10.1	16.7	5.3	0.0	0.0	‡	‡	‡	9.4	14.8	3.2
20.0	19.8	22.8	23.9	18.7	13.8	10.0	18.3	19.1	15.3	18.1	11.2	11.6	7.9	7.7	12.1	‡	10.9	‡	8.0	6.9	7.6	11.1	7.9	
Major Diagnostic Block during study period																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	8.5	10.5	11.8	7.3	1.5	0.7	6.0	0.0	10.2	17.4	26.1	16.5	0.0	‡	13.2	0.0	16.4	24.0	31.6	18.8	‡	‡	20.4
Circulatory system illness	4.1	22.4	29.6	35.3	58.9	69.5	71.5	45.4	7.9	40.8	31.9	49.6	65.7	89.9	81.4	57.3	‡	58.2	53.3	65.6	82.6	90.6	85.2	70.2
Digestive system illness	63.4	65.5	58.7	54.2	57.0	61.5	59.9	59.1	85.7	79.6	79.7	70.9	71.9	79.9	74.4	75.5	‡	96.4	85.3	85.9	85.4	88.7	74.1	86.0
Endocrine, nutritional and metabolic system illness	6.5	6.0	3.5	7.9	16.9	20.4	19.0	12.3	12.7	10.2	10.9	13.1	24.4	23.7	30.1	18.8	1.1	12.7	17.3	20.3	24.7	45.3	29.6	25.4
Illness of skin, subcutaneous tissue, breast	38.1	36.3	36.8	36.0	33.4	29.5	26.6	33.4	46.0	46.9	44.2	46.6	37.2	44.6	33.3	42.1	0.9	56.4	56.0	49.5	46.5	30.2	44.4	47.9
Injury, single site, major Musculoskeletal/connective tissue system illness	62.6	82.3	66.4	57.7	48.8	42.2	50.8	56.6	69.8	87.8	74.6	71.3	61.2	46.8	55.8	65.6	1.4	90.9	81.3	38.4	22.7	6.3	7.3	76.9
15.3	48.1	42.4	44.7	44.6	43.8	41.4	41.0	27.0	66.3	56.5	59.0	57.9	59.0	55.1	56.7	‡	89.1	73.3	71.7	79.2	69.8	66.7	73.8	

* Excludes planned return visits
 † Age group defined at first visit in first period of frequent attendance
 ‡ Cell suppressed, n ≤ 5

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Neurological system illness	18.1	27.8	30.7	32.3	36.6	44.2	52.5	36.3	23.8	37.8	52.9	55.6	56.2	64.0	64.1	54.3	58.2	70.7	74.1	75.0	83.0	68.5	71.7
Psychiatric illness	1.4	31.1	36.0	36.3	23.0	15.4	14.2	23.2	‡	54.1	58.7	62.7	36.0	18.7	21.2	40.9	67.3	68.0	71.2	52.1	28.3	16.7	55.7
Respiratory system illness	83.5	39.5	34.6	32.6	50.0	58.6	61.6	50.4	92.1	53.1	46.4	48.5	66.5	71.9	76.3	62.0	78.2	65.3	64.2	77.1	83.0	85.2	73.0
Urological system illness	11.1	17.7	21.0	17.9	27.3	40.4	47.4	27.3	14.3	32.7	27.5	24.3	42.6	65.5	60.3	39.1	49.1	45.3	31.6	42.4	58.5	72.2	43.2

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Table 3. Logistic regression predicting frequent attendance (FA): non-frequent vs i) all FA, ii) temporary FA, iii) repeat FA, iv) persistent FA. Persons aged 16 or over

Variable	Non-frequent vs all frequent attenders ⁹		Non-frequent vs temporary frequent attenders ¹⁰		Non-frequent vs repeat frequent attenders ¹¹		Non-frequent vs persistent frequent attenders ¹²	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex								
Male	1.2	(1.2,1.3)	1.3	(1.2,1.3)	1.3	(1.1,1.5)	1.0	(0.9,1.2)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
16-24 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
25-44	1.1	(1.0,1.2)	1.0	(0.9,1.1)	1.2	(1.0,1.5)	1.9	(1.4,2.6)
45-64	1.1	(1.0,1.2)	1.0	(0.9,1.2)	1.4	(1.1,1.8)	1.7	(1.2,2.4)
65-74	1.5	(1.3,1.6)	1.4	(1.3,1.6)	1.6	(1.2,2.1)	1.3	(0.9,2.0)
75+	1.6	(1.4,1.7)	1.6	(1.4,1.8)	1.4	(1.1,1.9)	0.9	(0.6,1.3)
Partner								
Yes	0.7	(0.6,0.7)	0.7	(0.7,0.8)	0.6	(0.5,0.7)	0.4	(0.3,0.5)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Uninsured (no private hospital insurance) ¹³								
Yes	2.0	(1.9,2.2)	1.9	(1.8,2.1)	2.5	(2.0,3.1)	2.3	(1.7,3.0)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	2.1	(1.9,2.4)	1.9	(1.6,2.2)	2.5	(1.8,3.3)	3.1	(2.2,4.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	3.3	(3.1,3.6)	3.2	(3.0,3.5)	3.7	(3.1,4.6)	3.3	(2.5,4.2)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Preferred language non-English**								
Yes	1.2	(1.1,1.4)	1.2	(1.1,1.4)	1.2	(0.9,1.6)	0.8	(0.5,1.4)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.7	(0.7,0.8)	0.7	(0.7,0.8)	0.6	(0.5,0.8)	0.6	(0.5,0.9)
Socio-economic status								
Quintile 1 (low)	1.5	(1.4,1.6)	1.5	(1.4,1.6)	1.4	(1.2,1.7)	1.4	(1.1,1.7)
Quintile 2	1.1	(1.0,1.2)	1.2	(1.1,1.3)	1.0	(0.8,1.2)	0.8	(0.6,1.1)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	0.8	(0.7,0.9)	0.8	(0.7,1.0)	0.6	(0.4,0.9)	0.6	(0.4,1.0)
Quintile 5 (high)	0.7	(0.6,0.8)	0.8	(0.6,0.9)	0.5	(0.3,0.8)	0.4	(0.2,0.8)
Major Diagnostic Block ¹⁴								
Alcohol/drug abuse and alcohol/drug induced mental disorders	6.7	(5.1,8.7)	5.2	(3.8,7.1)	11.1	(5.9,20.8)	26.5	(12.3,57.2)
Circulatory system illness	2.0	(1.8,2.3)	1.8	(1.6,2.1)	3.0	(2.1, 4.3)	5.6	(3.1, 9.9)
Digestive system illness	2.8	(2.5,3.2)	2.5	(2.2,2.8)	4.3	(3.0, 6.1)	8.5	(4.9, 14.7)
Endocrine, nutritional and metabolic system illness	2.5	(1.9,3.3)	2.0	(1.5,2.8)	4.9	(2.6, 9.3)	8.6	(3.3,22.4)
Illness of skin, subcutaneous tissue, breast	3.2	(2.7,3.7)	3.1	(2.6,3.6)	3.7	(2.3, 5.9)	3.9	(1.8, 8.5)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	1.8	(1.5,2.0)	1.5	(1.3,1.8)	2.8	(1.9, 4.3)	5.8	(3.1, 10.7)
Neurological system illness	2.1	(1.8,2.4)	1.7	(1.5,2.0)	3.2	(2.1, 4.8)	10.1	(5.6,18.1)
Psychiatric illness	6.7	(5.9,7.6)	5.0	(4.3,5.8)	13.8	(9.7,19.8)	25.5	(14.6,44.5)
Respiratory system illness	3.3	(2.9,3.7)	2.8	(2.5,3.2)	5.1	(3.5, 7.3)	9.4	(5.3,16.8)
Urological system illness	3.1	(2.7,3.6)	2.9	(2.5,3.4)	4.0	(2.6, 6.2)	5.1	(2.5,10.4)
Other	1.3	(1.1,1.5)	1.3	(1.1,1.4)	1.5	(1.0, 2.2)	1.3	(0.7, 2.4)

CI, Confidence Interval
OR, Odds Ratio

⁹ n=211,447, $\chi^2_{26} = 4829.6$ (p<.0001), R² = 8.5% (McFadden)

¹⁰ n=210,198, $\chi^2_{26} = 3395.2$ (p<.0001), R² = 7.1% (McFadden)

¹¹ n=206,440, $\chi^2_{26} = 1010.8$ (p<.0001), R² = 9.5% (McFadden)

¹² n=206,097, $\chi^2_{26} = 836.5$ (p<.0001), R² = 9.5% (McFadden)

¹³ Missing values imputed with patient's most recent non-missing value.

¹⁴ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Table 4. Logistic regression predicting frequent attendance (FA): non-frequent vs i) all FA, ii) temporary FA, iii) repeat FA, iv) persistent FA. Persons aged under 16

Variable	Non-frequent vs all frequent attenders ¹⁵		Non-frequent vs temporary frequent attenders ¹⁶		Non-frequent vs repeat frequent attenders ¹⁷		Non-frequent vs persistent frequent attenders ¹⁸	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex								
Male	0.9	(0.8,1.0)	1.0	(0.9,1.1)	0.6	(0.4,0.8)	0.4	(0.2,0.7)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
0-4 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
5-15	1.3	(1.2,1.5)	1.2	(1.1,1.3)	2.0	(1.4,2.9)	4.7	(2.5,8.7)
Uninsured (no private hospital insurance) ¹⁹								
Yes	1.9	(1.7,2.2)	1.9	(1.6,2.2)	1.9	(1.2,2.9)	3.6	(1.5,8.4)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	1.5	(1.2,1.8)	1.4	(1.2,1.7)	1.9	(1.3,3.0)	1.5	(0.7,3.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.5	(2.2,2.8)	2.4	(2.1,2.7)	3.0	(2.0,4.5)	3.9	(2.1,7.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.9	(0.8,1.1)	0.9	(0.7,1.1)	1.2	(0.7,2.0)	1.2	(0.5,2.6)
Socio-economic status								
Quintile 1 (low)	1.7	(1.5,2.0)	1.7	(1.4,1.9)	1.8	(1.2,2.7)	3.4	(1.7,6.7)
Quintile 2	1.7	(1.5,1.9)	1.7	(1.4,1.9)	1.6	(1.1,2.5)	3.5	(1.8,6.9)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	1.1	(0.9,1.4)	1.2	(0.9,1.5)	0.4	(0.1,1.2)	1.6	(0.5,5.6)
Quintile 5 (high)	0.9	(0.7,1.2)	0.9	(0.7,1.3)	0.4	(0.1,1.3)	1.1	(0.2,4.8)
Major Diagnostic Block ²⁰								
Circulatory system illness	1.3	(0.8,2.1)	1.0	(0.5,1.8)	3.6	(1.4, 9.5)	1.2	(0.2, 9.3)
Digestive system illness	1.6	(1.3,1.9)	1.4	(1.2,1.7)	2.1	(1.3, 3.6)	3.2	(1.6, 6.4)
Endocrine, nutritional and metabolic system illness	2.1	(1.2,3.8)	1.6	(0.8,3.2)	5.0	(1.5, 16.8)	6.3	(1.4,29.2)
Illness of skin, subcutaneous tissue, breast	0.9	(0.6,1.2)	0.9	(0.7,1.3)	0.7	(0.2, 2.2)	0.5	(0.1, 3.7)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	0.6	(0.4,0.9)	0.7	(0.4,1.0)	0.3	(0.0, 2.0)	0.5	(0.1, 4.0)
Neurological system illness	2.4	(1.9,3.2)	2.1	(1.5,2.8)	4.5	(2.3, 8.8)	4.9	(1.9,12.4)
Psychiatric illness	7.8	(5.9,10.2)	6.9	(5.1,9.4)	13.4	(7.0,25.8)	9.8	(3.8,25.2)
Respiratory system illness	2.1	(1.8,2.4)	2.1	(1.8,2.4)	2.3	(1.4, 3.9)	1.2	(0.5, 3.2)
Other	0.8	(0.7,0.9)	0.8	(0.6,0.9)	0.9	(0.5, 1.5)	0.5	(0.2, 1.3)

CI, Confidence Interval
OR, Odds Ratio

¹⁵ n=82,344, $\chi^2_{19} = 1076.2$ (p<.0001), R² = 6.5% (McFadden)

¹⁶ n=82,115, $\chi^2_{19} = 801.9$ (p<.0001), R² = 5.3% (McFadden)

¹⁷ n=80,958, $\chi^2_{19} = 232.4$ (p<.0001), R² = 7.9% (McFadden)

¹⁸ n=80,867, $\chi^2_{19} = 129.8$ (p<.0001), R² = 10.9% (McFadden)

¹⁹ Missing values imputed with patient's most recent non-missing value.

²⁰ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

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3 **Figure captions**
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9 **Figure 1.**
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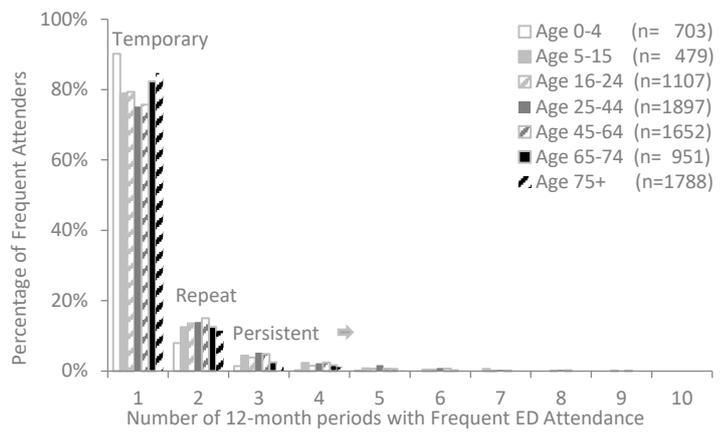
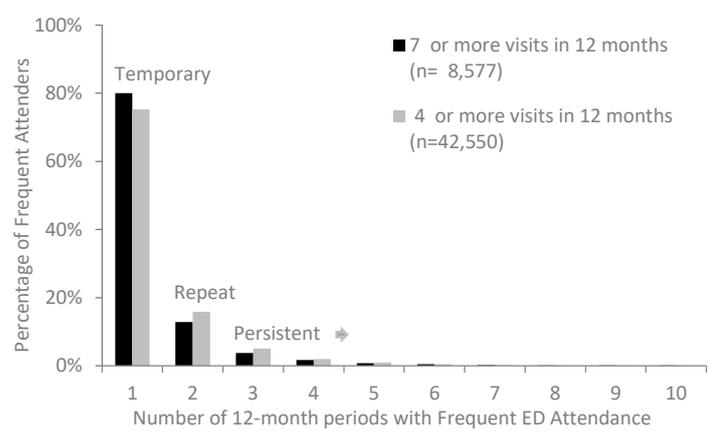
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12 Number of 12-month periods where the frequent attendance threshold was met by frequently
13 attending residents. *Left:* All residents with 7 or more visits in 12 months and all residents
14 with 4 or more visits in 12 months. *Right:* all residents with 7 or more visits in 12 months by
15 age group. Excludes planned return visits.
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26 **Figure 2.**
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28
29 Logistic regression model predicting ongoing vs temporary frequent attendance. *Left:* Persons
30 aged 16 and over (n=5,803). *Right:* Persons aged under 16 (n=1,546).
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34 Note: Reference categories for persons aged 16 and over - Age: 16-24, SEIFA: Quintile 3,
35 Major Diagnostic Block: Single Site Major Injury. Reference categories for persons aged
36 under 16 - Age: 0-4, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury.
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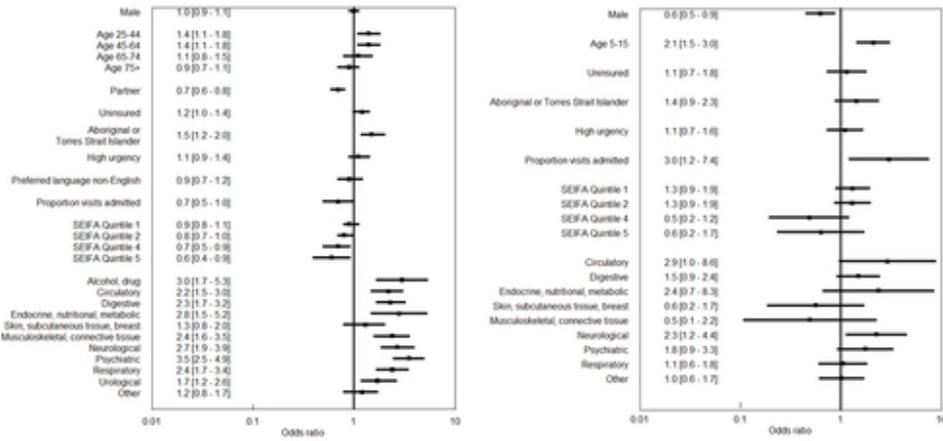


Figure 2. Logistic regression model predicting ongoing vs temporary frequent attendance. Left: Persons aged 16 and over (n=5,803). Right: Persons aged under 16 (n=1,546). Reference categories for adults: Age: 16-24, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury and for children: age: 0-4, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury

43x20mm (300 x 300 DPI)

Supplementary Material for Here one year, gone the next? Investigating duration and predictors of ongoing frequent emergency department attendance, a retrospective study in Australia.

Table 1. Diagnostic profile of all ED frequent attenders¹ by age group

	Age group ²							All
	0-4	5-15	16-24	25-44	45-64	65-74	75+	
<i>% of frequent attenders</i>	N persons							
	788	768	1004	1867	1677	1042	1431	8577
<i>Most common Major Diagnostic Block</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.2	2.0	0.1	0.0	1.0
Circulatory system illness	0.4	1.8	3.6	5.6	17.2	24.7	24.3	12.3
Digestive system illness	12.4	20.3	22.5	16.2	15.3	12.7	13.2	15.9
Endocrine, nutritional and metabolic system illness	0.6	1.0	1.2	1.1	0.9	1.1	1.0	1.0
Illness of skin, subcutaneous tissue, breast	1.9	4.2	5.2	6.6	4.8	3.0	2.7	4.3
Injury, single site, major	13.6	29.7	17.1	12.6	5.4	3.6	6.2	11.2
Musculoskeletal/connective tissue system illness	0.6	2.6	3.7	6.9	5.5	5.1	3.8	4.6
Neurological system illness	5.2	4.4	4.1	6.4	6.5	5.7	6.8	5.8
Psychiatric illness	0.1	10.2	13.9	16.3	7.0	1.5	1.0	7.8
Respiratory system illness	44.4	5.3	4.5	3.9	14.5	19.6	17.6	14.1
Urological system illness	1.0	1.8	2.4	2.1	4.2	10.5	13.7	5.4
Other MDBs	19.7	18.6	20.8	20.3	16.6	12.7	9.8	16.7
<i>Major Diagnostic Block during study period</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	9.2	12.5	16.1	9.6	1.4	0.8	8.0
Circulatory system illness	4.6	27.3	31.7	40.8	61.9	73.3	73.1	48.7
Digestive system illness	65.7	69.5	63.6	60.2	61.6	65.4	62.0	63.1
Endocrine, nutritional and metabolic system illness	7.0	7.0	5.6	10.0	19.5	22.1	20.6	14.0
Illness of skin, subcutaneous tissue, breast	38.8	39.1	39.2	39.1	35.1	32.6	28.0	35.5
Injury, single site, major	63.3	83.6	68.6	62.6	52.7	43.5	51.8	59.2
Musculoskeletal/connective tissue system illness	16.6	53.4	46.6	49.8	49.5	47.1	43.9	45.3
Neurological system illness	18.8	31.3	36.8	40.4	42.7	48.9	55.2	41.1
Psychiatric illness	1.7	36.6	41.5	44.1	27.4	16.5	15.0	27.8
Respiratory system illness	84.5	44.0	38.6	38.5	54.7	61.6	64.1	53.7
Urological system illness	11.6	21.9	23.7	20.4	30.8	44.6	49.8	30.0

¹ Excludes planned return visits

² Age group at first visit in first period of frequent attendance.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n.a.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	8
		(d) If applicable, explain how loss to follow-up was addressed	n.a.
		(e) Describe any sensitivity analyses	9
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-10
		(b) Give reasons for non-participation at each stage	n.a.
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	8
		(c) Summarise follow-up time (eg, average and total amount)	9-10
Outcome data	15*	Report numbers of outcome events or summary measures over time	9-10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11
		(b) Report category boundaries when continuous variables were categorized	8, In tables
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-14
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Here one year, gone the next? Investigating persistence of frequent emergency department attendance, a retrospective study in Australia.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-027700.R1
Article Type:	Research
Date Submitted by the Author:	15-Jan-2019
Complete List of Authors:	Lago, Luise; University of Wollongong Faculty of Business, Centre for Health Research Illawarra Shoalhaven Population Westley-Wise, Victoria; University of Wollongong Faculty of Business, Centre for Health Research Illawarra Shoalhaven Population; Illawarra Shoalhaven Local Health District Mullan, Judy; University of Wollongong Faculty of Business, Centre for Health Research Illawarra Shoalhaven Population Lambert, Kelly; University of Wollongong Faculty of Business, Centre for Health Research Illawarra Shoalhaven Population; Illawarra Shoalhaven Local Health District Zingel, Rebekah; Illawarra Shoalhaven Local Health District, Planning and Strategic Commissioning Carrigan, Thomas; Illawarra Shoalhaven Local Health District, Emergency Medicine Triner, Wayne; Illawarra Shoalhaven Local Health District, Emergency Medicine Eagar, Kathy; University of Wollongong Faculty of Business, Australian Health Services Research Institute, Faculty of Business
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology, Health services research, Health policy
Keywords:	emergency department, repeat use, longitudinal study, persistent, social determinants of health

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Manuscripts

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3 1 **Here one year, gone the next? Investigating persistence of frequent emergency**
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5 2 **department attendance, a retrospective study in Australia.**
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41 16 determinants of health;
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3 **18 Abstract**
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7 **19 Objectives:** Patients are presenting to Emergency Departments (EDs) with increasing
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9 **20** complexity at rates beyond population growth and ageing. Intervention studies target patients
10
11 **21** with 12 months or less of frequent attendance. However, these interventions are not well
12
13 **22** targeted since most patients do not remain frequent attenders. This paper quantifies
14
15 **23** temporary and ongoing frequent attendance and contrasts risk factors for each group.
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20 **24 Design:** Retrospective population-based study using 10 years of longitudinal data.
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24 **25 Setting:** An Australian geographic region that includes metropolitan and rural EDs.
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27 **26 Participants:** 332,100 residents visited any ED during the study period, of which 8,577 were
28
29 **27** frequent attenders (seven or more visits within 12 months).
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32 **28 Main outcome measure:** Risk factors for temporary (one year) and ongoing frequent
33
34 **29** attenders were identified using logistic regression models for adults and children. Ongoing
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36 **30** frequent attenders were further split into repeat (two years) and persistent (three or more
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38 **31** years).
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44 **32 Results:** Of 8,577 frequent attenders, 80.1% were temporary and 19.9% ongoing (12.9%
45
46 **33** repeat, 7.1% persistent). Among adults, ongoing were more likely than temporary frequent
47
48 **34** attenders to be young (age 25-44), of Aboriginal or Torres Strait Islander background, have
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50 **35** no partner, be from lower socio-economic areas, and less likely to be admitted. Ongoing
51
52 **36** frequent attenders had higher-rates of non-injury presentations, in particular substance-related
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54 **37** (OR=3.0, 95% CI 1.7 to 5.3) and psychiatric illness (OR=3.5, 95% CI 2.5 to 4.9). In
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56 **38** comparison, children who were ongoing were more likely than temporary frequent attenders
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3 39 to be female, aged 5-15, with higher likelihood of admission (OR=3.0, 95% CI 1.2 to 7.4)
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5 40 and rates of neurological conditions (OR=2.3, 95% CI 1.2 to 4.4).
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9 41 **Conclusions:** Intervention studies that target the entire frequent attender cohort are inevitably
10
11 42 unsuccessful because most frequent attenders are temporary. Future intervention studies
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13 43 should distinguish between temporary and ongoing frequent attenders, develop specific
14
15 44 interventions for each group, and include rigorous evaluation.
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19 20 45 **Article summary**

21
22 46 Strengths and limitations of this study:

- 23
24 47 • Our unique, longitudinal data platform has enabled this study on long-term patterns of
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26 48 attendance to all emergency departments within a single geographic region by frequent
27
28 49 attenders over 10 years.
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31 50 • We considered long-term frequent attendance patterns which allowed for patients
32
33 51 discontinuing frequent attendance and resuming later on.
34
35 52 • We contrasted socio-demographic and risk factors for temporary versus ongoing frequent
36
37 53 attendance and for both adults and children.
38
39 54 • We included metropolitan, regional and rural EDs in Australia, however findings from one
40
41 55 healthcare setting may not be generalisable to other settings.
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46
47 56 **Funding and support:** The authors acknowledge the Illawarra Health Information Platform
48
49 57 (IHIP) research partnership established between the Illawarra Shoalhaven Local Health
50
51 58 District (ISLHD) and the University of Wollongong, with ISLHD providing funding support
52
53 59 and the data used in this study, and the NSW Ministry of Health who authorised the data
54
55 60 release.
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4
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6
7 63 and interpretation. Patients and the public were not involved in the design or conduct of this
8
9 64 study.
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13 65 **Data statement:** This study accessed data from the Illawarra Health Information Platform
14
15 66 (IHIP) non-identifiable databank, which was established by the Illawarra Shoalhaven Local
16
17 67 Health District (ISLHD) and the University of Wollongong in NSW, Australia, for research,
18
19 68 planning and evaluation purposes. The study used deidentified participant data from 1 July
20
21 69 2005 to 30 June 2015. The Centre for Health Research Illawarra Shoalhaven Population and
22
23 70 the NSW Ministry of Health approved unit record data access. Additional materials are
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25 71 available in the supplementary appendix.
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31 72 **Competing interests:** The authors declare that they have no competing interests.
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73 INTRODUCTION

74 Background

75 Emergency Department (ED) frequent attenders are a complex and vulnerable patient group.¹⁻
76 ⁴ Compared to non-frequent ED attenders, they have higher rates of morbidity and mortality,⁵
77 mental health issues,⁵⁻⁷ substance use problems,^{6,8} and chronic diseases,⁸⁻¹⁰ and are more
78 likely to be homeless¹¹ and of low socio-economic status.¹² By definition, this group accounts
79 for a disproportionate share of ED visits. They are also more likely to attend multiple EDs to
80 address their unmet health needs.⁸

81 Interventions are primarily aimed at reducing ED visits,¹³⁻¹⁷ and improving social and
82 clinical outcomes.^{13,16,18} The most commonly studied intervention is case management.
83 ^{13,10,16,18} Other interventions include establishment of care plans with patient input,¹⁹ and
84 providing case notes from previous ED visits.²⁰ Case management in some cases reduced ED
85 costs and improved social and clinical outcomes, but in many studies had no impact, or
86 increased ED and primary care utilisation.¹³ The limited number of studies with control
87 groups has contributed to a lack of evidence on effective interventions, as before-and-after
88 studies fail to account for the high likelihood of frequent attenders becoming infrequent
89 without intervention.¹

90 Relevance

91 Few studies have investigated long-term use patterns among ED attenders across multiple
92 facilities.²¹ Most studies report data from a single year,²²⁻²⁸ or a small number of years,^{11,16} or
93 from a small number of facilities,^{9,29,30} with ongoing visit patterns given little consideration.¹
94 Multi-site studies of more than 2-3 years are scarce.^{1,21,31,32} The need for research into long-
95 term utilisation patterns among frequent attenders has been identified, in particular

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3 96 understanding predictors of ongoing use,²¹ and analysis by age group and frequency of visit,
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5 97 to distinguish meaningful sub-groups for intervention.^{1,33}
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8 98 Research addressing these knowledge gaps will assist with identifying and distinguishing
9
10 99 the characteristics of ongoing frequent attenders from those with temporary frequent ED use.
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12 100 This information will assist in planning appropriate support or interventions for the temporary
13
14 101 and ongoing subgroups of frequent attenders.
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17 18 102 **Objectives**

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20
21 103 The aim of this study was to contrast the attributes and risk factors of temporary frequent
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23 104 attenders, with ongoing frequent attenders. The ongoing frequent attenders were further
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25 105 subdivided into repeat frequent attenders, who met the frequent attendance threshold twice,
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27 106 and persistent frequent attenders, who met the threshold in three or more periods.
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31 32 107 **METHODS**

33 34 35 108 **Study design and setting**

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38 109 A retrospective population-based study was carried out using longitudinal data from an
39
40 110 Australian regional health service, the Illawarra Shoalhaven Local Health District (ISLHD).
41
42 111 The district services almost 390,000 residents in a 250 kilometre long coastal catchment area,
43
44 112 covering rural, regional and metropolitan areas.³⁴ Five of the eight public hospitals within the
45
46 113 district have an ED, the largest being one of the busiest adult and paediatric emergency
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48 114 departments in the state of New South Wales.³⁵
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52 53 115 **Selection of participants**

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56 116 This negligible risk study accessed data from the Illawarra Health Information Platform
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58 117 (IHIP). IHIP is a non-identifiable databank established by the ISLHD and the University of
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3 118 Wollongong for research, planning and evaluation purposes. IHIP holds a unique record
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5 119 number for every person who has accessed any ISLHD service since the late 1980s. Ethical
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8 120 approval was received to establish the IHIP non-identifiable databank and for the associated
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10 121 data linkage protocols.

11
12 122 Emergency Department data were analysed for all individuals who attended any of the
13
14 123 district's EDs at least once between 1 July 2005 and 30 June 2015. Non-residents of the
15
16
17 124 district's catchment area were excluded.

20 21 125 **Patient and Public Involvement**

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23 126 Previous studies by the authors on patient's reasons for attending ED,³⁶ and other literature
24
25 127 on patient perspectives in the ED,³⁷ shaped the research questions, including a focus on
26
27 128 understanding long-term use patterns rather than individual visits. The retrospective study
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29 129 was designed to inform future interventions and research. While patients were not directly
30
31 130 involved in the design or conduct of this study, a steering group that includes a patient
32
33 131 advisor will contribute to research translation and dissemination activities. Dissemination to
34
35 132 patients will also occur through the health district's Community Partnership Council and
36
37 133 other established patient advisory committees.

40 41 42 43 134 **Outcomes**

44
45 135 The primary outcome of the study was an estimate of the proportion of frequent attenders for
46
47 136 whom frequent attendance is a temporary phenomenon (occurring only once during the study
48
49 137 period). A secondary outcome was to identify and contrast risk factors for temporary and
50
51 138 ongoing frequent attendance to highlight characteristics associated with a continuing frequent
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53
54 139 ED use.

140 **Measurements**

141 Historically, frequent ED use has been defined as three to 12 visits per year,⁵ while highly
142 frequent use has been defined as four to 20 visits per year.^{7,38} Because of this variation,
143 Locker et al proposed that more than four ED visits per year was a non-random event, and
144 suggested this become a standard threshold for defining frequent ED attendance.⁶ This study
145 uses a more recently proposed definition based on a divergence of patient characteristics,
146 where non-frequent attenders present 1-6 times in a year, and frequent attenders 7 or more
147 times in a year.³⁹ A sub-group of highly frequent attenders,³⁹ who made 18 or more visits to
148 EDs in any 12-month period, were also investigated.

149 A 12-month window was used to count ED visits following a first (or index) ED visit, a
150 patient-based timeline not defined by calendar year.^{39,40} Subsequent 12 month windows
151 commenced at the next ED visit after each 12-month window. Consequently, a subsequent
152 period of frequent attendance was not constrained to immediate following a first period.

153 Duration of frequent ED attendance was measured by the number of 12-month windows
154 each patient had frequent ED use. Sub-groups of frequent attenders were identified to provide
155 insight into the varying needs of this complex and heterogeneous patient group. Temporary
156 frequent attenders were defined as those who met the frequent attendance threshold once
157 during the study period, and ongoing frequent attenders were looked at in two groups - repeat
158 frequent attenders who met the threshold twice, and persistent frequent attenders, who met
159 the threshold three or more times.

160 Demographic characteristics such as age, sex, preferred language, and marital status were
161 analysed according to the first ED visit in the study period. Private hospital insurance status
162 and Aboriginal and Torres Strait Islander status were analysed according to the most recent
163 visit to the ED,⁴¹ due to a higher proportion of missing data in the early study years. Triage

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3 164 category was averaged over all visits with an average of 4 to 5 considered low urgency. The
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5 165 proportion of all ED visits resulting in a hospital admission was calculated for each person.
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8 166 Socioeconomic status was based on Index of Relative Socio-economic Disadvantage
9
10 167 (IRSD) information.⁴² Each Australian postal area has an ISRD score and ranking. For the
11
12 168 purposes of this study, the rankings which were summarised as deciles were reduced to
13
14 169 quintiles, with low ranks representing the most disadvantaged.
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17 170 Patient diagnosis was recorded on discharge from the ED. Between 2009 and 2012 each
18
19 171 ED within the regional health service transitioned from ICD-9-CM diagnosis coding to
20
21 172 SNOMED recording of diagnosis. For this study, diagnoses according to ICD-9-CM coding
22
23 173 and SNOMED were therefore mapped to ICD-10-AM⁴³ and then aggregated to Major
24
25 174 Diagnostic Blocks (MDB) using the Independent Hospital Pricing Authority's Urgency
26
27 175 Related Group software v1.4.4.⁴⁴ Frequent ED attenders were primarily analysed according to
28
29 176 their most common MDB to reduce the likelihood of bias from with missing data (such as
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31 177 during system transition and for patients who did not wait), but also described based on
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33 178 whether they ever had a diagnosis in each MDB.
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39 179 **Data analysis**

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41 180 Associations between categorical variables were evaluated using Pearson's Chi Square Test.
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43 181 Multivariate logistic regression models were used to compare characteristics of non-frequent
44
45 182 attenders with frequent attenders and subgroups, and results summarised as odds ratios (OR)
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47 183 and 95% confidence intervals (CI). Demographic, diagnosis (MDB), and visit characteristics
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49 184 were included in regression models. The proportion of missing data was generally low,
50
51 185 ranging from <1% for items such as sex, Aboriginal or Torres Strait Islander status,
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53 186 socioeconomic status and triage category, to 5.3% for preferred language, 10.8% for hospital
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55 187 insurance and 11.4% for marital status. Those without an assigned MDB due to; no recorded
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57 188 diagnosis (7.5%), a diagnosis code not recognised by the grouper (3.9%) or patients who did
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3 189 not wait (3.5%), were excluded from analysis by diagnosis. Planned return visits accounted
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5 190 for 3.1% of all ED visits, and these were excluded from all analyses. Sensitivity analyses
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7 191 were carried out with an alternative threshold for frequent ED attendance of four visits per
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9 192 year, and including planned return visits. Statistical significance was set at 5%. All statistical
10
11
12 193 analysis was conducted using SAS version 9.4.⁴⁵
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16 194 **RESULTS**

17
18 195 A total of 1,199,633 ED visits by 332,100 individuals were recorded across the 10-year study
19
20 196 period (Table 1). Of residents who attended the ED, 2.6% (n=8 577) met the threshold for
21
22 197 frequent attendance (attended seven or more times within a 12-month window).
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24

25 198 Among frequent attenders, most (n=6866, 80.1%) met the attendance threshold only once
26
27 199 (temporary frequent attenders) (Figure 1). A further 12.9% (n= 1104) met the threshold twice
28
29 200 (repeat frequent attenders), while only 7.1% (n=607) met the threshold on three or more
30
31 201 occasions (persistent frequent attenders). Over the 10 years, these 607 persistent frequent
32
33 202 attenders made 38,338 ED visits. A similar pattern of predominantly temporary frequent
34
35 203 attendance was observed in each age group (Figure 1).
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39 204 A sensitivity analysis including planned return visits indicated similar patterns of long
40
41 205 term ED use. For example, 81.4% of frequent attenders were temporary frequent attenders
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43 206 when planned return visits were included. When the threshold of frequent attendance was
44
45 207 reduced to four visits in 12-months, 75.6% of individuals were temporary frequent attenders.
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50 208 **Demographic and visit characteristics**

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52 209 Compared to non- frequent attenders, frequent attenders were more likely to be male, older
53
54 210 (aged 65 or over), Aboriginal or Torres Strait Islander, have no partner, from non-English
55
56 211 speaking backgrounds, un-insured (publically insured only patients), and resident in lower
57
58 212 socio-economic areas (Table 1). Compared to the other groups of frequent attenders,
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3 213 persistent frequent attenders were young to middle aged adults, female, Aboriginal or Torres
4
5 214 Strait Islander, had no partner, were from lower socioeconomic areas, un-insured (publically
6
7 215 insured only patients) and not admitted (Table 1). During the ten-year study period, frequent
8
9 216 attenders had an average of 21.0 ED visits, compared to 3.2 for non- frequent attenders, with
10
11 217 more frequent attenders admitted to hospital.

16 218 **Diagnostic profile**

17
18 219 The most common diagnoses among frequent attenders were digestive, respiratory,
19
20 220 circulatory, single site major injury and psychiatric illness (Supplementary Material Table 1),
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22 221 however diagnostic profile differed by age and length of frequent attendance.

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24
25 222 Among the youngest frequent attenders, aged 0-4 years, respiratory illness was the most
26
27 223 common diagnosis across all groups' frequent attenders (Table 2). Among children aged 5-15
28
29 224 years, injury and digestive system illnesses were the two most common diagnoses in all sub-
30
31 225 groups, with injury being the most common diagnosis among temporary frequent attenders
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33 226 and digestive system illness among the persistent frequent attenders. Children also presented
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35 227 with psychiatric illness, which was the most common diagnosis for 9.3% of temporary
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37 228 frequent attenders, 14.3% of repeat frequent attenders and 12.7% of persistent frequent
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39 229 attenders.

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43 230 While injury and digestive system illness were also common among older teenagers and
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45 231 young adults (16-24 and 25-44 years), there were increasing numbers of patients visiting ED
46
47 232 primarily for psychiatric illness, particularly among repeat frequent attenders aged 25-44
48
49 233 years and persistent frequent attenders (Table 2).

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52 234 Among adults aged 45-64 years, the most common diagnoses were circulatory, digestive
53
54 235 and respiratory illnesses. Among older adults 65 years and above, circulatory followed by
55
56 236 respiratory system illnesses were most common, with the exception of persistent frequent
57
58 237 attenders who had more respiratory illness than circulatory illness. In the older age groups,

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3 238 aged 75 years and above, digestive system and urological system illness were common among
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5 239 all frequent attender groups.

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8 240 Analysis of all diagnoses reported in the study period (rather than most common) shows
9
10 241 that from the age of 25 years, ED visits relating to single site major injuries were common
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12 242 among temporary and repeat frequent attenders, while persistent frequent attenders had higher
13
14 243 proportions of respiratory, musculoskeletal, neurological and psychiatric visits (Table 2).
15
16 244 Among ongoing frequent attenders aged 5-15, 16-24 and 25-44, more than half presented with
17
18 245 a psychiatric diagnosis at least once during the study period.

22 23 246 **Risk factors associated with frequent attendance**

24
25 247 Multivariate logistic regression models were fit to assess the likelihood of being a frequent
26
27 248 attenders, based on socio-demographic and visit characteristics and diagnoses for those aged
28
29 249 16 and over (Table 3) and those aged under 16 (Table 4). Consistent with the findings of the
30
31 250 earlier descriptive analysis, being an adult frequent attender was associated with being: male;
32
33 251 older; Aboriginal or Torres Strait Islander; un-insured (publically insured only patients);
34
35 252 socio-economically disadvantaged; presenting with higher urgency; lower likelihood of
36
37 253 admission; and less likely to have a partner (Table 3). Compared to the reference category
38
39 254 (single site major injury), frequent attendance was associated with all diagnostic groups, with
40
41 255 the highest odds of psychiatric illness (OR=6.7, 95% CI 5.9 to 7.6) and alcohol/drug related
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43 256 disorders (OR=6.7, 95% CI 5.1 to 8.7) (Table 3).

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48 257 Among children aged under 16, frequent attenders were more likely to be older (age 5 to
49
50 258 15) and similarly to adult frequent attenders, were more likely to be Aboriginal or Torres
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52 259 Strait Islander, un-insured (publically insured only patients); socio-economically
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54 260 disadvantaged; and present with higher urgency (OR=2.5, 95% CI 2.2 to 2.8). However, they
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56 261 were not more likely to be male; and were no less likely to be admitted than non- frequent
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58 262 attenders (Table 4).

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3 263 Compared to the reference category (single site major injury), frequently attending
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5 264 children aged under 16 were more likely to present with digestive illness, endocrine,
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8 265 nutritional and metabolic system illness, neurological system illness, and respiratory illness.
9
10 266 As with adults, the highest risk of frequent attendance was presenters with psychiatric illness
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12 267 (OR=7.8, 95% CI 5.9 to 10.2) (Table 4).
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16 268 **Risk factors associated with frequent attendance by duration**

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18 269 Models fitted separately for each frequent attendance sub-group (temporary frequent
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20
21 270 attenders, repeat frequent attenders and persistent frequent attenders compared to non-
22
23 271 frequent attenders) led to different demographic risk factors. While temporary and repeat
24
25 272 adult frequent attenders were more likely to be male, after adjusting for other characteristics,
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27
28 273 sex was not a risk factor for persistent frequent attenders (OR=1.0, 95% CI 0.9 to 1.2) (Table
29
30 274 3). Persistent adult frequent attenders were also more likely to be in the middle age groups,
31
32 275 aged 25-64 years, whereas those aged 65 and over were more at risk for temporary and repeat
33
34 276 frequent attendance. Among those aged under 16, ongoing frequent attenders (repeat and
35
36
37 277 persistent) were more likely to be female and aged 5 to 15, neither of which were risk factors
38
39 278 for temporary frequent attendance (Table 4).
40

41 279 Demographic and clinical risk factors for adult frequent attendance were in many cases
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43
44 280 magnified among repeat and persistent frequent attenders (Table 3). For example, Aboriginal
45
46 281 or Torres Strait Islander background was a larger risk factor for those with long periods of
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48 282 frequent attendance (temporary frequent attenders OR=1.9, 95% CI 1.6 to 2.2 and persistent
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50 283 frequent attenders OR=3.1, 95% CI 2.2 to 4.2) and having a partner was less likely among
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52
53 284 longer duration frequent attenders (temporary frequent attenders OR=0.7, 95% CI 0.7 to 0.8
54
55 285 and persistent frequent attenders OR=0.4, 95% CI 0.3 to 0.5).
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57 286 Alcohol and drug-related disorders were much more prominent among longer-duration
58
59 287 frequent attenders (temporary frequent attenders OR=5.2, 95% CI 3.8 to 7.1 compared to
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3 288 persistent frequent attenders OR=26.5, 95% CI 12.3 to 57.2), as were neurological illness
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5 289 (temporary frequent attenders OR=1.7, 95% CI 1.5 to 2.0 compared to persistent frequent
6
7 290 attenders OR=10.1, 95% CI 5.6 to 18.1), and psychiatric illness (temporary frequent attenders
8
9 291 OR=5.0, 95% CI 4.3 to 5.8 compared to persistent frequent attenders OR=25.5, 95% CI 14.6
10
11 292 to 44.5) (Table 3).

16 293 **Risk factors for temporary versus ongoing frequent attendance**

18 294 Risk factors for ongoing frequent attenders (repeat and persistent) were modelled in
19
20 295 comparison to temporary frequent attenders, rather than non-frequent attenders. This
21
22 296 confirmed the earlier findings that ongoing frequent attenders are younger (aged 25-64) and
23
24 297 more likely to be Aboriginal or Torres Strait Islander, but less likely to have a partner, be
25
26 298 admitted, or be from high socio-economic areas (Figure 2, left image). Substance-related
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28 299 visits, psychiatric illness, endocrine/nutritional/metabolic illness and neurological illness
29
30 300 were again more likely for ongoing frequent attenders. Among children aged under 16,
31
32 301 ongoing frequent attenders were more likely than temporary frequent attenders to be female,
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34 302 aged 5-15, and present with neurological illness (Figure 2, right image). Highly frequent
35
36 303 users (18 or more visits in any 12-month period) were more likely to be ongoing frequent
37
38 304 attenders. Among those who only met the lower frequent attendance threshold (7-17 visits in
39
40 305 a 12-month period), 5.1% were persistent frequent attenders. In contrast, of patients who met
41
42 306 the highly frequent threshold at least once (18 or more visits in any 12-month period), 45.5%
43
44 307 were persistent frequent attenders.

52 308 **DISCUSSION**

54 309 This investigation of 10 years of longitudinal ED data has provided a novel perspective on
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56 310 the risk factors by duration of frequent attenders, for both adults and children. Investigation
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58 311 of visits to all EDs in the region found the majority of frequent ED attenders are temporary
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3 312 and only approximately 20% remain as frequent attenders in any of up to nine subsequent
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5 313 years. Persistent frequent attenders only accounted for 7.1% of frequent attenders.
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8 314 The estimate that 80.1% of frequent attenders are temporary is slightly higher than
9
10 315 other shorter-term studies carried out in the US,^{1, 33,43,46} Sweden³ and New Zealand,⁴⁷ where
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12 316 estimates varied between 58 and 72%. Definitions of temporary frequent attenders differ
13
14 317 slightly across studies, including: the threshold number of visits for frequent attenders;
15
16 318 whether the period of frequent attendance is patient-based (using an index visit) or calendar
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18 319 based; whether another period of frequent attendance immediately follows the first frequent
19
20 320 attendance period or is during the study period. We considered any periods of frequent
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22 321 attendance across the entire study period, to be inclusive of patients who re-established
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24 322 frequent attendance patterns.⁴⁸
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28 323 Systematic reviews show that internationally, intervention studies have been targeting
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30 324 the entire frequent attender cohort.^{13,14} However, differences in profile and risk factors for
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32 325 ongoing frequent attenders compared to temporary frequent attenders, and for adults and
33
34 326 children, demonstrate a need to consider different types of interventions. In particular, the
35
36 327 cohort of persistent frequent attenders may receive more benefit from case management, and
37
38 328 increased continuity of primary care provider⁴⁹ than temporary frequent attenders. Young
39
40 329 adults with ongoing frequent attendance related to substance disorders and psychiatric illness
41
42 330 may benefit from additional services outside the ED, while among children, older females
43
44 331 with neurological conditions (predominantly seizure-related and headaches) could benefit
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46 332 from pathways which reduce the likelihood of admission and result in reduced length of
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48 333 hospital stay.⁵⁰
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54 334 Our research has shown a complex relationship between ED attendance and hospital
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56 335 admission. Multivariate analysis showed frequent ED attendance was inversely associated
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58 336 with hospital admission, and duration of frequent ED attendance was not associated with
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3 337 hospital admission among adults, suggesting some frequent attenders may be treated and/or
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5 338 managed in a different setting. Highly frequent users do not use other health care services
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7
8 339 proportionally more than (low volume) frequent users,³⁹ suggesting highly frequent attenders
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10 340 may use ED's as a main source of care. It is therefore possible that the persistent frequent
11
12 341 attender cohort, of which almost half were highly frequent attenders, also use the ED as a
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14
15 342 main source of care.

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17 343 The heterogeneity of frequent attenders has contributed to ineffective policy
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19 344 development, with interventions needing to target specific sub-groups.⁵ Similar to evidence in
20
21 345 the literature, we identified three vulnerable patient groups at high risk of frequent
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23 346 attendance; those in situations of socioeconomic distress (e.g. low income, homelessness,
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25 347 social isolation);^{8,9,11,21,51} those living with mental health and substance use problems;^{8,21,39,47}
26
27 348 and the elderly.^{5,52} The first two of these groups are more likely to be ongoing frequent
28
29 349 attenders, while the latter, elderly group tend to be temporary frequent attenders. Due to the
30
31 350 ongoing nature of frequent ED attendance by those with socioeconomic and mental health
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33 351 issues, or both, it is imperative to find cost-effective alternatives. Temporary older frequent
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35 352 attenders are driving increases in ED utilisation and changing the clinical profile of
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37 353 EDs.^{53,54,55,56} This group are multimorbid, with complex, ongoing health care needs, and
38
39 354 required improved identification and management of those at risk of return.^{52,54,57,58} To date,
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41 355 hospital-based interventions for these elderly patients have had little effect on ED use,
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43 356 potentially due to their typically short-term nature. However, a systematic review found that
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45 357 interventions in outpatient and primary care/home settings (including geriatric assessment
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47 358 and management and case management) have reduced ED use among this patient cohort.⁵⁹

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49 359 Our research has shown a complex relationship between ED attendance and hospital
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51 360 admission and found longitudinal ED data investigating ongoing frequent use identifies
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54 361 additional and inflated risk factors. In accordance with the recommendations of Pines et al,³³

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3 362 the authors future research agenda includes using data in model development and testing for
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5 363 predicting patients who are at risk of becoming and/or remaining frequent attenders. This will
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7 364 improve generalisability of existing predictive models, which are mostly from the U.S.,^{46,60,61}
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9 365 often have small samples,^{11,60} focus on a specific patient sub-group (e.g. Medicaid users,⁴⁶ or
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11 366 using inconsistent thresholds for frequent attendance (3, 4 or 10 visits in a year).^{11,60,61}
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16 367 **Limitations**

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18 368 The inclusion of any patients whose with frequent attendance for any 12 month period during
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20 369 the 10 year study period enabled patients to be grouped according to long-term patterns of
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22 370 frequent attendance, however some temporary and repeat frequent attenders may have been
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24 371 classified differently had all participants had equal follow up time.
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28 372 Data quality, data consistency and the amount of missing information (in particular
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30 373 diagnosis) improved over time, which may impact descriptive and modelling results. The
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32 374 effect of missing diagnoses was minimised by modelling a patient's most common diagnostic
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34 375 block over all visits. While hospital insurance and preferred language were imputed using
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36 376 recent data, having a partner was considered more likely to change over the study period so
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38 377 missing cases were excluded from models.
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41 378 Social variables that may increase the risk of frequent attendance, such as use of
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43 379 primary care services, homelessness or isolation, are not routinely collected. Other factors
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45 380 that may be predictive of frequent attendance, such as patient satisfaction with treatment, and
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47 381 having a regular source of care⁶² were not collected.
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50 382 We could not link to data on deaths outside of the public hospital system and
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52 383 therefore could not explore reasons for patients discontinuing frequent attendance, however
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54 384 this is an area of potential future research. Finally, while we included data from metropolitan
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56 385 and rural EDs in one region in Australia, this may not be generalisable to other settings.
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3 386 **Conclusions**
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5 387 This study has provided a unique, longitudinal perspective on ED frequent attenders,
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7 388 contrasting the demographic and diagnostic profile of temporary, repeat and persistent
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9 389 frequent attenders. The distinction between temporary and ongoing frequently attending
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11 390 cohorts should be used when describing frequent attenders, and to inform appropriate
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13 391 interventions and better direct health resources.
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18 392 **Author contributions**
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20 393 LL carried out analysis, interpretation, and drafted the manuscript, VWW and KL assisted
21
22 394 with interpretation of the data and assisted with drafting and reviewing the manuscript, RZ,
23
24 395 JM, TC, and WT contributed to interpretation of the data and reviewed the manuscript, KE
25
26 396 was responsible for the study conception and contributed to interpretation of the data and
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28 397 reviewed the manuscript.
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Table 1. Characteristics of ED patients, 12-month windows, and visits* by length of frequent attendance

Patients	Frequent Attenders				Non-frequent ED attenders (N=323,523)	ED attenders (N=332,100)
	Temporary (N=6,866)	Repeat (N=1,104)	Persistent (N=607)	All (N=8,577)		
Age group (%) ††						
0-4	10.4	5.7	2.3	9.2	13.4	13.3
5-15	9.0	8.9	9.1	9.0	12.6	12.5
16-24	11.5	12.5	12.4	11.7	12.6	12.6
25-44	20.2	24.3	34.9	21.8	22.6	22.6
45-64	18.8	21.9	23.7	19.6	20.2	20.2
65-74	12.4	12.6	8.7	12.2	8.6	8.7
75+	17.8	14.1	8.9	16.7	10.1	10.2
Sex (%) †††						
Male	53.8	51.5	46.8	53.0	51.3	51.3
Female	46.2	48.6	53.2	47.0	48.8	48.7
Indigenous (%) ††††						
Aboriginal or Torres Strait Islander origin	7.4	10.6	12.5	8.2	3.3	3.4
Neither Aboriginal nor Torres Strait Islander origin	92.6	89.4	87.5	91.8	96.8	96.6
Partner ††††† (persons aged 16 and over)						
Yes	45.1	39.0	30.2	43.2	53.8	53.5
No	54.9	61.0	69.8	56.8	46.2	46.5
Private hospital insurance (%) †††††						
Yes	17.3	16.1	11.7	16.8	32.0	31.6
No	82.7	83.9	88.3	83.3	68.0	68.4
Preferred language (%) †††††						
English	78.9	82.2	82.1	79.6	87.7	87.5
Other	21.1	17.8	17.9	20.4	12.3	12.5
Socio-economic status †††††						
Quintile 1 (low)	30.0	32.8	34.4	30.7	22.2	22.4
Quintile 2	26.6	24.6	25.0	26.3	22.8	22.9
Quintile 3	32.8	35.6	34.6	33.3	40.4	40.2
Quintile 4	5.7	4.1	4.1	5.4	7.6	7.5
Quintile 5 (high)	4.8	2.9	1.8	4.4	7.0	7.0
Visits	(N=108,858)	(N=32,643)	(N=38,338)	(N=179,839)	(N=1,019,794)	(N=1,199,633)
Visits in study period (mean)	15.9	29.6	63.2	21.0	3.2	3.6
Visits per 12-month window (with 1+ visit) (mean)	4.2	5.8	9.5	5.1	1.7	1.8
Admitted (%) †††††						
Yes	37.0	38.0	33.5	36.4	30.8	31.6
No	63.0	62.0	66.5	63.6	69.2	68.4
Triage category †††††						
1 (highest urgency)	0.5	0.5	0.5	0.5	0.5	0.5
2	7.7	8.3	7.7	7.8	6.7	6.9
3	30.0	30.3	28.8	29.9	28.0	28.3
4	45.1	45.7	46.6	45.8	50.7	49.9
5 (lowest urgency)	16.7	15.3	16.4	16.7	14.2	14.5

* Excludes planned return visits

† As reported at earliest ED visit in study period

‡ χ^2 test for patient type (temporary frequent attendee, repeat frequent attendee, ongoing frequent attendee by: age $\chi^2_{12} = 164.5$ ($p < .0001$), sex $\chi^2_2 = 12.2$ ($p = 0.002$), Indigenous $\chi^2_2 = 29.1$ ($p < .0001$), Partner $\chi^2_2 = 43.8$ ($p < .0001$), Hospital insurance $\chi^2_2 = 10.8$ ($p = 0.045$) Preferred language $\chi^2_2 = 8.6$ ($p = 0.014$), Socio-economic status $\chi^2_8 = 34.6$ ($p < .0001$), Admitted $\chi^2_2 = 196.7$ ($p < .0001$), Triage category $\chi^2_8 = 76.0$ ($p < .0001$). Excludes unknown, missing, and not-stated.

§ As reported at most recent ED visit in study period. This is the recommended approach for Indigenous status (Randall et al 2013) and was required for hospital insurance due to incomplete early data at two facilities.

** Percentage missing, unknown, not stated - Partner 11.5%, Indigenous status (at last ED visit) 0.9%, Socio-economic status 0.0%, Hospital insurance (at last ED visit) 10.8%, Preferred language 5.3%, Admitted 0.0%, Triage category 0.2%

Table 2. Diagnostic profile of ED frequent attender patients* by duration of frequent attendance and age group

% of patients	Temporary frequent attender (frequent attender in one 12-month period)								Repeat frequent attender (frequent attender in two 12-month periods)								Persistent frequent attender (frequent attender in three or more 12-month periods)							
	Age group†								Age group								Age group							
	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All
N persons	711	615	791	1387	1291	850	1221	6866	63	98	138	268	242	139	156	1104	14	55	75	212	144	53	54	607
<i>Most common Major Diagnostic Block</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.0	1.6	0.0	0.0	0.8	0.0	0.0	‡	2.6	2.9	0.0	0.0	1.4	0.0	0.0	‡	2.8	4.2	‡	0.0	2.3
Circulatory system illness	*	1.3	3.5	5.5	17.5	24.4	23.7	12.2	0.0	5.1	‡	4.5	15.3	25.2	32.7	13.0	0.0	‡	‡	7.6	18.1	28.3	14.8	11.5
Digestive system illness	12.2	18.5	21.4	15.9	14.4	12.0	13.6	15.2	14.3	22.5	26.8	15.7	19.4	13.8	9.6	17.6	‡	36.4	26.7	18.4	16.7	15.1	14.8	19.9
Endocrine, nutritional and metabolic system illness	‡	0.8	0.9	1.1	0.7	1.1	1.2	0.9	‡	‡	‡	‡	2.1	‡	‡	1.4	0.0	‡	‡	‡	‡	0.0	0.0	1.3
Illness of skin, subcutaneous tissue, breast	2.0	4.7	5.6	7.1	5.4	3.3	2.9	4.7	‡	‡	5.1	5.6	2.9	‡	‡	3.4	0.0	‡	‡	4.3	‡	0.0	‡	2.6
Injury, single site, major Musculoskeletal/connective tissue system illness	14.5	31.7	20.0	13.4	6.3	3.9	6.2	12.1	‡	21.4	7.3	12.7	2.1	‡	5.8	7.7	‡	21.8	‡	7.6	3.5	0.0	‡	6.9
Neurological system illness	0.7	2.9	3.0	6.0	5.3	5.4	4.2	4.3	0.0	‡	5.1	9.3	6.6	5.0	‡	5.3	0.0	‡	8.0	9.4	5.6	0.0	‡	6.1
Psychiatric illness	4.6	3.6	3.5	5.6	5.3	5.9	7.0	5.3	9.5	7.1	5.1	6.3	8.7	5.8	3.9	6.5	‡	9.1	8.0	11.3	13.2	‡	11.1	10.4
Respiratory system illness	0.0	9.3	11.3	13.1	5.9	1.4	1.0	6.2	‡	14.3	21.0	25.0	10.7	‡	‡	12.9	0.0	12.7	29.3	26.4	10.4	‡	0.0	16.6
Urological system illness	44.0	6.0	4.6	4.0	14.3	18.4	17.1	14.4	47.6	‡	5.1	4.9	14.5	21.6	19.9	13.6	0.0	0.0	‡	2.4	16.7	34.0	22.2	11.2
Other MDBs	1.1	1.3	2.5	2.5	4.7	10.6	13.3	5.6	0.0	6.1	‡	‡	3.3	10.1	16.7	5.3	0.0	0.0	‡	‡	‡	9.4	14.8	3.2
20.0	19.8	22.8	23.9	18.7	13.8	10.0	18.3	19.1	15.3	18.1	11.2	11.6	7.9	7.7	12.1	‡	10.9	‡	8.0	6.9	7.6	11.1	7.9	
<i>Major Diagnostic Block during study period</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	8.5	10.5	11.8	7.3	1.5	0.7	6.0	0.0	10.2	17.4	26.1	16.5	0.0	‡	13.2	0.0	16.4	24.0	31.6	18.8	‡	‡	20.4
Circulatory system illness	4.1	22.4	29.6	35.3	58.9	69.5	71.5	45.4	7.9	40.8	31.9	49.6	65.7	89.9	81.4	57.3	‡	58.2	53.3	65.6	82.6	90.6	85.2	70.2
Digestive system illness	63.4	65.5	58.7	54.2	57.0	61.5	59.9	59.1	85.7	79.6	79.7	70.9	71.9	79.9	74.4	75.5	‡	96.4	85.3	85.9	85.4	88.7	74.1	86.0
Endocrine, nutritional and metabolic system illness	6.5	6.0	3.5	7.9	16.9	20.4	19.0	12.3	12.7	10.2	10.9	13.1	24.4	23.7	30.1	18.8	1.1	12.7	17.3	20.3	24.7	45.3	29.6	25.4
Illness of skin, subcutaneous tissue, breast	38.1	36.3	36.8	36.0	33.4	29.5	26.6	33.4	46.0	46.9	44.2	46.6	37.2	44.6	33.3	42.1	0.9	56.4	56.0	49.5	46.5	30.2	44.4	47.9
Injury, single site, major Musculoskeletal/connective tissue system illness	62.6	82.3	66.4	57.7	48.8	42.2	50.8	56.6	69.8	87.8	74.6	71.3	61.2	46.8	55.8	65.6	1.4	90.9	81.3	38.4	22.7	6.3	7.3	76.9
15.3	48.1	42.4	44.7	44.6	43.8	41.4	41.0	27.0	66.3	56.5	59.0	57.9	59.0	55.1	56.7	‡	7.7	89.1	73.3	71.7	79.2	69.8	66.7	73.8

* Excludes planned return visits

† Age group defined at first visit in first period of frequent attendance

‡ Cell suppressed, n ≤ 5

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Neurological system illness	18.1	27.8	30.7	32.3	36.6	44.2	52.5	36.3	23.8	37.8	52.9	55.6	56.2	64.0	64.1	54.3	58.2	70.7	74.1	75.0	83.0	68.5	71.7
Psychiatric illness	1.4	31.1	36.0	36.3	23.0	15.4	14.2	23.2	‡	54.1	58.7	62.7	36.0	18.7	21.2	40.9	67.3	68.0	71.2	52.1	28.3	16.7	55.7
Respiratory system illness	83.5	39.5	34.6	32.6	50.0	58.6	61.6	50.4	92.1	53.1	46.4	48.5	66.5	71.9	76.3	62.0	78.2	65.3	64.2	77.1	83.0	85.2	73.0
Urological system illness	11.1	17.7	21.0	17.9	27.3	40.4	47.4	27.3	14.3	32.7	27.5	24.3	42.6	65.5	60.3	39.1	49.1	45.3	31.6	42.4	58.5	72.2	43.2

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Table 3. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged 16 or over

Variable	Non-frequent vs all frequent attenders ⁹		Non-frequent vs temporary frequent attenders ¹⁰		Non-frequent vs repeat frequent attenders ¹¹		Non-frequent vs persistent frequent attenders ¹²	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex								
Male	1.2	(1.2,1.3)	1.3	(1.2,1.3)	1.3	(1.1,1.5)	1.0	(0.9,1.2)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
16-24 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
25-44	1.1	(1.0,1.2)	1.0	(0.9,1.1)	1.2	(1.0,1.5)	1.9	(1.4,2.6)
45-64	1.1	(1.0,1.2)	1.0	(0.9,1.2)	1.4	(1.1,1.8)	1.7	(1.2,2.4)
65-74	1.5	(1.3,1.6)	1.4	(1.3,1.6)	1.6	(1.2,2.1)	1.3	(0.9,2.0)
75+	1.6	(1.4,1.7)	1.6	(1.4,1.8)	1.4	(1.1,1.9)	0.9	(0.6,1.3)
Partner								
Yes	0.7	(0.6,0.7)	0.7	(0.7,0.8)	0.6	(0.5,0.7)	0.4	(0.3,0.5)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Uninsured (no private hospital insurance) ¹³								
Yes	2.0	(1.9,2.2)	1.9	(1.8,2.1)	2.5	(2.0,3.1)	2.3	(1.7,3.0)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	2.1	(1.9,2.4)	1.9	(1.6,2.2)	2.5	(1.8,3.3)	3.1	(2.2,4.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	3.3	(3.1,3.6)	3.2	(3.0,3.5)	3.7	(3.1,4.6)	3.3	(2.5,4.2)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Preferred language non-English**								
Yes	1.2	(1.1,1.4)	1.2	(1.1,1.4)	1.2	(0.9,1.6)	0.8	(0.5,1.4)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.7	(0.7,0.8)	0.7	(0.7,0.8)	0.6	(0.5,0.8)	0.6	(0.5,0.9)
Socio-economic status								
Quintile 1 (low)	1.5	(1.4,1.6)	1.5	(1.4,1.6)	1.4	(1.2,1.7)	1.4	(1.1,1.7)
Quintile 2	1.1	(1.0,1.2)	1.2	(1.1,1.3)	1.0	(0.8,1.2)	0.8	(0.6,1.1)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	0.8	(0.7,0.9)	0.8	(0.7,1.0)	0.6	(0.4,0.9)	0.6	(0.4,1.0)
Quintile 5 (high)	0.7	(0.6,0.8)	0.8	(0.6,0.9)	0.5	(0.3,0.8)	0.4	(0.2,0.8)
Major Diagnostic Block ¹⁴								
Alcohol/drug abuse and alcohol/drug induced mental disorders	6.7	(5.1,8.7)	5.2	(3.8,7.1)	11.1	(5.9,20.8)	26.5	(12.3,57.2)
Circulatory system illness	2.0	(1.8,2.3)	1.8	(1.6,2.1)	3.0	(2.1, 4.3)	5.6	(3.1, 9.9)
Digestive system illness	2.8	(2.5,3.2)	2.5	(2.2,2.8)	4.3	(3.0, 6.1)	8.5	(4.9, 14.7)
Endocrine, nutritional and metabolic system illness	2.5	(1.9,3.3)	2.0	(1.5,2.8)	4.9	(2.6, 9.3)	8.6	(3.3,22.4)
Illness of skin, subcutaneous tissue, breast	3.2	(2.7,3.7)	3.1	(2.6,3.6)	3.7	(2.3, 5.9)	3.9	(1.8, 8.5)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	1.8	(1.5,2.0)	1.5	(1.3,1.8)	2.8	(1.9, 4.3)	5.8	(3.1, 10.7)
Neurological system illness	2.1	(1.8,2.4)	1.7	(1.5,2.0)	3.2	(2.1, 4.8)	10.1	(5.6,18.1)
Psychiatric illness	6.7	(5.9,7.6)	5.0	(4.3,5.8)	13.8	(9.7,19.8)	25.5	(14.6,44.5)
Respiratory system illness	3.3	(2.9,3.7)	2.8	(2.5,3.2)	5.1	(3.5, 7.3)	9.4	(5.3,16.8)
Urological system illness	3.1	(2.7,3.6)	2.9	(2.5,3.4)	4.0	(2.6, 6.2)	5.1	(2.5,10.4)
Other	1.3	(1.1,1.5)	1.3	(1.1,1.4)	1.5	(1.0, 2.2)	1.3	(0.7, 2.4)

CI, Confidence Interval
OR, Odds Ratio

⁹ n=211,447, $\chi^2_{26} = 4829.6$ (p<.0001), R² = 8.5% (McFadden)

¹⁰ n=210,198, $\chi^2_{26} = 3395.2$ (p<.0001), R² = 7.1% (McFadden)

¹¹ n=206,440, $\chi^2_{26} = 1010.8$ (p<.0001), R² = 9.5% (McFadden)

¹² n=206,097, $\chi^2_{26} = 836.5$ (p<.0001), R² = 9.5% (McFadden)

¹³ Missing values imputed with patient's most recent non-missing value.

¹⁴ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Table 4. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged under 16

Variable	Non-frequent vs all frequent attenders ¹⁵		Non-frequent vs temporary frequent attenders ¹⁶		Non-frequent vs repeat frequent attenders ¹⁷		Non-frequent vs persistent frequent attenders ¹⁸	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Sex								
Male	0.9	(0.8,1.0)	1.0	(0.9,1.1)	0.6	(0.4,0.8)	0.4	(0.2,0.7)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
0-4 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
5-15	1.3	(1.2,1.5)	1.2	(1.1,1.3)	2.0	(1.4,2.9)	4.7	(2.5,8.7)
Uninsured (no private hospital insurance) ¹⁹								
Yes	1.9	(1.7,2.2)	1.9	(1.6,2.2)	1.9	(1.2,2.9)	3.6	(1.5,8.4)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	1.5	(1.2,1.8)	1.4	(1.2,1.7)	1.9	(1.3,3.0)	1.5	(0.7,3.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.5	(2.2,2.8)	2.4	(2.1,2.7)	3.0	(2.0,4.5)	3.9	(2.1,7.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.9	(0.8,1.1)	0.9	(0.7,1.1)	1.2	(0.7,2.0)	1.2	(0.5,2.6)
Socio-economic status								
Quintile 1 (low)	1.7	(1.5,2.0)	1.7	(1.4,1.9)	1.8	(1.2,2.7)	3.4	(1.7,6.7)
Quintile 2	1.7	(1.5,1.9)	1.7	(1.4,1.9)	1.6	(1.1,2.5)	3.5	(1.8,6.9)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	1.1	(0.9,1.4)	1.2	(0.9,1.5)	0.4	(0.1,1.2)	1.6	(0.5,5.6)
Quintile 5 (high)	0.9	(0.7,1.2)	0.9	(0.7,1.3)	0.4	(0.1,1.3)	1.1	(0.2,4.8)
Major Diagnostic Block ²⁰								
Circulatory system illness	1.3	(0.8,2.1)	1.0	(0.5,1.8)	3.6	(1.4, 9.5)	1.2	(0.2, 9.3)
Digestive system illness	1.6	(1.3,1.9)	1.4	(1.2,1.7)	2.1	(1.3, 3.6)	3.2	(1.6, 6.4)
Endocrine, nutritional and metabolic system illness	2.1	(1.2,3.8)	1.6	(0.8,3.2)	5.0	(1.5, 16.8)	6.3	(1.4,29.2)
Illness of skin, subcutaneous tissue, breast	0.9	(0.6,1.2)	0.9	(0.7,1.3)	0.7	(0.2, 2.2)	0.5	(0.1, 3.7)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	0.6	(0.4,0.9)	0.7	(0.4,1.0)	0.3	(0.0, 2.0)	0.5	(0.1, 4.0)
Neurological system illness	2.4	(1.9,3.2)	2.1	(1.5,2.8)	4.5	(2.3, 8.8)	4.9	(1.9,12.4)
Psychiatric illness	7.8	(5.9,10.2)	6.9	(5.1,9.4)	13.4	(7.0,25.8)	9.8	(3.8,25.2)
Respiratory system illness	2.1	(1.8,2.4)	2.1	(1.8,2.4)	2.3	(1.4, 3.9)	1.2	(0.5, 3.2)
Other	0.8	(0.7,0.9)	0.8	(0.6,0.9)	0.9	(0.5, 1.5)	0.5	(0.2, 1.3)

CI, Confidence Interval
OR, Odds Ratio

¹⁵ n=82,344, $\chi^2_{19} = 1076.2$ (p<.0001), R² = 6.5% (McFadden)

¹⁶ n=82,115, $\chi^2_{19} = 801.9$ (p<.0001), R² = 5.3% (McFadden)

¹⁷ n=80,958, $\chi^2_{19} = 232.4$ (p<.0001), R² = 7.9% (McFadden)

¹⁸ n=80,867, $\chi^2_{19} = 129.8$ (p<.0001), R² = 10.9% (McFadden)

¹⁹ Missing values imputed with patient's most recent non-missing value.

²⁰ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

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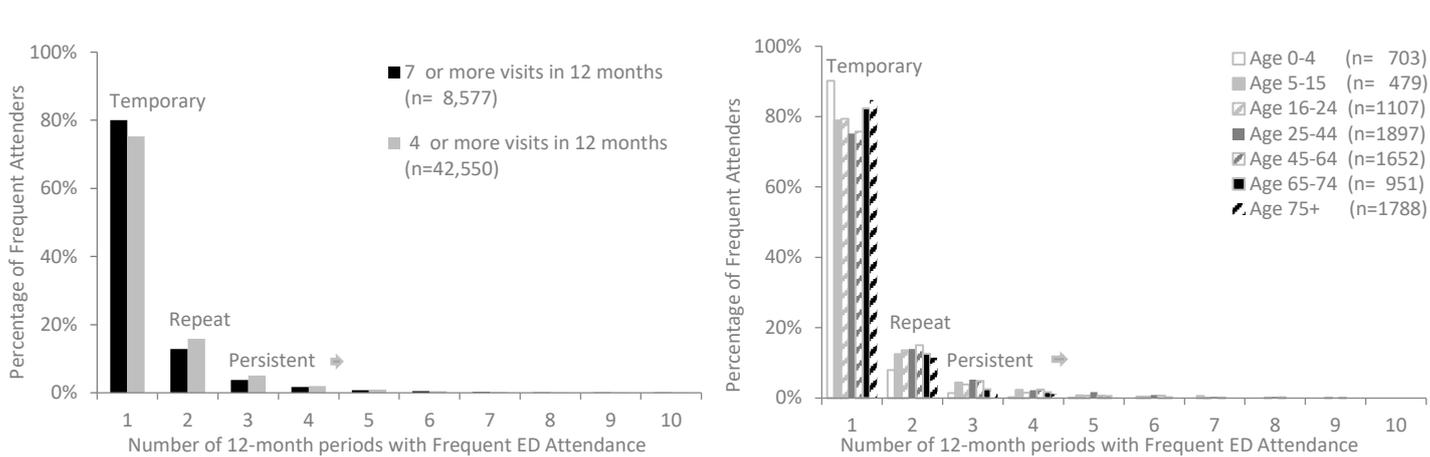
9 **Figure 1.**
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12 Number of 12-month periods where the frequent attendance threshold was met by frequently
13 attending residents. *Left:* All residents with 7 or more visits in 12 months and all residents
14 with 4 or more visits in 12 months. *Right:* all residents with 7 or more visits in 12 months by
15 age group. Excludes planned return visits.
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26 **Figure 2.**
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28
29 Logistic regression model identifying characteristics associated with ongoing vs temporary
30 frequent attendance. *Left:* Persons aged 16 and over (n=5,803). *Right:* Persons aged under 16
31 (n=1,546).
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36 Note: Reference categories for persons aged 16 and over - Age: 16-24, SEIFA: Quintile 3,
37 Major Diagnostic Block: Single Site Major Injury. Reference categories for persons aged
38 under 16 - Age: 0-4, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury.
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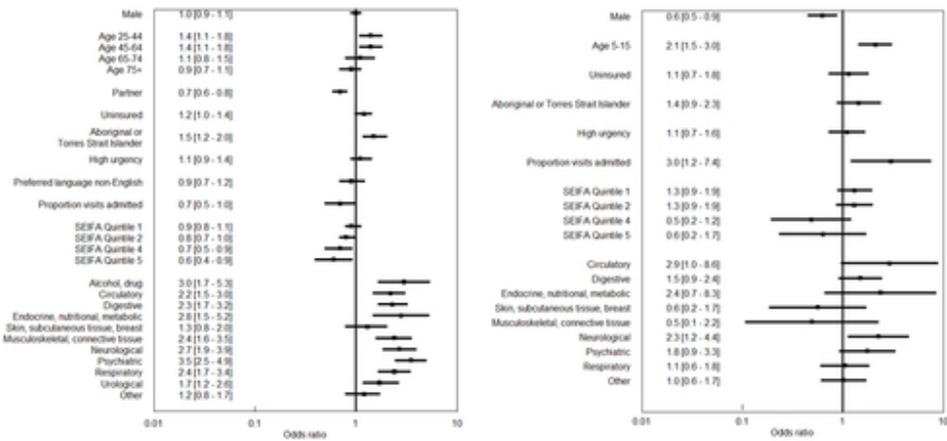


Figure 2. Logistic regression model identifying characteristics associated with ongoing vs temporary frequent attendance. Left: Persons aged 16 and over (n=5,803). Right: Persons aged under 16 (n=1,546). Reference categories for adults: Age: 16-24, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury and for children: age: 0-4, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury

43x20mm (300 x 300 DPI)

Supplementary Material for Here one year, gone the next? Investigating duration and predictors of ongoing frequent emergency department attendance, a retrospective study in Australia.

Table 1. Diagnostic profile of all ED frequent attenders¹ by age group

	Age group ²							All
	0-4	5-15	16-24	25-44	45-64	65-74	75+	
<i>% of frequent attenders</i>	N persons							
	788	768	1004	1867	1677	1042	1431	8577
<i>Most common Major Diagnostic Block</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.2	2.0	0.1	0.0	1.0
Circulatory system illness	0.4	1.8	3.6	5.6	17.2	24.7	24.3	12.3
Digestive system illness	12.4	20.3	22.5	16.2	15.3	12.7	13.2	15.9
Endocrine, nutritional and metabolic system illness	0.6	1.0	1.2	1.1	0.9	1.1	1.0	1.0
Illness of skin, subcutaneous tissue, breast	1.9	4.2	5.2	6.6	4.8	3.0	2.7	4.3
Injury, single site, major	13.6	29.7	17.1	12.6	5.4	3.6	6.2	11.2
Musculoskeletal/connective tissue system illness	0.6	2.6	3.7	6.9	5.5	5.1	3.8	4.6
Neurological system illness	5.2	4.4	4.1	6.4	6.5	5.7	6.8	5.8
Psychiatric illness	0.1	10.2	13.9	16.3	7.0	1.5	1.0	7.8
Respiratory system illness	44.4	5.3	4.5	3.9	14.5	19.6	17.6	14.1
Urological system illness	1.0	1.8	2.4	2.1	4.2	10.5	13.7	5.4
Other MDBs	19.7	18.6	20.8	20.3	16.6	12.7	9.8	16.7
<i>Major Diagnostic Block during study period</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	9.2	12.5	16.1	9.6	1.4	0.8	8.0
Circulatory system illness	4.6	27.3	31.7	40.8	61.9	73.3	73.1	48.7
Digestive system illness	65.7	69.5	63.6	60.2	61.6	65.4	62.0	63.1
Endocrine, nutritional and metabolic system illness	7.0	7.0	5.6	10.0	19.5	22.1	20.6	14.0
Illness of skin, subcutaneous tissue, breast	38.8	39.1	39.2	39.1	35.1	32.6	28.0	35.5
Injury, single site, major	63.3	83.6	68.6	62.6	52.7	43.5	51.8	59.2
Musculoskeletal/connective tissue system illness	16.6	53.4	46.6	49.8	49.5	47.1	43.9	45.3
Neurological system illness	18.8	31.3	36.8	40.4	42.7	48.9	55.2	41.1
Psychiatric illness	1.7	36.6	41.5	44.1	27.4	16.5	15.0	27.8
Respiratory system illness	84.5	44.0	38.6	38.5	54.7	61.6	64.1	53.7
Urological system illness	11.6	21.9	23.7	20.4	30.8	44.6	49.8	30.0

¹ Excludes planned return visits

² Age group at first visit in first period of frequent attendance.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n.a.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9-10
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	9-10
		(d) If applicable, explain how loss to follow-up was addressed	n.a.
		(e) Describe any sensitivity analyses	10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	n.a.
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-12
		(b) Indicate number of participants with missing data for each variable of interest	9-10
		(c) Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(b) Report category boundaries when continuous variables were categorized	8-9, In tables
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14-17
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Here one year, gone the next? Investigating persistence of frequent emergency department attendance, a retrospective study in Australia.

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Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology, Health services research, Health policy
Keywords:	emergency department, repeat use, longitudinal study, persistent, social determinants of health

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Manuscripts

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3 1 **Here one year, gone the next? Investigating persistence of frequent emergency**
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5 2 **department attendance, a retrospective study in Australia.**
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8
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39

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41 16 determinants of health;
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2
3 **18 Abstract**
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7 **19 Objectives:** Patients are presenting to Emergency Departments (EDs) with increasing
8
9 **20** complexity at rates beyond population growth and ageing. Intervention studies target patients
10
11 **21** with 12 months or less of frequent attendance. However, these interventions are not well
12
13 **22** targeted since most patients do not remain frequent attenders. This paper quantifies
14
15 **23** temporary and ongoing frequent attendance and contrasts risk factors for each group.
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20 **24 Design:** Retrospective population-based study using 10 years of longitudinal data.
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24 **25 Setting:** An Australian geographic region that includes metropolitan and rural EDs.
25
26

27 **26 Participants:** 332,100 residents visited any ED during the study period, of which 8,577 were
28
29 **27** frequent attenders (seven or more visits within 12 months).
30
31

32 **28 Main outcome measure:** Risk factors for temporary (one year) and ongoing frequent
33
34 **29** attenders were identified using logistic regression models for adults and children. Ongoing
35
36 **30** frequent attenders were further split into repeat (two years) and persistent (three or more
37
38 **31** years).
39
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43

44 **32 Results:** Of 8,577 frequent attenders, 80.1% were temporary and 19.9% ongoing (12.9%
45
46 **33** repeat, 7.1% persistent). Among adults, ongoing were more likely than temporary frequent
47
48 **34** attenders to be young to middle aged (age 25-64), , and less likely to be from a high socio
49
50 **35** economic area or be admitted. Ongoing frequent attenders had higher-rates of non-injury
51
52 **36** presentations, in particular substance-related (OR=2.5, 99% CI 1.1 to5.6) and psychiatric
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54 **37** illness (OR=2.9, 99% CI 1.8 to4.6). In comparison, children who were ongoing were more
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3 38 likely than temporary frequent attenders to be aged 5-15, and were not more likely to be
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5 39 admitted (OR=2.7, 99% CI 0.7 to10.9).
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9 40 **Conclusions:** Intervention studies that target the entire frequent attender cohort are inevitably
10
11 41 unsuccessful because most frequent attenders are temporary. Future intervention studies
12
13 42 should distinguish between temporary and ongoing frequent attenders, develop specific
14
15 43 interventions for each group, and include rigorous evaluation.
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19 20 44 **Article summary**

21
22 45 Strengths and limitations of this study:

- 23
24 46 • Our unique, longitudinal data platform has enabled this study on long-term patterns of
25
26 47 attendance to all emergency departments within a single geographic region by frequent
27
28 48 attenders over 10 years.
29
30 49 • We considered long-term frequent attendance patterns which allowed for patients
31
32 50 discontinuing frequent attendance and resuming later on.
33
34 51 • We contrasted socio-demographic and risk factors for temporary versus ongoing frequent
35
36 52 attendance and for both adults and children.
37
38 53 • We included metropolitan, regional and rural EDs in Australia, however findings from one
39
40 54 healthcare setting may not be generalisable to other settings.
41
42
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45
46

47 55 **Funding and support:** The authors acknowledge the Illawarra Health Information Platform
48
49 56 (IHIP) research partnership established between the Illawarra Shoalhaven Local Health
50
51 57 District (ISLHD) and the University of Wollongong, with ISLHD providing funding support
52
53 58 and the data used in this study, and the NSW Ministry of Health who authorised the data
54
55 59 release.
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2
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4
5 61 McAlister, and Niki Cirillo for reviewing the manuscript, and assistance with accessing data
6
7 62 and interpretation. Patients and the public were not involved in the design or conduct of this
8
9 63 study.
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14 64 **Data statement:** This study accessed data from the Illawarra Health Information Platform
15
16 65 (IHIP) non-identifiable databank, which was established by the Illawarra Shoalhaven Local
17
18 66 Health District (ISLHD) and the University of Wollongong in NSW, Australia, for research,
19
20 67 planning and evaluation purposes. The study used deidentified participant data from 1 July
21
22 68 2005 to 30 June 2015. The Centre for Health Research Illawarra Shoalhaven Population and
23
24 69 the NSW Ministry of Health approved unit record data access. Additional materials are
25
26 70 available in the supplementary appendix.
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31 71 **Competing interests:** The authors declare that they have no competing interests.
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72 INTRODUCTION

73 Background

74 Emergency Department (ED) frequent attenders are a complex and vulnerable patient group.¹⁻
75 ⁴ Compared to non-frequent ED attenders, they have higher rates of morbidity and mortality,⁵
76 mental health issues,⁵⁻⁷ substance use problems,^{6,8} and chronic diseases,⁸⁻¹⁰ and are more
77 likely to be homeless¹¹ and of low socio-economic status.¹² By definition, this group accounts
78 for a disproportionate share of ED visits. They are also more likely to attend multiple EDs to
79 address their unmet health needs.⁸

80 Interventions are primarily aimed at reducing ED visits,¹³⁻¹⁷ and improving social and
81 clinical outcomes.^{13,16,18} The most commonly studied intervention is case management.
82 ^{13,10,16,18} Other interventions include establishment of care plans with patient input,¹⁹ and
83 providing case notes from previous ED visits.²⁰ Case management in some cases reduced ED
84 costs and improved social and clinical outcomes, but in many studies had no impact, or
85 increased ED and primary care utilisation.¹³ The limited number of studies with control
86 groups has contributed to a lack of evidence on effective interventions, as before-and-after
87 studies fail to account for the high likelihood of frequent attenders becoming infrequent
88 without intervention.¹

89 Relevance

90 Few studies have investigated long-term use patterns among ED attenders across multiple
91 facilities.²¹ Most studies report data from a single year,²²⁻²⁸ or a small number of years,^{11,16} or
92 from a small number of facilities,^{9,29,30} with ongoing visit patterns given little consideration.¹
93 Multi-site studies of more than 2-3 years are scarce.^{1,21,31,32} The need for research into long-
94 term utilisation patterns among frequent attenders has been identified, in particular

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3 95 understanding predictors of ongoing use,²¹ and analysis by age group and frequency of visit,
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5 96 to distinguish meaningful sub-groups for intervention.^{1,33}
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8 97 Research addressing these knowledge gaps will assist with identifying and distinguishing
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10 98 the characteristics of ongoing frequent attenders from those with temporary frequent ED use.
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12 99 This information will assist in planning appropriate support or interventions for the temporary
13
14
15 100 and ongoing subgroups of frequent attenders.
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17

18 101 **Objectives**

20
21 102 The aim of this study was to contrast the attributes and risk factors of temporary frequent
22
23 103 attenders, with ongoing frequent attenders. The ongoing frequent attenders were further
24
25 104 subdivided into repeat frequent attenders, who met the frequent attendance threshold twice,
26
27 105 and persistent frequent attenders, who met the threshold in three or more periods.
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30

31 32 106 **METHODS**

33 34 35 36 107 **Study design and setting**

37
38 108 A retrospective population-based study was carried out using longitudinal data from an
39
40 109 Australian regional health service, the Illawarra Shoalhaven Local Health District (ISLHD).
41
42 110 The district services almost 390,000 residents in a 250 kilometre long coastal catchment area,
43
44 111 covering rural, regional and metropolitan areas.³⁴ Five of the eight public hospitals within the
45
46 112 district have an ED, the largest being one of the busiest adult and paediatric emergency
47
48 113 departments in the state of New South Wales.³⁵
49
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53 54 114 **Selection of participants**

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56 115 This negligible risk study accessed data from the Illawarra Health Information Platform
57
58 116 (IHIP). IHIP is a non-identifiable databank established by the ISLHD and the University of
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3 117 Wollongong for research, planning and evaluation purposes. IHIP holds a unique record
4
5 118 number for every person who has accessed any ISLHD service since the late 1980s.
6
7
8 119 Emergency Department data were analysed for all individuals who attended any of the
9
10 120 district's EDs at least once between 1 July 2005 and 30 June 2015. Non-residents of the
11
12 121 district's catchment area were excluded.

14 122 **Ethical approval**

16
17 123 The study involved the use of existing non-identifiable data sourced from ISLHD routine
18
19 124 administrative data and accessed from IHIP. Ethical approval for establishment of IHIP's
20
21 125 non-identifiable databank, including the ISLHD administrative data, was obtained from the
22
23 126 University of Wollongong and Illawarra Shoalhaven Local Health District's Health and
24
25 127 Medical Human Research Ethics Committee (HREC) on 14 November 2016 (Ethics number:
26
27 128 2016/306). The CHRISP Executive Steering Committee also approved this study. This
28
29 129 committee includes senior representatives of both institutions including the Chief Executive
30
31 130 and Director of Research at ISLHD, and the Deputy Vice-Chancellor Research at UOW. The
32
33 131 committee, as the institutional review board, deemed the study exempt from ethical review,
34
35 132 as it was negligible risk, involved only routinely collected non-identifiable data that had
36
37 133 already been approved by the HREC, and were already stored in IHIP, used only unlinked
38
39 134 data, and did not require any further approvals (e.g. specific ethics approval from the
40
41 135 Aboriginal Health & Medical Research Council). This study was completed in accordance
42
43 136 with the National Statement on Ethical Research 2007 (updated 2018, The National Health
44
45 137 and Medical Research Council, the Australian Research Council and Universities Australia)
46
47 138 and the Helsinki Declaration (as revised in 2013).

54 139 **Patient and Public Involvement**

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56
57 140 Previous studies by the authors on patient's reasons for attending ED,³⁶ and other literature
58
59 141 on patient perspectives in the ED,³⁷ shaped the research questions, including a focus on

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3 142 understanding long-term use patterns rather than individual visits. The retrospective study
4
5 143 was designed to inform future interventions and research. While patients were not directly
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7
8 144 involved in the design or conduct of this study, a steering group that includes a patient
9
10 145 advisor will contribute to research translation and dissemination activities. Dissemination to
11
12 146 patients will also occur through the health district's Community Partnership Council and
13
14
15 147 other established patient advisory committees.
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18 148 **Outcomes**

19
20 149 The primary outcome of the study was an estimate of the proportion of frequent attenders for
21
22
23 150 whom frequent attendance is a temporary phenomenon (occurring only once during the study
24
25 151 period). A secondary outcome was to identify and contrast risk factors for temporary and
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27
28 152 ongoing frequent attendance to highlight characteristics associated with a continuing frequent
29
30 153 ED use.
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33 154 **Measurements**

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35
36 155 Historically, frequent ED use has been defined as three to 12 visits per year,⁵ while highly
37
38 156 frequent use has been defined as four to 20 visits per year.^{7,38} Because of this variation,
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40
41 157 Locker et al proposed that more than four ED visits per year was a non-random event, and
42
43 158 suggested this become a standard threshold for defining frequent ED attendance.⁶ This study
44
45 159 uses a more recently proposed definition based on a divergence of patient characteristics,
46
47
48 160 where non-frequent attenders present 1-6 times in a year, and frequent attenders 7 or more
49
50 161 times in a year.³⁹ A sub-group of highly frequent attenders,³⁹ who made 18 or more visits to
51
52 162 EDs in any 12-month period, were also investigated.
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55 163 A 12-month window was used to count ED visits following a first (or index) ED visit, a
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57 164 patient-based timeline not defined by calendar year.^{39,40} Subsequent 12 month windows
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3 165 commenced at the next ED visit after each 12-month window. Consequently, a subsequent
4
5 166 period of frequent attendance was not constrained to immediate following a first period.
6

7
8 167 Duration of frequent ED attendance was measured by the number of 12-month windows
9
10 168 each patient had frequent ED use. Sub-groups of frequent attenders were identified to provide
11
12 169 insight into the varying needs of this complex and heterogeneous patient group. Temporary
13
14 170 frequent attenders were defined as those who met the frequent attendance threshold once
15
16 171 during the study period, and ongoing frequent attenders were looked at in two groups - repeat
17
18 172 frequent attenders who met the threshold twice, and persistent frequent attenders, who met
19
20 173 the threshold three or more times.
21
22

23
24 174 Demographic characteristics such as age, sex, preferred language, and marital status were
25
26 175 analysed according to the first ED visit in the study period. Private hospital insurance status
27
28 176 and Aboriginal and Torres Strait Islander status were analysed according to the most recent
29
30 177 visit to the ED,⁴¹ due to a higher proportion of missing data in the early study years. Triage
31
32 178 category was averaged over all visits with an average of 4 to 5 considered low urgency. The
33
34 179 proportion of all ED visits resulting in a hospital admission was calculated for each person.
35
36

37
38 180 Socioeconomic status was based on Index of Relative Socio-economic Disadvantage
39
40 181 (IRSD) information.⁴² Each Australian postal area has an IRSD score and ranking. For the
41
42 182 purposes of this study, the rankings which were summarised as deciles were reduced to
43
44 183 quintiles, with low ranks representing the most disadvantaged.
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46

47 184 Patient diagnosis was recorded on discharge from the ED. Between 2009 and 2012 each
48
49 185 ED within the regional health service transitioned from ICD-9-CM diagnosis coding to
50
51 186 SNOMED recording of diagnosis. For this study, diagnoses according to ICD-9-CM coding
52
53 187 and SNOMED were therefore mapped to ICD-10-AM⁴³ and then aggregated to Major
54
55 188 Diagnostic Blocks (MDB) using the Independent Hospital Pricing Authority's Urgency
56
57 189 Related Group software v1.4.4.⁴⁴ Frequent ED attenders were primarily analysed according to
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3 190 their most common MDB to reduce the likelihood of bias from with missing data (such as
4
5 191 during system transition and for patients who did not wait), but also described based on
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7
8 192 whether they ever had a diagnosis in each MDB.
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10

11 193 **Data analysis**

14 194 Associations between categorical variables were evaluated using Pearson's Chi Square Test.
15
16 195 Multivariate mixed logistic regression models with crossed random effects to control for
17
18 196 attendance at one or more ED's were used to identify factors associated with frequent
19
20
21 197 attendance among persistent, repeat and ongoing groups, each compared with non-frequent
22
23 198 attenders. Results were summarised as odds ratios (OR) and confidence intervals (CI)
24
25 199 presented with alpha of 5% adjusted for multiple comparisons via Bonferroni correction
26
27
28 200 according to the number of model parameters estimated in each model. This resulted in odds
29
30 201 ratios with 99.8% confidence intervals for models relating to adults, and 99.6% relating to
31
32 202 children (where less model parameters were used). Demographic, diagnosis (MDB), and visit
33
34 203 characteristics were included in regression models. The proportion of missing data was
35
36
37 204 generally low, ranging from <1% for items such as sex, Aboriginal or Torres Strait Islander
38
39 205 status, socioeconomic status and triage category, to 5.3% for preferred language, 10.8% for
40
41 206 hospital insurance and 11.4% for marital status. Those without an assigned MDB due to; no
42
43
44 207 recorded diagnosis (7.5%), a diagnosis code not recognised by the grouper (3.9%) or patients
45
46 208 who did not wait (3.5%), were excluded from analysis by diagnosis. Planned return visits
47
48 209 accounted for 3.1% of all ED visits, and these were excluded from all analyses. Sensitivity
49
50
51 210 analyses were carried out with an alternative threshold for frequent ED attendance of four
52
53 211 visits per year, and including planned return visits. Statistical significance was set at 5%. All
54
55 212 statistical analysis was conducted using SAS version 9.4.⁴⁵ Multilevel logistic models with
56
57
58 213 crossed random effects were fit using PROC GLIMMIX with model fit, discrimination and
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60

214 calibration assessed using Chi-squared/ degrees of freedom, Area Under the Curve (AUC)
215 and Hosmer-Lemeshow chi-square respectively.

216 **RESULTS**

217 A total of 1,199,633 ED visits by 332,100 individuals were recorded across the 10-year study
218 period (Table 1). Of residents who attended the ED, 2.6% (n=8 577) met the threshold for
219 frequent attendance (attended seven or more times within a 12-month window).

220 Among frequent attenders, most (n=6866, 80.1%) met the attendance threshold only once
221 (temporary frequent attenders) (Figure 1). A further 12.9% (n= 1104) met the threshold twice
222 (repeat frequent attenders), while only 7.1% (n=607) met the threshold on three or more
223 occasions (persistent frequent attenders). Over the 10 years, these 607 persistent frequent
224 attenders made 38,338 ED visits. A similar pattern of predominantly temporary frequent
225 attendance was observed in each age group (Figure 1).

226 A sensitivity analysis including planned return visits indicated similar patterns of long
227 term ED use. For example, 81.4% of frequent attenders were temporary frequent attenders
228 when planned return visits were included. When the threshold of frequent attendance was
229 reduced to four visits in 12-months, 75.6% of individuals were temporary frequent attenders.

230 **Demographic and visit characteristics**

231 Compared to non- frequent attenders, frequent attenders were more likely to be male, older
232 (aged 65 or over), Aboriginal or Torres Strait Islander, have no partner, from non-English
233 speaking backgrounds, un-insured (publically insured only patients), and resident in lower
234 socio-economic areas (Table 1). Compared to the other groups of frequent attenders,
235 persistent frequent attenders were young to middle aged adults, female, Aboriginal or Torres
236 Strait Islander, had no partner, were from lower socioeconomic areas, un-insured (publically
237 insured only patients) and not admitted (Table 1). During the ten-year study period, frequent

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3 238 attenders had an average of 21.0 ED visits, compared to 3.2 for non- frequent attenders, with
4
5 239 more frequent attenders admitted to hospital.
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9 **240 Diagnostic profile**

10
11 241 The most common diagnoses among frequent attenders were digestive, respiratory,
12
13 242 circulatory, single site major injury and psychiatric illness (Supplementary Material Table 1),
14
15
16 243 however diagnostic profile differed by age and length of frequent attendance.
17

18
19 244 Among the youngest frequent attenders, aged 0-4 years, respiratory illness was the most
20
21 245 common diagnosis across all groups' frequent attenders (Table 2). Among children aged 5-15
22
23 246 years, injury and digestive system illnesses were the two most common diagnoses in all sub-
24
25 247 groups, with injury being the most common diagnosis among temporary frequent attenders
26
27
28 248 and digestive system illness among the persistent frequent attenders. Children also presented
29
30 249 with psychiatric illness, which was the most common diagnosis for 9.3% of temporary
31
32 250 frequent attenders, 14.3% of repeat frequent attenders and 12.7% of persistent frequent
33
34
35 251 attenders.
36

37 252 While injury and digestive system illness were also common among older teenagers and
38
39 253 young adults (16-24 and 25-44 years), there were increasing numbers of patients visiting ED
40
41 254 primarily for psychiatric illness, particularly among repeat frequent attenders aged 25-44
42
43
44 255 years and persistent frequent attenders (Table 2).
45

46 256 Among adults aged 45-64 years, the most common diagnoses were circulatory, digestive
47
48 257 and respiratory illnesses. Among older adults 65 years and above, circulatory followed by
49
50 258 respiratory system illnesses were most common, with the exception of persistent frequent
51
52
53 259 attenders who had more respiratory illness than circulatory illness. In the older age groups,
54
55 260 aged 75 years and above, digestive system and urological system illness were common among
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57
58 261 all frequent attendee groups.
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3 262 Analysis of all diagnoses reported in the study period (rather than most common) shows
4
5 263 that from the age of 25 years, ED visits relating to single site major injuries were common
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7
8 264 among temporary and repeat frequent attenders, while persistent frequent attenders had higher
9
10 265 proportions of respiratory, musculoskeletal, neurological and psychiatric visits (Table 2).
11
12 266 Among ongoing frequent attenders aged 5-15, 16-24 and 25-44, more than half presented with
13
14
15 267 a psychiatric diagnosis at least once during the study period.

17 18 268 **Risk factors associated with frequent attendance**

19
20 269 Multivariate multilevel logistic regression models with crossed random effects were fit to
21
22 270 assess the likelihood of being a frequent attenders, based on socio-demographic and visit
23
24
25 271 characteristics and diagnoses for those aged 16 and over (Table 3) and those aged under 16
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27
28 272 (Table 4). Consistent with the findings of the earlier descriptive analysis, being an adult
29
30 273 frequent attender was associated with being: male; older; Aboriginal or Torres Strait Islander;
31
32 274 un-insured (publically insured only patients); socio-economically disadvantaged; presenting
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34
35 275 with higher urgency; lower likelihood of admission; and less likely to have a partner (Table
36
37 276 3). Compared to the reference category (single site major injury), frequent attendance was
38
39 277 associated with all diagnostic groups, with the highest odds of psychiatric illness (OR=6.2,
40
41 278 99% CI 5.1 to 7.5) and alcohol/drug related disorders (OR=6.4, 99% CI 4.3 to 9.7) (Table 3).

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43
44 279 Among children aged under 16, frequent attenders were more likely to be older (age 5 to
45
46 280 15) and similarly to adult frequent attenders, were more likely to be Aboriginal or Torres
47
48 281 Strait Islander, un-insured (publically insured only patients); socio-economically
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50
51 282 disadvantaged; and present with higher urgency (OR=2.3, 99% CI 1.9 to 2.9). However, they
52
53 283 were not more likely to be male; and were no less likely to be admitted than non- frequent
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55 284 attenders (Table 4).

56
57 285 Compared to the reference category (single site major injury), frequently attending
58
59 286 children aged under 16 were more likely to present with digestive illness, neurological system

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3 287 illness, and respiratory illness. As with adults, the highest risk of frequent attendance was
4
5 288 presenters with psychiatric illness (OR=6.7, 99% CI 4.1 to 11.1) (Table 4).
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9 **289 Risk factors associated with frequent attendance by duration**

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11 290 Models fitted separately for each frequent attendance sub-group (temporary frequent
12
13 291 attenders compared to non-frequent, repeat frequent attenders compared to non-frequent and
14
15 292 persistent frequent attenders compared to non-frequent attenders) led to different
16
17 293 demographic risk factors. While temporary adult frequent attenders were more likely to be
18
19 294 male, after adjusting for other characteristics, sex was not a risk factor for repeat (OR=1.2,
20
21 295 99% CI 1.1 to 1.3) or persistent frequent attenders (OR=1.0, 99% CI 0.7 to 1.2) (Table 3).
22
23 296 Persistent adult frequent attenders were also more likely to be in the middle age groups, aged
24
25 297 25-44 years. Among those aged under 16, repeat frequent attenders were more likely to be
26
27 298 female and aged 5 to 15 (OR=0.6, 99% CI 0.3 to 1.0), which was the same OR for persistent
28
29 299 attenders (OR=0.6, 99%CI 0.2 to 1.4), though not statistically significant after adjustment for
30
31 300 multiple comparisons (Table 4).
32
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36
37 301 Demographic and clinical risk factors for adult frequent attendance were in many cases
38
39 302 magnified among repeat and persistent frequent attenders (Table 3). For example, Aboriginal
40
41 303 or Torres Strait Islander background was a larger risk factor for those with long periods of
42
43 304 frequent attendance (temporary frequent attenders OR=1.9, 99% CI 1.5 to 2.3 and persistent
44
45 305 frequent attenders OR=2.6, 99% CI 1.6 to 4.2) and having a partner was less likely among
46
47 306 longer duration frequent attenders (temporary frequent attenders OR=0.7, 99% CI 0.7 to 0.8
48
49 307 and persistent frequent attenders OR=0.5, 95% CI 0.4 to 0.7).
50
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53 308 Alcohol and drug-related disorders were much more prominent among longer-duration
54
55 309 frequent attenders (temporary frequent attenders OR=5.1, 99% CI 3.2 to 8.2 compared to
56
57 310 persistent frequent attenders OR=17.9, 99% CI 6.2 to 51.5), as were neurological illness
58
59 311 (temporary frequent attenders OR=1.8, 99% CI 1.4 to 2.3 compared to persistent frequent
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3 312 attenders OR=6.8, 99% CI 3.3 to 13.7), and psychiatric illness (temporary frequent attenders
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5 313 OR=4.8, 99% CI 3.8 to 6.0 compared to persistent frequent attenders OR=13.7, 99% CI 7.1 to
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7 314 26.5) (Table 3).
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9

11 315 **Risk factors for temporary versus ongoing frequent attendance**

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14 316 Risk factors for the ongoing frequent attender group (repeat and persistent combined)
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16 317 were modelled in comparison to temporary frequent attenders. This confirmed the earlier
17
18 318 findings that ongoing frequent attenders are younger (aged 25-64) but less likely to have be
19
20 319 admitted, or be from high socio-economic areas (Figure 2, left image). Substance-related
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22 320 visits, psychiatric illness, and neurological illness were again more likely for ongoing
23
24 321 frequent attenders. Among children aged under 16, ongoing frequent attenders were more
25
26 322 likely than temporary frequent attenders to be aged 5-15 (Figure 2, right image). Highly
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28 323 frequent users (18 or more visits in any 12-month period) were more likely to be ongoing
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30 324 frequent attenders. Among those who only met the lower frequent attendance threshold (7-17
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32 325 visits in a 12-month period), 5.1% were persistent frequent attenders. In contrast, of patients
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34 326 who met the highly frequent threshold at least once (18 or more visits in any 12-month
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36 327 period), 45.5% were persistent frequent attenders.
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43 328 **DISCUSSION**

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45 329 This investigation of 10 years of longitudinal ED data has provided a novel perspective on
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47 330 the risk factors by duration of frequent attenders, for both adults and children. Investigation
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49 331 of visits to all EDs in the region found the majority of frequent ED attenders are temporary
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51 332 and only approximately 20% remain as frequent attenders in any of up to nine subsequent
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53 333 years. Persistent frequent attenders only accounted for 7.1% of frequent attenders.
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56
57 334 The estimate that 80.1% of frequent attenders are temporary is slightly higher than
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59 335 other shorter-term studies carried out in the US,^{1, 33,43,46} Sweden³ and New Zealand,⁴⁷ where
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3 336 estimates varied between 58 and 72%. Definitions of temporary frequent attenders differ
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5 337 slightly across studies, including: the threshold number of visits for frequent attenders;
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7 338 whether the period of frequent attendance is patient-based (using an index visit) or calendar
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9 339 based; whether another period of frequent attendance immediately follows the first frequent
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11 340 attendance period or is during the study period. We considered any periods of frequent
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13 341 attendance across the entire study period, to be inclusive of patients who re-established
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15 342 frequent attendance patterns.⁴⁸

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19 343 Systematic reviews show that internationally, intervention studies have been targeting
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21 344 the entire frequent attender cohort.^{13,14} However, differences in profile and risk factors for
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23 345 ongoing frequent attenders compared to temporary frequent attenders, and for adults and
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25 346 children, demonstrate a need to consider different types of interventions. In particular, the
26
27 347 cohort of persistent frequent attenders may receive more benefit from case management, and
28
29 348 increased continuity of primary care provider⁴⁹ than temporary frequent attenders. Young
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31 349 adults with ongoing frequent attendance related to substance disorders and psychiatric illness
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33 350 may benefit from additional services outside the ED, while among children, older females
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35 351 with neurological conditions (predominantly seizure-related and headaches) could benefit
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37 352 from pathways which reduce the likelihood of admission and result in reduced length of
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39 353 hospital stay.⁵⁰

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44 354 Our research has shown a complex relationship between ED attendance and hospital
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46 355 admission. Multivariate analysis showed frequent ED attendance was inversely associated
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48 356 with hospital admission, and duration of frequent ED attendance was not associated with
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50 357 hospital admission among adults, suggesting some frequent attenders may be treated and/or
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52 358 managed in a different setting. Highly frequent users do not use other health care services
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54 359 proportionally more than (low volume) frequent users,³⁹ suggesting highly frequent attenders
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56 360 may use ED's as a main source of care. It is therefore possible that the persistent frequent
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3 361 attender cohort, of which almost half were highly frequent attenders, also use the ED as a
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5 362 main source of care.

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7 363 The heterogeneity of frequent attenders has contributed to ineffective policy
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9 364 development, with interventions needing to target specific sub-groups.⁵ Similar to evidence in
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11 365 the literature, we identified three vulnerable patient groups at high risk of frequent
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13 366 attendance; those in situations of socioeconomic distress (e.g. low income, homelessness,
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15 367 social isolation);^{8,9,11,21,51} those living with mental health and substance use problems;^{8,21,39,47}
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17 368 and the elderly.^{5,52} The first two of these groups are more likely to be ongoing frequent
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19 369 attenders, while the latter, elderly group tend to be temporary frequent attenders. Due to the
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21 370 ongoing nature of frequent ED attendance by those with socioeconomic and mental health
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23 371 issues, or both, it is imperative to find cost-effective alternatives. Temporary older frequent
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25 372 attenders are driving increases in ED utilisation and changing the clinical profile of
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27 373 EDs.^{53,54,55,56} This group are multimorbid, with complex, ongoing health care needs, and
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29 374 required improved identification and management of those at risk of return.^{52,54,57,58} To date,
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31 375 hospital-based interventions for these elderly patients have had little effect on ED use,
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33 376 potentially due to their typically short-term nature. However, a systematic review found that
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35 377 interventions in outpatient and primary care/home settings (including geriatric assessment
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37 378 and management and case management) have reduced ED use among this patient cohort.⁵⁹

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39 379 Our research has shown a complex relationship between ED attendance and hospital
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41 380 admission and found longitudinal ED data investigating ongoing frequent use identifies
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43 381 additional and inflated risk factors. In accordance with the recommendations of Pines et al,³³
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45 382 the authors future research agenda includes using data in model development and testing for
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47 383 predicting patients who are at risk of becoming and/or remaining frequent attenders. This will
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49 384 improve generalisability of existing predictive models, which are mostly from the U.S.,^{46,60,61}

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3 385 often have small samples,^{11,60} focus on a specific patient sub-group (e.g. Medicaid users,⁴⁶ or
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5 386 using inconsistent thresholds for frequent attendance (3, 4 or 10 visits in a year).^{11,60,61}
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9 387 **Limitations**

10
11 388 The inclusion of any patients whose with frequent attendance for any 12 month period during
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13 389 the 10 year study period enabled patients to be grouped according to long-term patterns of
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15 390 frequent attendance, however some temporary and repeat frequent attenders may have been
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17 391 classified differently had all participants had equal follow up time.
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21 392 Logistic regression models identifying factors associated with frequent attendance used
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23 393 both characteristics of the person (e.g. socio-demographics) and their presentations to ED
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25 394 (diagnosis, urgency) throughout the study period, therefore there is confounding between the
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27 395 independent and dependent variables. When developing models to predict future frequent
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29 396 attendance, these would need to use only characteristics prior to a period of frequent
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31 397 attendance. Data quality, data consistency and the amount of missing information (in
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33 398 particular diagnosis) improved over time, which may impact descriptive and modelling
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35 399 results. The effect of missing diagnoses was minimised by modelling a patient's most
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37 400 common diagnostic block over all visits. While hospital insurance and preferred language
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39 401 were imputed using recent data, having a partner was considered more likely to change over
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41 402 the study period so missing cases were excluded from models.
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46 403 Social variables that may increase the risk of frequent attendance, such as use of
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48 404 primary care services, homelessness or isolation, are not routinely collected. Other factors
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50 405 that may be predictive of frequent attendance, such as patient satisfaction with treatment, and
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52 406 having a regular source of care⁶² were not collected.
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55 407 We could not link to data on deaths outside of the public hospital system and
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57 408 therefore could not explore reasons for patients discontinuing frequent attendance, however
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3 409 this is an area of potential future research. Finally, while we included data from metropolitan
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5 410 and rural EDs in one region in Australia, this may not be generalisable to other settings.
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9 411 **Conclusions**

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11 412 This study has provided a unique, longitudinal perspective on ED frequent attenders,
12
13 413 contrasting the demographic and diagnostic profile of temporary, repeat and persistent
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15 414 frequent attenders. The distinction between temporary and ongoing frequently attending
16
17 415 cohorts should be used when describing frequent attenders, and to inform appropriate
18
19 416 interventions and better direct health resources.
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24 417 **Author contributions**

25
26 418 LL carried out analysis, interpretation, and drafted the manuscript, VWW and KL assisted
27
28 419 with interpretation of the data and assisted with drafting and reviewing the manuscript, RZ,
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30 420 JM, TC, and WT contributed to interpretation of the data and reviewed the manuscript, KE
31
32 421 was responsible for the study conception and contributed to interpretation of the data and
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34 422 reviewed the manuscript.
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Table 1. Characteristics of ED patients, 12-month windows, and visits* by length of frequent attendance

Patients	Frequent Attenders				Non-frequent ED attenders (N=323,523)	ED attenders (N=332,100)
	Temporary (N=6,866)	Repeat (N=1,104)	Persistent (N=607)	All (N=8,577)		
Age group (%) ††						
0-4	10.4	5.7	2.3	9.2	13.4	13.3
5-15	9.0	8.9	9.1	9.0	12.6	12.5
16-24	11.5	12.5	12.4	11.7	12.6	12.6
25-44	20.2	24.3	34.9	21.8	22.6	22.6
45-64	18.8	21.9	23.7	19.6	20.2	20.2
65-74	12.4	12.6	8.7	12.2	8.6	8.7
75+	17.8	14.1	8.9	16.7	10.1	10.2
Sex (%) †††						
Male	53.8	51.5	46.8	53.0	51.3	51.3
Female	46.2	48.6	53.2	47.0	48.8	48.7
Indigenous (%) ††††						
Aboriginal or Torres Strait Islander origin	7.4	10.6	12.5	8.2	3.3	3.4
Neither Aboriginal nor Torres Strait Islander origin	92.6	89.4	87.5	91.8	96.8	96.6
Partner ††††† (persons aged 16 and over)						
Yes	45.1	39.0	30.2	43.2	53.8	53.5
No	54.9	61.0	69.8	56.8	46.2	46.5
Private hospital insurance (%) †††††						
Yes	17.3	16.1	11.7	16.8	32.0	31.6
No	82.7	83.9	88.3	83.3	68.0	68.4
Preferred language (%) †††††						
English	78.9	82.2	82.1	79.6	87.7	87.5
Other	21.1	17.8	17.9	20.4	12.3	12.5
Socio-economic status †††††						
Quintile 1 (low)	30.0	32.8	34.4	30.7	22.2	22.4
Quintile 2	26.6	24.6	25.0	26.3	22.8	22.9
Quintile 3	32.8	35.6	34.6	33.3	40.4	40.2
Quintile 4	5.7	4.1	4.1	5.4	7.6	7.5
Quintile 5 (high)	4.8	2.9	1.8	4.4	7.0	7.0
Visits	(N=108,858)	(N=32,643)	(N=38,338)	(N=179,839)	(N=1,019,794)	(N=1,199,633)
Visits in study period (mean)	15.9	29.6	63.2	21.0	3.2	3.6
Visits per 12-month window (with 1+ visit) (mean)	4.2	5.8	9.5	5.1	1.7	1.8
Admitted (%) †††††						
Yes	37.0	38.0	33.5	36.4	30.8	31.6
No	63.0	62.0	66.5	63.6	69.2	68.4
Triage category †††††						
1 (highest urgency)	0.5	0.5	0.5	0.5	0.5	0.5
2	7.7	8.3	7.7	7.8	6.7	6.9
3	30.0	30.3	28.8	29.9	28.0	28.3
4	45.1	45.7	46.6	45.8	50.7	49.9
5 (lowest urgency)	16.7	15.3	16.4	16.7	14.2	14.5

* Excludes planned return visits

† As reported at earliest ED visit in study period

‡ χ^2 test for patient type (temporary frequent attendee, repeat frequent attendee, ongoing frequent attendee by: age $\chi^2_{12} = 164.5$ ($p < .0001$), sex $\chi^2_2 = 12.2$ ($p = 0.002$), Indigenous $\chi^2_2 = 29.1$ ($p < .0001$), Partner $\chi^2_2 = 43.8$ ($p < .0001$), Hospital insurance $\chi^2_2 = 10.8$ ($p = 0.045$) Preferred language $\chi^2_2 = 8.6$ ($p = 0.014$), Socio-economic status $\chi^2_5 = 34.6$ ($p < .0001$), Admitted $\chi^2_2 = 196.7$ ($p < .0001$), Triage category $\chi^2_5 = 76.0$ ($p < .0001$). Excludes unknown, missing, and not-stated.

§ As reported at most recent ED visit in study period. This is the recommended approach for Indigenous status (Randall et al 2013) and was required for hospital insurance due to incomplete early data at two facilities.

** Percentage missing, unknown, not stated - Partner 11.5%, Indigenous status (at last ED visit) 0.9%, Socio-economic status 0.0%, Hospital insurance (at last ED visit) 10.8%, Preferred language 5.3%, Admitted 0.0%, Triage category 0.2%

Table 2. Diagnostic profile of ED frequent attender patients* by duration of frequent attendance and age group

% of patients	Temporary frequent attender (frequent attender in one 12-month period)								Repeat frequent attender (frequent attender in two 12-month periods)								Persistent frequent attender (frequent attender in three or more 12-month periods)							
	Age group†								Age group								Age group							
	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All
N persons	711	615	791	1387	1291	850	1221	6866	63	98	138	268	242	139	156	1104	14	55	75	212	144	53	54	607
<i>Most common Major Diagnostic Block</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.0	1.6	0.0	0.0	0.8	0.0	0.0	‡	2.6	2.9	0.0	0.0	1.4	0.0	0.0	‡	2.8	4.2	‡	0.0	2.3
Circulatory system illness	*	1.3	3.5	5.5	17.5	24.4	23.7	12.2	0.0	5.1	‡	4.5	15.3	25.2	32.7	13.0	0.0	‡	‡	7.6	18.1	28.3	14.8	11.5
Digestive system illness	12.2	18.5	21.4	15.9	14.4	12.0	13.6	15.2	14.3	22.5	26.8	15.7	19.4	13.8	9.6	17.6	‡	36.4	26.7	18.4	16.7	15.1	14.8	19.9
Endocrine, nutritional and metabolic system illness	‡	0.8	0.9	1.1	0.7	1.1	1.2	0.9	‡	‡	‡	‡	2.1	‡	‡	1.4	0.0	‡	‡	‡	‡	0.0	0.0	1.3
Illness of skin, subcutaneous tissue, breast	2.0	4.7	5.6	7.1	5.4	3.3	2.9	4.7	‡	‡	5.1	5.6	2.9	‡	‡	3.4	0.0	‡	‡	4.3	‡	0.0	‡	2.6
Injury, single site, major Musculoskeletal/connective tissue system illness	14.5	31.7	20.0	13.4	6.3	3.9	6.2	12.1	‡	21.4	7.3	12.7	2.1	‡	5.8	7.7	‡	21.8	‡	7.6	3.5	0.0	‡	6.9
Neurological system illness	0.7	2.9	3.0	6.0	5.3	5.4	4.2	4.3	0.0	‡	5.1	9.3	6.6	5.0	‡	5.3	0.0	‡	8.0	9.4	5.6	0.0	‡	6.1
Psychiatric illness	4.6	3.6	3.5	5.6	5.3	5.9	7.0	5.3	9.5	7.1	5.1	6.3	8.7	5.8	3.9	6.5	‡	9.1	8.0	11.3	13.2	‡	11.1	10.4
Respiratory system illness	0.0	9.3	11.3	13.1	5.9	1.4	1.0	6.2	‡	14.3	21.0	25.0	10.7	‡	‡	12.9	0.0	12.7	29.3	26.4	10.4	‡	0.0	16.6
Urological system illness	44.0	6.0	4.6	4.0	14.3	18.4	17.1	14.4	47.6	‡	5.1	4.9	14.5	21.6	19.9	13.6	0.0	0.0	‡	2.4	16.7	34.0	22.2	11.2
Other MDBs	1.1	1.3	2.5	2.5	4.7	10.6	13.3	5.6	0.0	6.1	‡	‡	3.3	10.1	16.7	5.3	0.0	0.0	‡	‡	‡	9.4	14.8	3.2
20.0	19.8	22.8	23.9	18.7	13.8	10.0	18.3	19.1	15.3	18.1	11.2	11.6	7.9	7.7	12.1	‡	10.9	‡	8.0	6.9	7.6	11.1	7.9	
<i>Major Diagnostic Block during study period</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	8.5	10.5	11.8	7.3	1.5	0.7	6.0	0.0	10.2	17.4	26.1	16.5	0.0	‡	13.2	0.0	16.4	24.0	31.6	18.8	‡	‡	20.4
Circulatory system illness	4.1	22.4	29.6	35.3	58.9	69.5	71.5	45.4	7.9	40.8	31.9	49.6	65.7	89.9	81.4	57.3	‡	58.2	53.3	65.6	82.6	90.6	85.2	70.2
Digestive system illness	63.4	65.5	58.7	54.2	57.0	61.5	59.9	59.1	85.7	79.6	79.7	70.9	71.9	79.9	74.4	75.5	‡	96.4	85.3	85.9	85.4	88.7	74.1	86.0
Endocrine, nutritional and metabolic system illness	6.5	6.0	3.5	7.9	16.9	20.4	19.0	12.3	12.7	10.2	10.9	13.1	24.4	23.7	30.1	18.8	1.1	12.7	17.3	20.3	24.7	45.3	29.6	25.4
Illness of skin, subcutaneous tissue, breast	38.1	36.3	36.8	36.0	33.4	29.5	26.6	33.4	46.0	46.9	44.2	46.6	37.2	44.6	33.3	42.1	0.9	56.4	56.0	49.5	46.5	30.2	44.4	47.9
Injury, single site, major Musculoskeletal/connective tissue system illness	62.6	82.3	66.4	57.7	48.8	42.2	50.8	56.6	69.8	87.8	74.6	71.3	61.2	46.8	55.8	65.6	1.4	90.9	81.3	38.4	22.7	6.3	7.3	76.9
15.3	48.1	42.4	44.7	44.6	43.8	41.4	41.0	27.0	66.3	56.5	59.0	57.9	59.0	55.1	56.7	0.7	89.1	73.3	71.7	79.2	69.8	66.7	73.8	

* Excludes planned return visits

† Age group defined at first visit in first period of frequent attendance

‡ Cell suppressed, n ≤ 5

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Neurological system illness	18.1	27.8	30.7	32.3	36.6	44.2	52.5	36.3	23.8	37.8	52.9	55.6	56.2	64.0	64.1	54.3	58.2	70.7	74.1	75.0	83.0	68.5	71.7
Psychiatric illness	1.4	31.1	36.0	36.3	23.0	15.4	14.2	23.2	‡	54.1	58.7	62.7	36.0	18.7	21.2	40.9	67.3	68.0	71.2	52.1	28.3	16.7	55.7
Respiratory system illness	83.5	39.5	34.6	32.6	50.0	58.6	61.6	50.4	92.1	53.1	46.4	48.5	66.5	71.9	76.3	62.0	78.2	65.3	64.2	77.1	83.0	85.2	73.0
Urological system illness	11.1	17.7	21.0	17.9	27.3	40.4	47.4	27.3	14.3	32.7	27.5	24.3	42.6	65.5	60.3	39.1	49.1	45.3	31.6	42.4	58.5	72.2	43.2

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Table 3. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged 16 or over

Variable	Non-frequent vs all frequent attenders ⁹		Non-frequent vs temporary frequent attenders ¹⁰		Non-frequent vs repeat frequent attenders ¹¹		Non-frequent vs persistent frequent attenders ¹²	
	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)
Sex								
Male	1.2	(1.1,1.3)	1.2	(1.1,1.3)	1.2	(1.0,1.5)	0.9	(0.7,1.2)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
16-24 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
25-44	1.2	(1.0,1.3)	1.1	(1.0,1.3)	1.6	(1.1,2.3)	1.9	(1.2,3.0)
45-64	1.4	(1.2,1.6)	1.3	(1.1,1.5)	2.0	(1.3,2.9)	2.4	(1.5,3.9)
65-74	1.8	(1.5,2.1)	1.6	(1.4,2.0)	2.2	(1.4,3.4)	2.1	(1.1,3.8)
75+	2.1	(1.8,2.5)	2.1	(1.7,2.4)	2.3	(1.5,3.6)	1.6	(0.9,2.9)
Partner								
Yes	0.7	(0.6,0.8)	0.7	(0.7,0.8)	0.6	(0.5,0.8)	0.5	(0.4,0.7)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Uninsured (no private hospital insurance) ¹³								
Yes	1.7	(1.6,1.9)	1.7	(1.5,1.9)	1.8	(1.3,2.4)	1.9	(1.2,2.8)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	2.0	(1.7,2.4)	1.9	(1.5,2.3)	2.5	(1.7,3.7)	2.6	(1.6,4.2)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.1	(1.9,2.3)	2.0	(1.8,2.3)	2.4	(1.8,3.2)	1.9	(1.3,2.7)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Preferred language non-English**								
Yes	1.1	(0.9,1.4)	1.2	(0.9,1.4)	1.2	(0.7,2.0)	0.7	(0.3,1.8)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.7	(0.6,0.8)	0.7	(0.6,0.9)	0.6	(0.4,0.9)	0.5	(0.3,0.9)
Socio-economic status								
Quintile 1 (low)	1.4	(1.2,1.5)	1.4	(1.2,1.5)	1.3	(1.0,1.7)	1.4	(1.0,2.0)
Quintile 2	0.9	(0.8,1.0)	0.9	(0.8,1.1)	0.9	(0.6,1.2)	0.8	(0.5,1.3)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	0.6	(0.5,0.8)	0.7	(0.6,0.9)	0.5	(0.3,0.8)	0.5	(0.2,1.1)
Quintile 5 (high)	0.6	(0.5,0.7)	0.7	(0.5,0.8)	0.4	(0.2,0.7)	0.3	(0.1,0.8)
Major Diagnostic Block ¹⁴								
Alcohol/drug abuse and alcohol/drug induced mental disorders	6.4	(4.3,9.7)	5.1	(3.2,8.2)	11.2	(4.4,28.3)	17.9	(6.2,51.5)
Circulatory system illness	2.3	(1.9,2.7)	2.0	(1.7,2.5)	3.4	(2.0, 5.5)	4.0	(2.0, 8.0)
Digestive system illness	2.8	(2.4,3.3)	2.5	(2.1,3.0)	4.3	(2.7, 7.0)	5.6	(2.9,10.6)
Endocrine, nutritional and metabolic system illness	2.8	(1.9,4.2)	2.4	(1.5,3.7)	4.8	(1.8, 13.1)	6.5	(1.7,24.4)
Illness of skin, subcutaneous tissue, breast	2.9	(2.4,3.7)	2.9	(2.2,3.6)	3.6	(1.9, 7.0)	2.7	(1.0,7.3)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	1.7	(1.4,2.1)	1.5	(1.2,1.9)	2.6	(1.5, 4.7)	3.1	(1.4,6.7)
Neurological system illness	2.2	(1.8,2.7)	1.8	(1.4,2.3)	3.2	(1.8, 5.8)	6.8	(3.3,13.7)
Psychiatric illness	6.2	(5.1,7.5)	4.8	(3.8,6.0)	12.5	(7.6,20.5)	13.7	(7.1,26.5)
Respiratory system illness	3.3	(2.8,4.0)	3.0	(2.4,3.6)	5.1	(3.1, 8.5)	5.6	(2.8,11.4)
Urological system illness	3.2	(2.6,3.9)	3.0	(2.4,3.8)	4.3	(2.3, 7.8)	3.4	(1.3,8.6)
Other	1.7	(1.4,1.9)	1.6	(1.4,2.0)	1.8	(1.1, 3.0)	1.3	(0.6,2.8)

CI, 99.8% Confidence Interval (α adjusted for multiple comparisons, $1-\alpha/m = 1-0.05/26 = 0.998$)
OR, Odds Ratio

⁹ n=211,447, AUC=0.82, Hosmer-Lemeshow $\chi^2=1,867$ ($p<0.0001$), Generalized Chi-Square / DF = 0.90,

¹⁰ n=210,198, AUC=0.80, Hosmer-Lemeshow $\chi^2=1,461$ ($p<0.0001$), Generalized Chi-Square / DF = 0.90,

¹¹ N=206,440, AUC=0.87, Hosmer-Lemeshow $\chi^2=877$ ($p<0.0001$), Generalized Chi-Square / DF =0.79,

¹² N=206,097, AUC=0.89, Hosmer-Lemeshow $\chi^2=678$ ($p<0.0001$), Generalized Chi-Square / DF =0.89,

¹³ Missing values imputed with patient's most recent non-missing value.

¹⁴ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Table 4. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged under 16

Variable	Non-frequent vs all frequent attenders ¹⁵		Non-frequent vs temporary frequent attenders ¹⁶		Non-frequent vs repeat frequent attenders ¹⁷		Non-frequent vs persistent frequent attenders ¹⁸	
	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)
Sex								
Male	0.9	(0.8,1.1)	1.0	(0.8,1.2)	0.6	(0.3,1.0)	0.6	(0.2,1.4)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
0-4 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
5-15	1.0	(0.8,1.2)	1.0	(0.8,1.1)	1.4	(0.8,2.4)	1.3	(0.5,3.1)
Uninsured (no private hospital insurance) ¹⁹								
Yes	1.8	(1.4,2.2)	1.8	(1.4,2.2)	1.7	(0.8,3.4)	2.3	(0.7,7.9)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	1.7	(1.3,2.2)	1.7	(1.3,2.2)	1.4	(0.6,3.2)	1.8	(0.5,6.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.3	(1.9,2.9)	2.3	(1.8,2.8)	2.5	(1.2,4.9)	4.7	(1.1,19.1)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.9	(0.7,1.3)	0.9	(0.6,1.3)	1.3	(0.5,3.5)	1.6	(0.3,8.2)
Socio-economic status								
Quintile 1 (low)	1.7	(1.4,2.0)	1.6	(1.3,2.0)	2.1	(1.2,3.6)	2.3	(0.9,5.8)
Quintile 2-5 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Major Diagnostic Block ²⁰								
Digestive system illness	1.7	(1.3,2.2)	1.6	(1.2,2.1)	2.3	(1.0, 5.2)	6.0	(1.4, 24.7)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Neurological system illness	2.7	(1.8,4.1)	2.4	(1.5,3.9)	5.0	(1.7, 14.4)	7.6	(1.2,48.1)
Psychiatric illness	6.7	(4.1,11.1)	6.1	(3.5,10.6)	8.6	(2.4,31.2)	34.7	(6.3,190.6)
Respiratory system illness	2.4	(1.8,3.0)	2.4	(1.9,3.0)	2.7	(1.3, 5.9)	2.0	(0.4, 10.2)
Other	0.9	(0.7,1.1)	0.9	(0.7,1.2)	1.2	(0.5, 2.7)	1.4	(0.3, 6.5)

CI, Confidence Interval

OR, Odds Ratio

¹⁵ n=82,344, AUC=0.83, Hosmer-Lemeshow = 456 (p<0.0001), Generalized Chi-Square / DF = 0.87

¹⁶ n=82,115, AUC=0.82, Hosmer-Lemeshow = 415 (p<0.0001), Generalized Chi-Square / DF =0.85

¹⁷ n=80,958, AUC=0.87, Hosmer-Lemeshow = 158 (p<0.0001), Generalized Chi-Square / DF =0.88

¹⁸ n=80,867, AUC=0.93, Hosmer-Lemeshow = 64 (p<0.0001), Generalized Chi-Square / DF =0.64

¹⁹ Missing values imputed with patient's most recent non-missing value.

²⁰ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Figure captions

Figure 1.

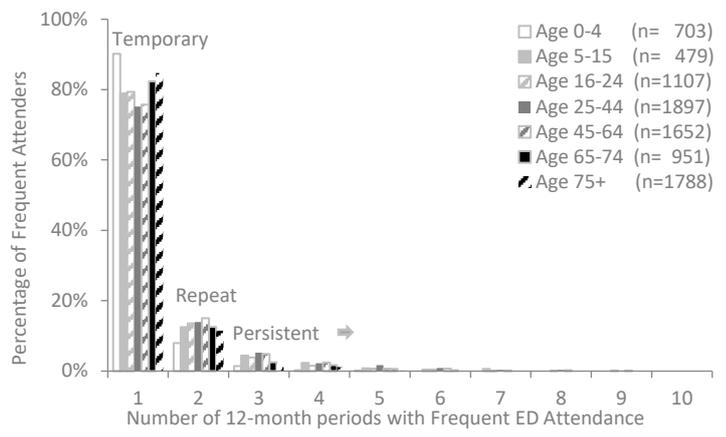
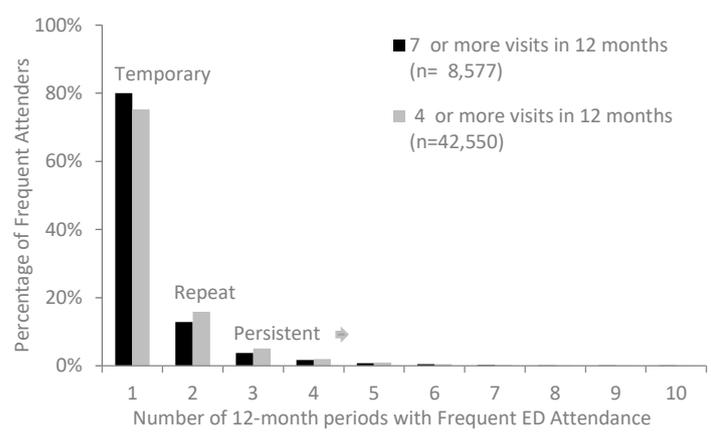
Number of 12-month periods where the frequent attendance threshold was met by frequently attending residents. *Left*: All residents with 7 or more visits in 12 months and all residents with 4 or more visits in 12 months. *Right*: all residents with 7 or more visits in 12 months by age group. Excludes planned return visits.

Figure 2.

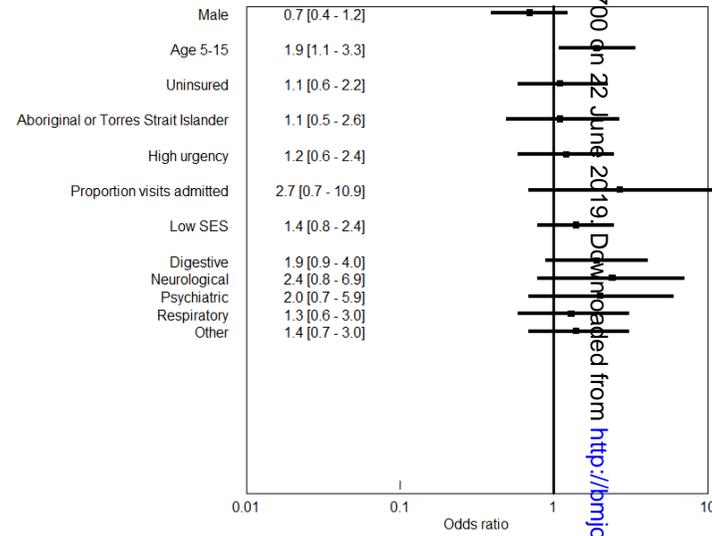
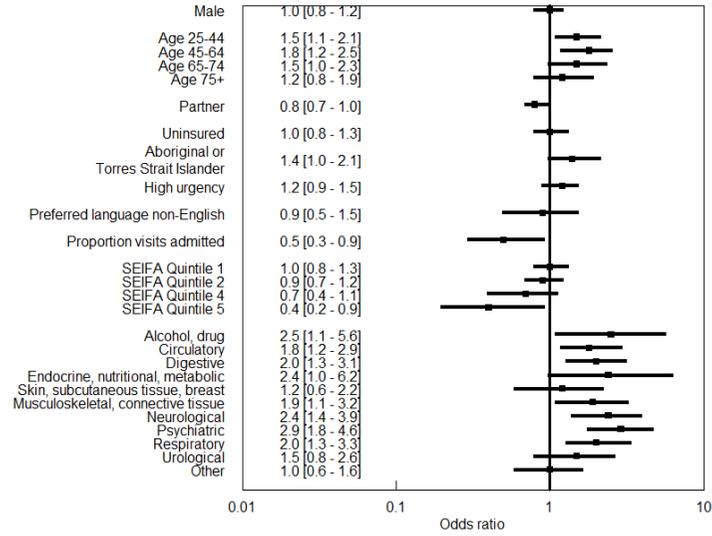
Logistic regression model identifying characteristics associated with ongoing vs temporary frequent attendance. *Left*: Persons aged 16 and over (n=5,803). *Right*: Persons aged under 16 (n=1,546).

Note: Reference categories for persons aged 16 and over - Age: 16-24, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury. Reference categories for persons aged under 16 - Age: 0-4, SEIFA: Quintile 2-5, Major Diagnostic Block: Single Site Major Injury.

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For peer review only



Review only

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Supplementary Material for Here one year, gone the next? Investigating duration and predictors of ongoing frequent emergency department attendance, a retrospective study in Australia.

Table 1. Diagnostic profile of all ED frequent attenders¹ by age group

	Age group ²							All
	0-4	5-15	16-24	25-44	45-64	65-74	75+	
<i>% of frequent attenders</i>	N persons							
	788	768	1004	1867	1677	1042	1431	8577
<i>Most common Major Diagnostic Block</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.2	2.0	0.1	0.0	1.0
Circulatory system illness	0.4	1.8	3.6	5.6	17.2	24.7	24.3	12.3
Digestive system illness	12.4	20.3	22.5	16.2	15.3	12.7	13.2	15.9
Endocrine, nutritional and metabolic system illness	0.6	1.0	1.2	1.1	0.9	1.1	1.0	1.0
Illness of skin, subcutaneous tissue, breast	1.9	4.2	5.2	6.6	4.8	3.0	2.7	4.3
Injury, single site, major	13.6	29.7	17.1	12.6	5.4	3.6	6.2	11.2
Musculoskeletal/connective tissue system illness	0.6	2.6	3.7	6.9	5.5	5.1	3.8	4.6
Neurological system illness	5.2	4.4	4.1	6.4	6.5	5.7	6.8	5.8
Psychiatric illness	0.1	10.2	13.9	16.3	7.0	1.5	1.0	7.8
Respiratory system illness	44.4	5.3	4.5	3.9	14.5	19.6	17.6	14.1
Urological system illness	1.0	1.8	2.4	2.1	4.2	10.5	13.7	5.4
Other MDBs	19.7	18.6	20.8	20.3	16.6	12.7	9.8	16.7
<i>Major Diagnostic Block during study period</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	9.2	12.5	16.1	9.6	1.4	0.8	8.0
Circulatory system illness	4.6	27.3	31.7	40.8	61.9	73.3	73.1	48.7
Digestive system illness	65.7	69.5	63.6	60.2	61.6	65.4	62.0	63.1
Endocrine, nutritional and metabolic system illness	7.0	7.0	5.6	10.0	19.5	22.1	20.6	14.0
Illness of skin, subcutaneous tissue, breast	38.8	39.1	39.2	39.1	35.1	32.6	28.0	35.5
Injury, single site, major	63.3	83.6	68.6	62.6	52.7	43.5	51.8	59.2
Musculoskeletal/connective tissue system illness	16.6	53.4	46.6	49.8	49.5	47.1	43.9	45.3
Neurological system illness	18.8	31.3	36.8	40.4	42.7	48.9	55.2	41.1
Psychiatric illness	1.7	36.6	41.5	44.1	27.4	16.5	15.0	27.8
Respiratory system illness	84.5	44.0	38.6	38.5	54.7	61.6	64.1	53.7
Urological system illness	11.6	21.9	23.7	20.4	30.8	44.6	49.8	30.0

¹ Excludes planned return visits

² Age group at first visit in first period of frequent attendance.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n.a.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9-10
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	9-10
		(d) If applicable, explain how loss to follow-up was addressed	n.a.
		(e) Describe any sensitivity analyses	10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	n.a.
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-12
		(b) Indicate number of participants with missing data for each variable of interest	9-10
		(c) Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(b) Report category boundaries when continuous variables were categorized	8-9, In tables
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14-17
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Here one year, gone the next? Investigating persistence of frequent emergency department attendance, a retrospective study in Australia.

Journal:	<i>BMJ Open</i>
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Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Epidemiology, Health services research, Health policy
Keywords:	emergency department, repeat use, longitudinal study, persistent, social determinants of health

SCHOLARONE™
Manuscripts

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3 **1 Here one year, gone the next? Investigating persistence of frequent emergency**
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5 **2 department attendance, a retrospective study in Australia.**
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8
9 3 Luise Lago PhD^{1,2}, Victoria Westley-Wise MBBS, MPH^{1,3}, Judy Mullan PhD^{1,2}, Kelly
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38
39

40 **15 Keywords:** emergency department; repeat use; longitudinal study; persistent; social
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42 16 determinants of health;
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46 **17 Word count:** Manuscript: 4,112. Abstract: 272.
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3 **18 Abstract**
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7 **19 Objectives:** Patients are presenting to Emergency Departments (EDs) with increasing
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9 **20** complexity at rates beyond population growth and ageing. Intervention studies target patients
10
11 **21** with 12 months or less of frequent attendance. However, these interventions are not well
12
13 **22** targeted since most patients do not remain frequent attenders. This paper quantifies
14
15 **23** temporary and ongoing frequent attendance and contrasts risk factors for each group.
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20 **24 Design:** Retrospective population-based study using 10 years of longitudinal data.
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24 **25 Setting:** An Australian geographic region that includes metropolitan and rural EDs.
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27 **26 Participants:** 332,100 residents visited any ED during the study period.
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31 **27 Main outcome measure:** Frequent attendance was defined as seven or more visits to any ED
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33 **28** in the region within a 12-month period. Temporary frequent attendance was defined as
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35 **29** meeting this threshold only once, and ongoing more than once. Risk factors for temporary
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37 **30** and ongoing frequent attenders were identified using logistic regression models for adults and
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39 **31** children.
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44 **32 Results:** Of 8,577 frequent attenders, 80.1% were temporary and 19.9% ongoing (12.9%
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46 **33** repeat, 7.1% persistent). Among adults, ongoing were more likely than temporary frequent
47
48 **34** attenders to be young to middle aged (age 25-64), and less likely to be from a high socio-
49
50 **35** economic area or be admitted. Ongoing frequent attenders had higher-rates of non-injury
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52 **36** presentations, in particular substance-related (OR=2.5, 99% CI 1.1 to 5.6) and psychiatric
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54 **37** illness (OR=2.9, 99% CI 1.8 to 4.6). In comparison, children who were ongoing were more
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3 38 likely than temporary frequent attenders to be aged 5-15, and were not more likely to be
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5 39 admitted (OR=2.7, 99% CI 0.7 to 10.9).
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9 40 **Conclusions:** Future intervention studies should distinguish between temporary and ongoing
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11 41 frequent attenders, develop specific interventions for each group, and include rigorous
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14 42 evaluation.
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17 43 **Article summary**

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20 44 Strengths and limitations of this study:

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22 45 • Our unique, longitudinal data platform has enabled this study on long-term patterns of
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24 46 attendance to all emergency departments within a single geographic region by frequent
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27 47 attenders over 10 years.
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29 48 • We considered long-term frequent attendance patterns, which allowed for patients
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31 49 discontinuing frequent attendance and resuming later on.
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34 50 • We contrasted socio-demographic and risk factors for temporary versus ongoing frequent
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36 51 attendance and for both adults and children.
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39 52 • We included metropolitan, regional and rural EDs in Australia, however findings from one
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41 53 healthcare setting may not be generalisable to other settings.
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44

45 54 **Funding and support:** The authors acknowledge the Illawarra Health Information Platform
46
47 55 (IHIP) research partnership established between the Illawarra Shoalhaven Local Health
48
49 56 District (ISLHD) and the University of Wollongong, with ISLHD providing funding support
50
51
52 57 and the data used in this study, and the NSW Ministry of Health who authorised the data
53
54 58 release.
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4
5
6 60 McAlister, and Niki Cirillo for reviewing the manuscript, and assistance with accessing data
7
8 61 and interpretation. Patients and the public were not involved in the design or conduct of this
9
10 62 study.

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14 63 **Data statement:** This study accessed data from the Illawarra Health Information Platform
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16 64 (IHIP) non-identifiable databank, established by the Illawarra Shoalhaven Local Health
17
18 65 District (ISLHD) and the University of Wollongong in NSW, Australia, for research,
19
20 66 planning and evaluation purposes. The study used deidentified participant data from 1 July
21
22 67 2005 to 30 June 2015. The Centre for Health Research Illawarra Shoalhaven Population and
23
24 68 the NSW Ministry of Health approved unit record data access. Additional materials are
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26 69 available in the supplementary appendix.

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31 70 **Competing interests:** The authors declare that they have no competing interests.
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71 INTRODUCTION

72 Background

73 Emergency Department (ED) frequent attenders are a complex and vulnerable patient group.¹⁻
74 ⁴ Compared to non-frequent ED attenders, they have higher rates of morbidity and mortality,⁵
75 mental health issues,⁵⁻⁷ substance use problems,^{6,8} and chronic diseases,⁸⁻¹⁰ and are more
76 likely to be homeless¹¹ and of low socio-economic status.¹² By definition, this group accounts
77 for a disproportionate share of ED visits. They are also more likely to attend multiple EDs to
78 address their unmet health needs.⁸

79 Interventions are primarily aimed at reducing ED visits,¹³⁻¹⁷ and improving social and
80 clinical outcomes.^{13,16,18} The most commonly studied intervention is case management.
81 ^{13,10,16,18} Other interventions include establishment of care plans with patient input,¹⁹ and
82 providing case notes from previous ED visits.²⁰ Case management in some cases reduced ED
83 costs and improved social and clinical outcomes, but in many studies had no impact, or
84 increased ED and primary care utilisation.¹³ The limited number of studies with control
85 groups has contributed to a lack of evidence on effective interventions, as before-and-after
86 studies fail to account for the high likelihood of frequent attenders becoming infrequent
87 without intervention.¹

88 Relevance

89 Few studies have investigated long-term use patterns among ED attenders across multiple
90 facilities.²¹ Most studies report data from a single year,²²⁻²⁸ or a small number of years,^{11,16} or
91 from a small number of facilities,^{9,29,30} with ongoing visit patterns given little consideration.¹
92 Multi-site studies of more than 2-3 years are scarce.^{1,21,31,32} The need for research into long-
93 term utilisation patterns among frequent attenders has been identified, in particular

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3 94 understanding predictors of ongoing use,²¹ and analysis by age group and frequency of visit,
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5 95 to distinguish meaningful sub-groups for intervention.^{1,33}
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8 96 Research addressing these knowledge gaps will assist with identifying and distinguishing
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10 97 the characteristics of ongoing frequent attenders from those with temporary frequent ED use.
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12 98 This information will assist in planning appropriate support or interventions for the temporary
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14 99 and ongoing subgroups of frequent attenders.
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17 18 100 **Objectives**

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21 101 The aim of this study was to contrast the attributes and risk factors of temporary frequent
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23 102 attenders, with ongoing frequent attenders. The ongoing frequent attenders were further
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25 103 subdivided into repeat frequent attenders, who met the frequent attendance threshold twice,
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27 104 and persistent frequent attenders, who met the threshold in three or more periods.
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31 32 105 **METHODS**

33 34 35 106 **Study design and setting**

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38 107 A retrospective population-based study was carried out using longitudinal data from an
39
40 108 Australian regional health service, the Illawarra Shoalhaven Local Health District (ISLHD).
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42 109 The district services almost 390,000 residents in a 250 kilometre long coastal catchment area,
43
44 110 covering rural, regional and metropolitan areas.³⁴ Five of the eight public hospitals within the
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46 111 district have an ED, the largest being one of the busiest adult and paediatric emergency
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48 112 departments in the state of New South Wales.³⁵
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52 53 113 **Selection of participants**

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56 114 This negligible risk study accessed data from the Illawarra Health Information Platform
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58 115 (IHIP). IHIP is a non-identifiable databank established by the ISLHD and the University of
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3 116 Wollongong for research, planning and evaluation purposes. IHIP holds a unique record
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5 117 number for every person who has accessed any ISLHD service since the late 1980s.
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8 118 Emergency Department data were analysed for all individuals who attended any of the
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10 119 district's EDs at least once between 1 July 2005 and 30 June 2015. Non-residents of the
11
12 120 district's catchment area were excluded.

14 121 **Ethical approval**

16 122 The study involved the use of existing non-identifiable data sourced from ISLHD routine
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18 123 administrative data and accessed from IHIP. Ethical approval for establishment of IHIP's
19
20 124 non-identifiable databank, including the ISLHD administrative data, was obtained from the
21
22 125 University of Wollongong and Illawarra Shoalhaven Local Health District's Health and
23
24 126 Medical Human Research Ethics Committee (HREC) on 14 November 2016 (Ethics number:
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26 127 2016/306). The CHRISP Executive Steering Committee also approved this study. This
27
28 128 committee includes senior representatives of both institutions including the Chief Executive
29
30 129 and Director of Research at ISLHD, and the Deputy Vice-Chancellor Research at UOW. The
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32 130 committee, as the institutional review board, deemed the study exempt from ethical review,
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34 131 as it was negligible risk, involved only routinely collected non-identifiable data that had
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36 132 already been approved by the HREC, and were already stored in IHIP, used only unlinked
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38 133 data, and did not require any further approvals (e.g. specific ethics approval from the
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40 134 Aboriginal Health & Medical Research Council). This study was completed in accordance
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42 135 with the National Statement on Ethical Research 2007 (updated 2018, The National Health
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44 136 and Medical Research Council, the Australian Research Council and Universities Australia)
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46 137 and the Helsinki Declaration (as revised in 2013).

54 138 **Patient and Public Involvement**

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56 139 Previous studies by the authors on patient's reasons for attending ED,³⁶ and other literature
57
58 140 on patient perspectives in the ED,³⁷ shaped the research questions, including a focus on

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3 141 understanding long-term use patterns rather than individual visits. The retrospective study
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5 142 was designed to inform future interventions and research. While patients were not directly
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7 143 involved in the design or conduct of this study, a steering group that includes a patient
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9 144 advisor will contribute to research translation and dissemination activities. Dissemination to
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11 145 patients will also occur through the health district's Community Partnership Council and
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13 146 other established patient advisory committees.
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18 147 **Outcomes**

19
20 148 The primary outcome of the study was an estimate of the proportion of frequent attenders for
21
22 149 whom frequent attendance is a temporary phenomenon (occurring only once during the study
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24 150 period). A secondary outcome was to identify and contrast risk factors for temporary and
25
26 151 ongoing frequent attendance to highlight characteristics associated with a continuing frequent
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28 152 ED use.
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34 153 **Measurements**

35
36 154 Historically, frequent ED use has been defined as three to 12 visits per year,⁵ while highly
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38 155 frequent use has been defined as four to 20 visits per year.^{7,38} Because of this variation,
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40 156 Locker et al proposed that more than four ED visits per year was a non-random event, and
41
42 157 suggested this become a standard threshold for defining frequent ED attendance.⁶ This study
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44 158 uses a more recently proposed definition based on a divergence of patient characteristics,
45
46 159 where non-frequent attenders present 1-6 times in a year, and frequent attenders 7 or more
47
48 160 times in a year.³⁹ A sub-group of highly frequent attenders,³⁹ who made 18 or more visits to
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50 161 EDs in any 12-month period, were also investigated.
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55 162 A 12-month window was used to count ED visits following a first (or index) ED visit, a
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57 163 patient-based timeline not defined by calendar year.^{39,40} Subsequent 12 month windows
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3 164 commenced at the next ED visit after each 12-month window. Consequently, a subsequent
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5 165 period of frequent attendance was not constrained to immediate following a first period.
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8 166 Duration of frequent ED attendance was measured by the number of 12-month windows
9
10 167 each patient had frequent ED use. Sub-groups of frequent attenders were identified to provide
11
12 168 insight into the varying needs of this complex and heterogeneous patient group. Temporary
13
14 169 frequent attenders were defined as those who met the frequent attendance threshold once
15
16 170 during the study period, and ongoing frequent attenders were looked at in two groups - repeat
17
18 171 frequent attenders who met the threshold twice, and persistent frequent attenders, who met
19
20 172 the threshold three or more times.
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23
24 173 Demographic characteristics such as age, sex, preferred language, and marital status were
25
26 174 analysed according to the first ED visit in the study period. Private hospital insurance status
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28 175 and Aboriginal and Torres Strait Islander status were analysed according to the most recent
29
30 176 visit to the ED,⁴¹ due to a higher proportion of missing data in the early study years. Triage
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32 177 category was averaged over all visits with an average of 4 to 5 considered low urgency. The
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34 178 proportion of all ED visits resulting in a hospital admission was calculated for each person.
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38 179 Socioeconomic status was based on Index of Relative Socio-economic Disadvantage
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40 180 (IRSD) information.⁴² Each Australian postal area has an IRSD score and ranking. For the
41
42 181 purposes of this study, the rankings which were summarised as deciles were reduced to
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44 182 quintiles, with low ranks representing the most disadvantaged.
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47 183 Patient diagnosis was recorded on discharge from the ED. Between 2009 and 2012 each
48
49 184 ED within the regional health service transitioned from ICD-9-CM diagnosis coding to
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51 185 SNOMED recording of diagnosis. For this study, diagnoses according to ICD-9-CM coding
52
53 186 and SNOMED were therefore mapped to ICD-10-AM⁴³ and then aggregated to Major
54
55 187 Diagnostic Blocks (MDB) using the Independent Hospital Pricing Authority's Urgency
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57 188 Related Group software v1.4.4.⁴⁴ Frequent ED attenders were primarily analysed according to
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3 189 their most common MDB to reduce the likelihood of bias from with missing data (such as
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5 190 during system transition and for patients who did not wait), but also described based on
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8 191 whether they ever had a diagnosis in each MDB.
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11 192 **Data analysis**

13 193 Associations between categorical variables were evaluated using Pearson's Chi Square Test.
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15 194 Multivariate mixed logistic regression models with crossed random effects to control for
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17 195 attendance at one or more ED's were used to identify factors associated with frequent
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19 196 attendance among persistent, repeat and ongoing groups, each compared with non-frequent
20
21 197 attenders. Results were summarised as odds ratios (OR) and confidence intervals (CI)
22
23 198 presented with alpha of 5% adjusted for multiple comparisons via Bonferroni correction
24
25 199 according to the number of model parameters estimated in each model. This resulted in odds
26
27 200 ratios with 99.8% confidence intervals for models relating to adults, and 99.6% relating to
28
29 201 children (where less model parameters were used). Demographic, diagnosis (MDB), and visit
30
31 202 characteristics were included in regression models. The proportion of missing data was
32
33 203 generally low, ranging from <1% for items such as sex, Aboriginal or Torres Strait Islander
34
35 204 status, socioeconomic status and triage category, to 5.3% for preferred language, 10.8% for
36
37 205 hospital insurance and 11.4% for marital status. Those without an assigned MDB due to; no
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39 206 recorded diagnosis (7.5%), a diagnosis code not recognised by the grouper (3.9%) or patients
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41 207 who did not wait (3.5%), were excluded from analysis by diagnosis. Planned return visits
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43 208 accounted for 3.1% of all ED visits, and these were excluded from all analyses. Sensitivity
44
45 209 analyses were carried out with an alternative threshold for frequent ED attendance of four
46
47 210 visits per year, and including planned return visits. Statistical significance was set at 5%. All
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49 211 statistical analysis was conducted using SAS version 9.4.⁴⁵ Multilevel logistic models with
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51 212 crossed random effects were fit using PROC GLIMMIX with model fit, discrimination and
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213 calibration assessed using Chi-squared/ degrees of freedom, Area Under the Curve (AUC)
214 and Hosmer-Lemeshow chi-square respectively.

215 **RESULTS**

216 A total of 1,199,633 ED visits by 332,100 individuals were recorded across the 10-year study
217 period (Table 1). Of residents who attended the ED, 2.6% (n=8 577) met the threshold for
218 frequent attendance (attended seven or more times within a 12-month window).

219 Among frequent attenders, most (n=6866, 80.1%) met the attendance threshold only once
220 (temporary frequent attenders) (Figure 1). A further 12.9% (n= 1104) met the threshold twice
221 (repeat frequent attenders), while only 7.1% (n=607) met the threshold on three or more
222 occasions (persistent frequent attenders). Over the 10 years, these 607 persistent frequent
223 attenders made 38,338 ED visits. A similar pattern of predominantly temporary frequent
224 attendance was observed in each age group (Figure 1).

225 A sensitivity analysis including planned return visits indicated similar patterns of long
226 term ED use. For example, 81.4% of frequent attenders were temporary frequent attenders
227 when planned return visits were included. When the threshold of frequent attendance was
228 reduced to four visits in 12-months, 75.6% of individuals were temporary frequent attenders.

229 **Demographic and visit characteristics**

230 Compared to non- frequent attenders, frequent attenders were more likely to be male, older
231 (aged 65 or over), Aboriginal or Torres Strait Islander, have no partner, from non-English
232 speaking backgrounds, un-insured (publically insured only patients), and resident in lower
233 socio-economic areas (Table 1). Compared to the other groups of frequent attenders,
234 persistent frequent attenders were young to middle aged adults, female, Aboriginal or Torres
235 Strait Islander, had no partner, were from lower socioeconomic areas, un-insured (publically
236 insured only patients) and not admitted (Table 1). During the ten-year study period, frequent

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3 237 attenders had an average of 21.0 ED visits, compared to 3.2 for non- frequent attenders, with
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5 238 more frequent attenders admitted to hospital.
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9 **239 Diagnostic profile**

10
11 240 The most common diagnoses among frequent attenders were digestive, respiratory,
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13 241 circulatory, single site major injury and psychiatric illness (Supplementary Material Table 1),
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15
16 242 however diagnostic profile differed by age and length of frequent attendance.
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18
19 243 Among the youngest frequent attenders, aged 0-4 years, respiratory illness was the most
20
21 244 common diagnosis across all groups' frequent attenders (Table 2). Among children aged 5-15
22
23 245 years, injury and digestive system illnesses were the two most common diagnoses in all sub-
24
25 246 groups, with injury being the most common diagnosis among temporary frequent attenders
26
27
28 247 and digestive system illness among the persistent frequent attenders. Children also presented
29
30 248 with psychiatric illness, which was the most common diagnosis for 9.3% of temporary
31
32 249 frequent attenders, 14.3% of repeat frequent attenders and 12.7% of persistent frequent
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34
35 250 attenders.
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37 251 While injury and digestive system illness were also common among older teenagers and
38
39 252 young adults (16-24 and 25-44 years), there were increasing numbers of patients visiting ED
40
41 253 primarily for psychiatric illness, particularly among repeat frequent attenders aged 25-44
42
43
44 254 years and persistent frequent attenders (Table 2).
45

46 255 Among adults aged 45-64 years, the most common diagnoses were circulatory, digestive
47
48 256 and respiratory illnesses. Among older adults 65 years and above, circulatory followed by
49
50 257 respiratory system illnesses were most common, with the exception of persistent frequent
51
52
53 258 attenders who had more respiratory illness than circulatory illness. In the older age groups,
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55 259 aged 75 years and above, digestive system and urological system illness were common among
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57
58 260 all frequent attendee groups.
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3 261 Analysis of all diagnoses reported in the study period (rather than most common) shows
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5 262 that from the age of 25 years, ED visits relating to single site major injuries were common
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8 263 among temporary and repeat frequent attenders, while persistent frequent attenders had higher
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10 264 proportions of respiratory, musculoskeletal, neurological and psychiatric visits (Table 2).
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12 265 Among ongoing frequent attenders aged 5-15, 16-24 and 25-44, more than half presented with
13
14 266 a psychiatric diagnosis at least once during the study period.
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18 267 **Risk factors associated with frequent attendance**

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20 268 Multivariate multilevel logistic regression models with crossed random effects were fit to
21
22 269 assess the likelihood of being a frequent attenders, based on socio-demographic and visit
23
24 270 characteristics and diagnoses for those aged 16 and over (Table 3) and those aged under 16
25
26 271 (Table 4). Consistent with the findings of the earlier descriptive analysis, being an adult
27
28 272 frequent attender was associated with being: male; older; Aboriginal or Torres Strait Islander;
29
30 273 un-insured (publically insured only patients); socio-economically disadvantaged; presenting
31
32 274 with higher urgency; lower likelihood of admission; and less likely to have a partner (Table
33
34 275 3). Compared to the reference category (single site major injury), frequent attendance was
35
36 276 associated with all diagnostic groups, with the highest odds of psychiatric illness (OR=6.2,
37
38 277 99% CI 5.1 to 7.5) and alcohol/drug related disorders (OR=6.4, 99% CI 4.3 to 9.7) (Table 3).
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44 278 Among children aged under 16, frequent attenders were more likely to be older (age 5 to
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46 279 15) and similarly to adult frequent attenders, were more likely to be Aboriginal or Torres
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48 280 Strait Islander, un-insured (publically insured only patients); socio-economically
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50 281 disadvantaged; and present with higher urgency (OR=2.3, 99% CI 1.9 to 2.9). However, they
51
52 282 were not more likely to be male; and were no less likely to be admitted than non- frequent
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54 283 attenders (Table 4).
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57 284 Compared to the reference category (single site major injury), frequently attending
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59 285 children aged under 16 were more likely to present with digestive illness, neurological system
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3 286 illness, and respiratory illness. As with adults, the highest risk of frequent attendance was
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5 287 presenters with psychiatric illness (OR=6.7, 99% CI 4.1 to 11.1) (Table 4).
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9 **288 Risk factors associated with frequent attendance by duration**

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11 289 Models fitted separately for each frequent attendance sub-group (temporary frequent
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13 290 attenders compared to non-frequent, repeat frequent attenders compared to non-frequent and
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15 291 persistent frequent attenders compared to non-frequent attenders) led to different
16
17 292 demographic risk factors. While temporary adult frequent attenders were more likely to be
18
19 293 male, after adjusting for other characteristics, sex was not a risk factor for repeat (OR=1.2,
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21 294 99% CI 1.1 to 1.3) or persistent frequent attenders (OR=1.0, 99% CI 0.7 to 1.2) (Table 3).
22
23 295 Persistent adult frequent attenders were also more likely to be in the middle age groups, aged
24
25 296 25-44 years. Among those aged under 16, repeat frequent attenders were more likely to be
26
27 297 female and aged 5 to 15 (OR=0.6, 99% CI 0.3 to 1.0), which was the same OR for persistent
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29 298 attenders (OR=0.6, 99%CI 0.2 to 1.4), though not statistically significant after adjustment for
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31 299 multiple comparisons (Table 4).
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37 300 Demographic and clinical risk factors for adult frequent attendance were in many cases
38
39 301 magnified among repeat and persistent frequent attenders (Table 3). For example, Aboriginal
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41 302 or Torres Strait Islander background was a larger risk factor for those with long periods of
42
43 303 frequent attendance (temporary frequent attenders OR=1.9, 99% CI 1.5 to 2.3 and persistent
44
45 304 frequent attenders OR=2.6, 99% CI 1.6 to 4.2) and having a partner was less likely among
46
47 305 longer duration frequent attenders (temporary frequent attenders OR=0.7, 99% CI 0.7 to 0.8
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49 306 and persistent frequent attenders OR=0.5, 95% CI 0.4 to 0.7).
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53 307 Alcohol and drug-related disorders were much more prominent among longer-duration
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55 308 frequent attenders (temporary frequent attenders OR=5.1, 99% CI 3.2 to 8.2 compared to
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57 309 persistent frequent attenders OR=17.9, 99% CI 6.2 to 51.5), as were neurological illness
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59 310 (temporary frequent attenders OR=1.8, 99% CI 1.4 to 2.3 compared to persistent frequent
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3 311 attenders OR=6.8, 99% CI 3.3 to 13.7), and psychiatric illness (temporary frequent attenders
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5 312 OR=4.8, 99% CI 3.8 to 6.0 compared to persistent frequent attenders OR=13.7, 99% CI 7.1 to
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7 313 26.5) (Table 3).
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11 314 **Risk factors for temporary versus ongoing frequent attendance**

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14 315 Risk factors for the ongoing frequent attender group (repeat and persistent combined)
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16 316 were modelled in comparison to temporary frequent attenders. This confirmed the earlier
17
18 317 findings that ongoing frequent attenders are younger (aged 25-64) but less likely to have be
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20 318 admitted, or be from high socio-economic areas (Figure 2, left image). Substance-related
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22 319 visits, psychiatric illness, and neurological illness were again more likely for ongoing
23
24 320 frequent attenders. Among children aged under 16, ongoing frequent attenders were more
25
26 321 likely than temporary frequent attenders to be aged 5-15 (Figure 2, right image). Highly
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28 322 frequent users (18 or more visits in any 12-month period) were more likely to be ongoing
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30 323 frequent attenders. Among those who only met the lower frequent attendance threshold (7-17
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32 324 visits in a 12-month period), 5.1% were persistent frequent attenders. In contrast, of patients
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34 325 who met the highly frequent threshold at least once (18 or more visits in any 12-month
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36 326 period), 45.5% were persistent frequent attenders.
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43 327 **DISCUSSION**

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45 328 This investigation of 10 years of longitudinal ED data has provided a novel perspective on
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47 329 the risk factors by duration of frequent attenders, for both adults and children. Investigation
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49 330 of visits to all EDs in the region found the majority of frequent ED attenders are temporary
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51 331 and only approximately 20% remain as frequent attenders in any of up to nine subsequent
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53 332 years. Persistent frequent attenders only accounted for 7.1% of frequent attenders. This did
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55 333 not vary when the threshold was reduced from seven down to four visits in 12 months, or
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57 334 when planned return visits were included in the analyses.
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3 335 The estimate that 80.1% of frequent attenders are temporary is slightly higher than
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5 336 other shorter-term studies carried out in the US,^{1, 33,43,46} Sweden³ and New Zealand,⁴⁷ where
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7 337 estimates varied between 58 and 72%. Definitions of temporary frequent attenders differ
8
9 338 slightly across studies, including: the threshold number of visits for frequent attenders;
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11 339 whether the period of frequent attendance is patient-based (using an index visit) or calendar
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13 340 based; whether another period of frequent attendance immediately follows the first frequent
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15 341 attendance period or is during the study period. We considered any periods of frequent
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17 342 attendance across the entire study period, to be inclusive of patients who re-established
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19 343 frequent attendance patterns.⁴⁸

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23 344 Systematic reviews show that internationally, intervention studies have been targeting
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25 345 the entire frequent attender cohort.^{13,14} However, differences in profile and risk factors for
26
27 346 ongoing frequent attenders compared to temporary frequent attenders, and for adults and
28
29 347 children, demonstrate a need to consider different types of interventions. In particular, the
30
31 348 cohort of persistent frequent attenders may receive more benefit from case management, and
32
33 349 increased continuity of primary care provider⁴⁹ than temporary frequent attenders. Young
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35 350 adults with ongoing frequent attendance related to substance disorders and psychiatric illness
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37 351 may benefit from additional services outside the ED, while among children, older females
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39 352 with neurological conditions (predominantly seizure-related and headaches) could benefit
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41 353 from pathways which reduce the likelihood of admission and result in reduced length of
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43 354 hospital stay.⁵⁰

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47 355 Our research has shown a complex relationship between ED attendance and hospital
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49 356 admission. Multivariate analysis showed frequent ED attendance was inversely associated
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51 357 with hospital admission, and duration of frequent ED attendance was not associated with
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53 358 hospital admission among adults, suggesting some frequent attenders may be treated and/or
54
55 359 managed in a different setting. Highly frequent users do not use other health care services
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3 360 proportionally more than (low volume) frequent users,³⁹ suggesting highly frequent attenders
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5 361 may use ED's as a main source of care. It is therefore possible that the persistent frequent
6
7 362 attender cohort, of which almost half were highly frequent attenders, also use the ED as a
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9
10 363 main source of care.

11
12 364 The heterogeneity of frequent attenders has contributed to ineffective policy
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14 365 development, with interventions needing to target specific sub-groups.⁵ Similar to evidence in
15
16 366 the literature, we identified three vulnerable patient groups at high risk of frequent
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18 367 attendance; those in situations of socioeconomic distress (e.g. low income, homelessness,
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20 368 social isolation),^{8,9,11,21,51} those living with mental health and substance use problems;^{8,21,39,47}
21
22 369 and the elderly.^{5,52} The first two of these groups are more likely to be ongoing frequent
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24 370 attenders, while the latter, elderly group tend to be temporary frequent attenders. Due to the
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26 371 ongoing nature of frequent ED attendance by those with socioeconomic and mental health
27
28 372 issues, or both, it is imperative to find cost-effective alternatives. Temporary older frequent
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30 373 attenders are driving increases in ED utilisation and changing the clinical profile of
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32 374 EDs.^{53,54,55,56} This group are multimorbid, with complex, ongoing health care needs, and
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34 375 required improved identification and management of those at risk of return.^{52,54,57,58} To date,
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36 376 hospital-based interventions for these elderly patients have had little effect on ED use,
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38 377 potentially due to their typically short-term nature. However, a systematic review found that
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40 378 interventions in outpatient and primary care/home settings (including geriatric assessment
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42 379 and management and case management) have reduced ED use among this patient cohort.⁵⁹

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44 380 Our research has shown a complex relationship between ED attendance and hospital
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46 381 admission and found longitudinal ED data investigating ongoing frequent use identifies
47
48 382 additional and inflated risk factors. In accordance with the recommendations of Pines et al,³³
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50 383 the authors future research agenda includes using data in model development and testing for
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52 384 predicting patients who are at risk of becoming and/or remaining frequent attenders. This will
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3 385 improve generalisability of existing predictive models, which are mostly from the U.S.,^{46,60,61}
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5 386 often have small samples,^{11,60} focus on a specific patient sub-group (e.g. Medicaid users,⁴⁶ or
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7 387 using inconsistent thresholds for frequent attendance (3, 4 or 10 visits in a year).^{11,60,61}
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11 388 **Limitations**

13
14 389 The inclusion of any patients whose with frequent attendance for any 12 month period during
15
16 390 the 10 year study period enabled patients to be grouped according to long-term patterns of
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18 391 frequent attendance, however some temporary and repeat frequent attenders may have been
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20 392 classified differently had all participants had equal follow up time.
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23 393 Logistic regression models identifying factors associated with frequent attendance used
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25 394 both characteristics of the person (e.g. socio-demographics) and their presentations to ED
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27 395 (diagnosis, urgency) throughout the study period, therefore there is confounding between the
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29 396 independent and dependent variables. When developing models to predict future frequent
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31 397 attendance, these would need to use only characteristics prior to a period of frequent
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33 398 attendance. Data quality, data consistency and the amount of missing information (in
34
35 399 particular diagnosis) improved over time, which may impact descriptive and modelling
36
37 400 results. The effect of missing diagnoses was minimised by modelling a patient's most
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39 401 common diagnostic block over all visits. While hospital insurance and preferred language
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41 402 were imputed using recent data, having a partner was considered more likely to change over
42
43 403 the study period so missing cases were excluded from models.
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48 404 Social variables that may increase the risk of frequent attendance, such as use of
49
50 405 primary care services, homelessness or isolation, are not routinely collected. Other factors
51
52 406 that may be predictive of frequent attendance, such as patient satisfaction with treatment, and
53
54 407 having a regular source of care⁶² were not collected.
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57 408 We could not link to data on deaths outside of the public hospital system and
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59 409 therefore could not explore reasons for patients discontinuing frequent attendance, however
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3 410 this is an area of potential future research. Finally, while we included data from metropolitan
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5 411 and rural EDs in one region in Australia, this may not be generalisable to other settings.
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9 412 **Conclusions**

10
11 413 This study has provided a unique, longitudinal perspective on ED frequent attenders,
12
13 414 contrasting the demographic and diagnostic profile of temporary, repeat and persistent
14
15 415 frequent attenders. The distinction between temporary and ongoing frequently attending
16
17 416 cohorts should be used when describing frequent attenders, and to inform appropriate
18
19 417 interventions and better direct health resources.
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24 418 **Author contributions**

25
26 419 LL carried out analysis, interpretation, and drafted the manuscript, VWW and KL assisted
27
28 420 with interpretation of the data and assisted with drafting and reviewing the manuscript, RZ,
29
30 421 JM, TC, and WT contributed to interpretation of the data and reviewed the manuscript, KE
31
32 422 was responsible for the study conception and contributed to interpretation of the data and
33
34 423 reviewed the manuscript.
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Table 1. Characteristics of ED patients, 12-month windows, and visits* by length of frequent attendance

Patients	Frequent Attenders				Non-frequent ED attenders (N=323,523)	ED attenders (N=332,100)
	Temporary (N=6,866)	Repeat (N=1,104)	Persistent (N=607)	All (N=8,577)		
Age group (% of patients) **						
0-4	10.4	5.7	2.3	9.2	13.4	13.3
5-15	9.0	8.9	9.1	9.0	12.6	12.5
16-24	11.5	12.5	12.4	11.7	12.6	12.6
25-44	20.2	24.3	34.9	21.8	22.6	22.6
45-64	18.8	21.9	23.7	19.6	20.2	20.2
65-74	12.4	12.6	8.7	12.2	8.6	8.7
75+	17.8	14.1	8.9	16.7	10.1	10.2
Sex (% of patients) ††						
Male	53.8	51.5	46.8	53.0	51.3	51.3
Female	46.2	48.6	53.2	47.0	48.8	48.7
Indigenous (% of patients) ††**						
Aboriginal or Torres Strait Islander origin	7.4	10.6	12.5	8.2	3.3	3.4
Neither Aboriginal nor Torres Strait Islander origin	92.6	89.4	87.5	91.8	96.8	96.6
Partner ††*** (% of patients, persons aged						
Yes	45.1	39.0	30.2	43.2	53.8	53.5
No	54.9	61.0	69.8	56.8	46.2	46.5
Private hospital insurance (% of						
Yes	17.3	16.1	11.7	16.8	32.0	31.6
No	82.7	83.9	88.3	83.3	68.0	68.4
Preferred language (% of patients) ††***						
English	78.9	82.2	82.1	79.6	87.7	87.5
Other	21.1	17.8	17.9	20.4	12.3	12.5
Socio-economic status ††*** (% of						
Quintile 1 (low)	30.0	32.8	34.4	30.7	22.2	22.4
Quintile 2	26.6	24.6	25.0	26.3	22.8	22.9
Quintile 3	32.8	35.6	34.6	33.3	40.4	40.2
Quintile 4	5.7	4.1	4.1	5.4	7.6	7.5
Quintile 5 (high)	4.8	2.9	1.8	4.4	7.0	7.0
Visits	(N=108,858)	(N=32,643)	(N=38,338)	(N=179,839)	(N=1,019,794)	(N=1,199,633)
Visits in study period (mean visits)	15.9	29.6	63.2	21.0	3.2	3.6
Visits per 12-month window (with 1+ visit) (mean visits)	4.2	5.8	9.5	5.1	1.7	1.8
Admitted (% of visits) ††***						
Yes	37.0	38.0	33.5	36.4	30.8	31.6
No	63.0	62.0	66.5	63.6	69.2	68.4
Triage category ††*** (% of visits)						
1 (highest urgency)	0.5	0.5	0.5	0.5	0.5	0.5
2	7.7	8.3	7.7	7.8	6.7	6.9
3	30.0	30.3	28.8	29.9	28.0	28.3
4	45.1	45.7	46.6	45.8	50.7	49.9
5 (lowest urgency)	16.7	15.3	16.4	16.7	14.2	14.5

* Excludes planned return visits

† As reported at earliest ED visit in study period

‡ χ^2 test for patient type (temporary frequent attendee, repeat frequent attendee, ongoing frequent attendee by: age $\chi^2_{12} = 164.5$ ($p < .0001$), sex $\chi^2_2 = 12.2$ ($p = 0.002$), Indigenous $\chi^2_2 = 29.1$ ($p < .0001$), Partner $\chi^2_2 = 43.8$ ($p < .0001$), Hospital insurance $\chi^2_2 = 10.8$ ($p = 0.045$) Preferred language $\chi^2_2 = 8.6$ ($p = 0.014$), Socio-economic status $\chi^2_8 = 34.6$ ($p < .0001$), Admitted $\chi^2_2 = 196.7$ ($p < .0001$), Triage category $\chi^2_8 = 76.0$ ($p < .0001$). Excludes unknown, missing, and not-stated.

§ As reported at most recent ED visit in study period. This is the recommended approach for Indigenous status (Randall et al 2013) and was required for hospital insurance due to incomplete early data at two facilities.

** Percentage missing, unknown, not stated - Partner 11.5%, Indigenous status (at last ED visit) 0.9%, Socio-economic status 0.0%, Hospital insurance (at last ED visit) 10.8%, Preferred language 5.3%, Admitted 0.0%, Triage category 0.2%

Table 2. Diagnostic profile of ED frequent attender patients* by duration of frequent attendance and age group (% of patients)

% of patients	Temporary frequent attender (frequent attender in one 12-month period)								Repeat frequent attender (frequent attender in two 12-month periods)								Persistent frequent attender (frequent attender in three or more 12-month periods)							
	Age group†								Age group								Age group							
	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All	0-4	5-15	16-24	25-44	45-64	65-74	75+	All
N persons	711	615	791	1387	1291	850	1221	6866	63	98	138	268	242	139	156	1104	14	55	75	212	144	53	54	607
<i>Most common Major Diagnostic Block</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.0	1.6	0.0	0.0	0.8	0.0	0.0	‡	2.6	2.9	0.0	0.0	1.4	0.0	0.0	‡	2.8	4.2	‡	0.0	2.3
Circulatory system illness	*	1.3	3.5	5.5	17.5	24.4	23.7	12.2	0.0	5.1	‡	4.5	15.3	25.2	32.7	13.0	0.0	‡	‡	7.6	18.1	28.3	14.8	11.5
Digestive system illness	12.2	18.5	21.4	15.9	14.4	12.0	13.6	15.2	14.3	22.5	26.8	15.7	19.4	13.8	9.6	17.6	‡	36.4	26.7	18.4	16.7	15.1	14.8	19.9
Endocrine, nutritional and metabolic system illness	‡	0.8	0.9	1.1	0.7	1.1	1.2	0.9	‡	‡	‡	‡	2.1	‡	‡	1.4	0.0	‡	‡	‡	‡	0.0	0.0	1.3
Illness of skin, subcutaneous tissue, breast	2.0	4.7	5.6	7.1	5.4	3.3	2.9	4.7	‡	‡	5.1	5.6	2.9	‡	‡	3.4	0.0	‡	‡	4.3	‡	0.0	‡	2.6
Injury, single site, major Musculoskeletal/connective tissue system illness	14.5	31.7	20.0	13.4	6.3	3.9	6.2	12.1	‡	21.4	7.3	12.7	2.1	‡	5.8	7.7	‡	21.8	‡	7.6	3.5	0.0	‡	6.9
Neurological system illness	0.7	2.9	3.0	6.0	5.3	5.4	4.2	4.3	0.0	‡	5.1	9.3	6.6	5.0	‡	5.3	0.0	‡	8.0	9.4	5.6	0.0	‡	6.1
Psychiatric illness	4.6	3.6	3.5	5.6	5.3	5.9	7.0	5.3	9.5	7.1	5.1	6.3	8.7	5.8	3.9	6.5	‡	9.1	8.0	11.3	13.2	‡	11.1	10.4
Respiratory system illness	0.0	9.3	11.3	13.1	5.9	1.4	1.0	6.2	‡	14.3	21.0	25.0	10.7	‡	‡	12.9	0.0	12.7	29.3	26.4	10.4	‡	0.0	16.6
Urological system illness	44.0	6.0	4.6	4.0	14.3	18.4	17.1	14.4	47.6	‡	5.1	4.9	14.5	21.6	19.9	13.6	0.0	0.0	‡	2.4	16.7	34.0	22.2	11.2
Other MDBs	1.1	1.3	2.5	2.5	4.7	10.6	13.3	5.6	0.0	6.1	‡	‡	3.3	10.1	16.7	5.3	0.0	0.0	‡	‡	‡	9.4	14.8	3.2
20.0	19.8	22.8	23.9	18.7	13.8	10.0	18.3	19.1	15.3	18.1	11.2	11.6	7.9	7.7	12.1	‡	10.9	‡	8.0	6.9	7.6	11.1	7.9	
<i>Major Diagnostic Block during study period</i>																								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	8.5	10.5	11.8	7.3	1.5	0.7	6.0	0.0	10.2	17.4	26.1	16.5	0.0	‡	13.2	0.0	16.4	24.0	31.6	18.8	‡	‡	20.4
Circulatory system illness	4.1	22.4	29.6	35.3	58.9	69.5	71.5	45.4	7.9	40.8	31.9	49.6	65.7	89.9	81.4	57.3	‡	58.2	53.3	65.6	82.6	90.6	85.2	70.2
Digestive system illness	63.4	65.5	58.7	54.2	57.0	61.5	59.9	59.1	85.7	79.6	79.7	70.9	71.9	79.9	74.4	75.5	‡	96.4	85.3	85.9	85.4	88.7	74.1	86.0
Endocrine, nutritional and metabolic system illness	6.5	6.0	3.5	7.9	16.9	20.4	19.0	12.3	12.7	10.2	10.9	13.1	24.4	23.7	30.1	18.8	1.1	12.7	17.3	20.3	24.7	45.3	29.6	25.4
Illness of skin, subcutaneous tissue, breast	38.1	36.3	36.8	36.0	33.4	29.5	26.6	33.4	46.0	46.9	44.2	46.6	37.2	44.6	33.3	42.1	0.9	56.4	56.0	49.5	46.5	30.2	44.4	47.9
Injury, single site, major Musculoskeletal/connective tissue system illness	62.6	82.3	66.4	57.7	48.8	42.2	50.8	56.6	69.8	87.8	74.6	71.3	61.2	46.8	55.8	65.6	1.4	90.9	81.3	38.4	22.7	6.3	7.3	76.9
15.3	48.1	42.4	44.7	44.6	43.8	41.4	41.0	27.0	66.3	56.5	59.0	57.9	59.0	55.1	56.7	‡	89.1	73.3	71.7	79.2	69.8	66.7	73.8	

* Excludes planned return visits

† Age group defined at first visit in first period of frequent attendance

‡ Cell suppressed, n ≤ 5

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Neurological system illness	18.1	27.8	30.7	32.3	36.6	44.2	52.5	36.3	23.8	37.8	52.9	55.6	56.2	64.0	64.1	54.3	†	58.2	70.7	74.1	75.0	83.0	68.5	71.7
Psychiatric illness	1.4	31.1	36.0	36.3	23.0	15.4	14.2	23.2	‡	54.1	58.7	62.7	36.0	18.7	21.2	40.9	‡	67.3	68.0	71.2	52.1	28.3	16.7	55.7
Respiratory system illness	83.5	39.5	34.6	32.6	50.0	58.6	61.6	50.4	92.1	53.1	46.4	48.5	66.5	71.9	76.3	62.0	‡	78.2	65.3	64.2	77.1	83.0	85.2	73.0
Urological system illness	11.1	17.7	21.0	17.9	27.3	40.4	47.4	27.3	14.3	32.7	27.5	24.3	42.6	65.5	60.3	39.1	‡	49.1	45.3	31.6	42.4	58.5	72.2	43.2

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Table 3. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged 16 or over

Variable	Non-frequent vs all frequent attenders ⁹		Non-frequent vs temporary frequent attenders ¹⁰		Non-frequent vs repeat frequent attenders ¹¹		Non-frequent vs persistent frequent attenders ¹²	
	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)
Sex								
Male	1.2	(1.1,1.3)	1.2	(1.1,1.3)	1.2	(1.0,1.5)	0.9	(0.7,1.2)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
16-24 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
25-44	1.2	(1.0,1.3)	1.1	(1.0,1.3)	1.6	(1.1,2.3)	1.9	(1.2,3.0)
45-64	1.4	(1.2,1.6)	1.3	(1.1,1.5)	2.0	(1.3,2.9)	2.4	(1.5,3.9)
65-74	1.8	(1.5,2.1)	1.6	(1.4,2.0)	2.2	(1.4,3.4)	2.1	(1.1,3.8)
75+	2.1	(1.8,2.5)	2.1	(1.7,2.4)	2.3	(1.5,3.6)	1.6	(0.9,2.9)
Partner								
Yes	0.7	(0.6,0.8)	0.7	(0.7,0.8)	0.6	(0.5,0.8)	0.5	(0.4,0.7)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Uninsured (no private hospital insurance) ¹³								
Yes	1.7	(1.6,1.9)	1.7	(1.5,1.9)	1.8	(1.3,2.4)	1.9	(1.2,2.8)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	2.0	(1.7,2.4)	1.9	(1.5,2.3)	2.5	(1.7,3.7)	2.6	(1.6,4.2)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.1	(1.9,2.3)	2.0	(1.8,2.3)	2.4	(1.8,3.2)	1.9	(1.3,2.7)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Preferred language non-English**								
Yes	1.1	(0.9,1.4)	1.2	(0.9,1.4)	1.2	(0.7,2.0)	0.7	(0.3,1.8)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.7	(0.6,0.8)	0.7	(0.6,0.9)	0.6	(0.4,0.9)	0.5	(0.3,0.9)
Socio-economic status								
Quintile 1 (low)	1.4	(1.2,1.5)	1.4	(1.2,1.5)	1.3	(1.0,1.7)	1.4	(1.0,2.0)
Quintile 2	0.9	(0.8,1.0)	0.9	(0.8,1.1)	0.9	(0.6,1.2)	0.8	(0.5,1.3)
Quintile 3 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Quintile 4	0.6	(0.5,0.8)	0.7	(0.6,0.9)	0.5	(0.3,0.8)	0.5	(0.2,1.1)
Quintile 5 (high)	0.6	(0.5,0.7)	0.7	(0.5,0.8)	0.4	(0.2,0.7)	0.3	(0.1,0.8)
Major Diagnostic Block ¹⁴								
Alcohol/drug abuse and alcohol/drug induced mental disorders	6.4	(4.3,9.7)	5.1	(3.2,8.2)	11.2	(4.4,28.3)	17.9	(6.2,51.5)
Circulatory system illness	2.3	(1.9,2.7)	2.0	(1.7,2.5)	3.4	(2.0, 5.5)	4.0	(2.0, 8.0)
Digestive system illness	2.8	(2.4,3.3)	2.5	(2.1,3.0)	4.3	(2.7, 7.0)	5.6	(2.9,10.6)
Endocrine, nutritional and metabolic system illness	2.8	(1.9,4.2)	2.4	(1.5,3.7)	4.8	(1.8, 13.1)	6.5	(1.7,24.4)
Illness of skin, subcutaneous tissue, breast	2.9	(2.4,3.7)	2.9	(2.2,3.6)	3.6	(1.9, 7.0)	2.7	(1.0,7.3)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Musculoskeletal/connective tissue system illness	1.7	(1.4,2.1)	1.5	(1.2,1.9)	2.6	(1.5, 4.7)	3.1	(1.4,6.7)
Neurological system illness	2.2	(1.8,2.7)	1.8	(1.4,2.3)	3.2	(1.8, 5.8)	6.8	(3.3,13.7)
Psychiatric illness	6.2	(5.1,7.5)	4.8	(3.8,6.0)	12.5	(7.6,20.5)	13.7	(7.1,26.5)
Respiratory system illness	3.3	(2.8,4.0)	3.0	(2.4,3.6)	5.1	(3.1, 8.5)	5.6	(2.8,11.4)
Urological system illness	3.2	(2.6,3.9)	3.0	(2.4,3.8)	4.3	(2.3, 7.8)	3.4	(1.3,8.6)
Other	1.7	(1.4,1.9)	1.6	(1.4,2.0)	1.8	(1.1, 3.0)	1.3	(0.6,2.8)

CI, 99.8% Confidence Interval (α adjusted for multiple comparisons, $1-\alpha/m = 1-0.05/26 = 0.998$)
OR, Odds Ratio

⁹ n=211,447, AUC=0.82, Hosmer-Lemeshow $\chi^2=1,867$ (p<0.0001), Generalized Chi-Square / DF = 0.90,

¹⁰ n=210,198, AUC=0.80, Hosmer-Lemeshow $\chi^2=1,461$ (p<0.0001), Generalized Chi-Square / DF = 0.90,

¹¹ N=206,440, AUC=0.87, Hosmer-Lemeshow $\chi^2=877$ (p<0.0001), Generalized Chi-Square / DF =0.79,

¹² N=206,097, AUC=0.89, Hosmer-Lemeshow $\chi^2=678$ (p<0.0001), Generalized Chi-Square / DF =0.89,

¹³ Missing values imputed with patient's most recent non-missing value.

¹⁴ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Table 4. Logistic regression modelling characteristics associated with frequent attendance: non-frequent vs i) all frequent attenders, ii) temporary frequent attenders, iii) repeat frequent attenders, iv) persistent frequent attenders. Persons aged under 16

Variable	Non-frequent vs all frequent attenders ¹⁵		Non-frequent vs temporary frequent attenders ¹⁶		Non-frequent vs repeat frequent attenders ¹⁷		Non-frequent vs persistent frequent attenders ¹⁸	
	OR	(CI)	OR	(CI)	OR	(CI)	OR	(CI)
Sex								
Male	0.9	(0.8,1.1)	1.0	(0.8,1.2)	0.6	(0.3,1.0)	0.6	(0.2,1.4)
Female (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Age group								
0-4 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
5-15	1.0	(0.8,1.2)	1.0	(0.8,1.1)	1.4	(0.8,2.4)	1.3	(0.5,3.1)
Uninsured (no private hospital insurance) ¹⁹								
Yes	1.8	(1.4,2.2)	1.8	(1.4,2.2)	1.7	(0.8,3.4)	2.3	(0.7,7.9)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Aboriginal or Torres Strait Islander								
Yes	1.7	(1.3,2.2)	1.7	(1.3,2.2)	1.4	(0.6,3.2)	1.8	(0.5,6.3)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
High average triage (1-3)								
Yes	2.3	(1.9,2.9)	2.3	(1.8,2.8)	2.5	(1.2,4.9)	4.7	(1.1,19.1)
No (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Proportion of visits admitted	0.9	(0.7,1.3)	0.9	(0.6,1.3)	1.3	(0.5,3.5)	1.6	(0.3,8.2)
Socio-economic status								
Quintile 1 (low)	1.7	(1.4,2.0)	1.6	(1.3,2.0)	2.1	(1.2,3.6)	2.3	(0.9,5.8)
Quintile 2-5 (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Major Diagnostic Block ²⁰								
Digestive system illness	1.7	(1.3,2.2)	1.6	(1.2,2.1)	2.3	(1.0, 5.2)	6.0	(1.4, 24.7)
Injury, single site, major (reference)	1.0	-	1.0	-	1.0	-	1.0	-
Neurological system illness	2.7	(1.8,4.1)	2.4	(1.5,3.9)	5.0	(1.7, 14.4)	7.6	(1.2,48.1)
Psychiatric illness	6.7	(4.1,11.1)	6.1	(3.5,10.6)	8.6	(2.4,31.2)	34.7	(6.3,190.6)
Respiratory system illness	2.4	(1.8,3.0)	2.4	(1.9,3.0)	2.7	(1.3, 5.9)	2.0	(0.4, 10.2)
Other	0.9	(0.7,1.1)	0.9	(0.7,1.2)	1.2	(0.5, 2.7)	1.4	(0.3, 6.5)

CI, Confidence Interval (α adjusted for multiple comparisons, $1-\alpha/m = 1-0.05/26 = 0.998$)
OR, Odds Ratio

¹⁵ n=82,344, AUC=0.83, Hosmer-Lemeshow = 456 (p<0.0001), Generalized Chi-Square / DF = 0.87

¹⁶ n=82,115, AUC=0.82, Hosmer-Lemeshow = 415 (p<0.0001), Generalized Chi-Square / DF =0.85

¹⁷ n=80,958, AUC=0.87, Hosmer-Lemeshow = 158 (p<0.0001), Generalized Chi-Square / DF =0.88

¹⁸ n=80,867, AUC=0.93, Hosmer-Lemeshow = 64 (p<0.0001), Generalized Chi-Square / DF =0.64

¹⁹ Missing values imputed with patient's most recent non-missing value.

²⁰ Most frequent MDB over all visits. Excludes missing diagnoses and those unable to be mapped to an MDB. All MDBs which included less than five ongoing, repeat or temporary frequent attenders was included with "Other MDB" in a category labelled 'Other'.

Figure captions

Figure 1.

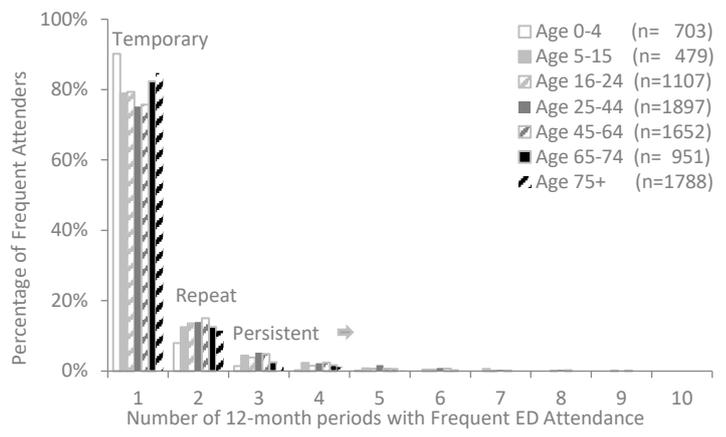
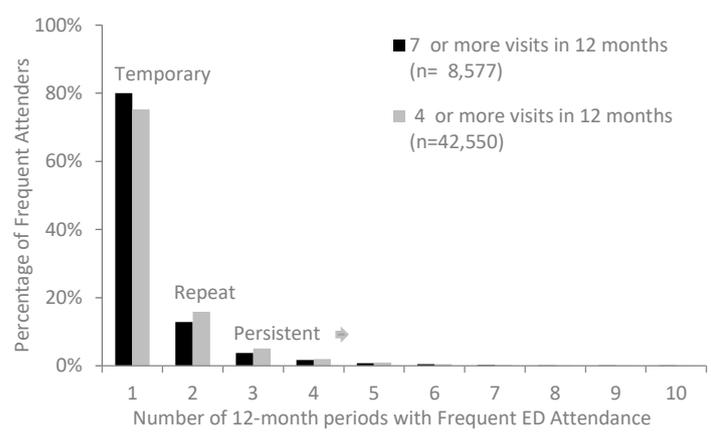
Number of 12-month periods where the frequent attendance threshold was met by frequently attending residents. *Left:* All residents with 7 or more visits in 12 months and all residents with 4 or more visits in 12 months. *Right:* all residents with 7 or more visits in 12 months by age group. Excludes planned return visits.

Figure 2.

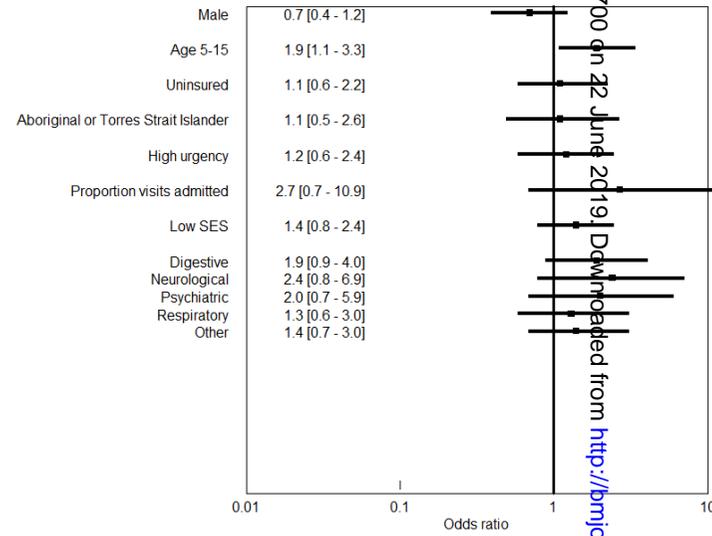
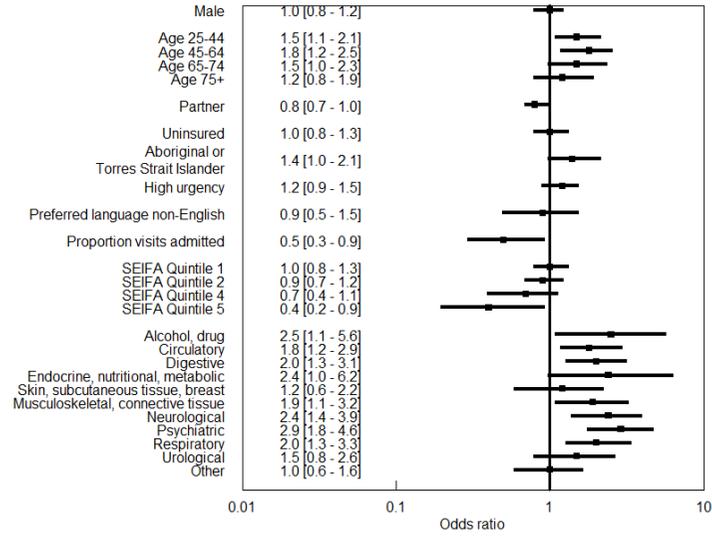
Logistic regression model identifying characteristics associated with ongoing vs temporary frequent attendance. *Left:* Persons aged 16 and over (n=5,803). *Right:* Persons aged under 16 (n=1,546).

Note: Reference categories for persons aged 16 and over - Age: 16-24, SEIFA: Quintile 3, Major Diagnostic Block: Single Site Major Injury. Reference categories for persons aged under 16 - Age: 0-4, SEIFA: Quintile 2-5, Major Diagnostic Block: Single Site Major Injury.

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Supplementary Material for Here one year, gone the next? Investigating duration and predictors of ongoing frequent emergency department attendance, a retrospective study in Australia.

Table 1. Diagnostic profile of all ED frequent attenders¹ by age group

	Age group ²							All
	0-4	5-15	16-24	25-44	45-64	65-74	75+	
<i>% of frequent attenders</i>	N persons							
	788	768	1004	1867	1677	1042	1431	8577
<i>Most common Major Diagnostic Block</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	0.0	1.0	2.2	2.0	0.1	0.0	1.0
Circulatory system illness	0.4	1.8	3.6	5.6	17.2	24.7	24.3	12.3
Digestive system illness	12.4	20.3	22.5	16.2	15.3	12.7	13.2	15.9
Endocrine, nutritional and metabolic system illness	0.6	1.0	1.2	1.1	0.9	1.1	1.0	1.0
Illness of skin, subcutaneous tissue, breast	1.9	4.2	5.2	6.6	4.8	3.0	2.7	4.3
Injury, single site, major	13.6	29.7	17.1	12.6	5.4	3.6	6.2	11.2
Musculoskeletal/connective tissue system illness	0.6	2.6	3.7	6.9	5.5	5.1	3.8	4.6
Neurological system illness	5.2	4.4	4.1	6.4	6.5	5.7	6.8	5.8
Psychiatric illness	0.1	10.2	13.9	16.3	7.0	1.5	1.0	7.8
Respiratory system illness	44.4	5.3	4.5	3.9	14.5	19.6	17.6	14.1
Urological system illness	1.0	1.8	2.4	2.1	4.2	10.5	13.7	5.4
Other MDBs	19.7	18.6	20.8	20.3	16.6	12.7	9.8	16.7
<i>Major Diagnostic Block during study period</i>								
Alcohol/drug abuse and alcohol/drug induced mental disorders	0.0	9.2	12.5	16.1	9.6	1.4	0.8	8.0
Circulatory system illness	4.6	27.3	31.7	40.8	61.9	73.3	73.1	48.7
Digestive system illness	65.7	69.5	63.6	60.2	61.6	65.4	62.0	63.1
Endocrine, nutritional and metabolic system illness	7.0	7.0	5.6	10.0	19.5	22.1	20.6	14.0
Illness of skin, subcutaneous tissue, breast	38.8	39.1	39.2	39.1	35.1	32.6	28.0	35.5
Injury, single site, major	63.3	83.6	68.6	62.6	52.7	43.5	51.8	59.2
Musculoskeletal/connective tissue system illness	16.6	53.4	46.6	49.8	49.5	47.1	43.9	45.3
Neurological system illness	18.8	31.3	36.8	40.4	42.7	48.9	55.2	41.1
Psychiatric illness	1.7	36.6	41.5	44.1	27.4	16.5	15.0	27.8
Respiratory system illness	84.5	44.0	38.6	38.5	54.7	61.6	64.1	53.7
Urological system illness	11.6	21.9	23.7	20.4	30.8	44.6	49.8	30.0

¹ Excludes planned return visits

² Age group at first visit in first period of frequent attendance.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n.a.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9-10
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	9-10
		(d) If applicable, explain how loss to follow-up was addressed	n.a.
		(e) Describe any sensitivity analyses	10
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	n.a.
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-12
		(b) Indicate number of participants with missing data for each variable of interest	9-10
		(c) Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(b) Report category boundaries when continuous variables were categorized	8-9, In tables
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14-17
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.