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Differences between frequent emergency department users in a secondary rural hospital and a tertiary suburban hospital in central Japan

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6 **Differences between frequent emergency department users in a secondary rural**
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9 **hospital and a tertiary suburban hospital in central Japan**
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Abstract

Objectives

Little research has been conducted on outcomes of frequent Emergency Department (ED) users in a country like Japan which universal health insurance. The study aims to: 1) document the proportion of ED visits that are by frequent users, and 2) describe the differences in characteristics of frequent ED users and other ED users including expenditures between a secondary and a tertiary hospital.

Design

A retrospective chart review for a period of one year

Setting

A secondary hospital and a tertiary hospital in central Japan

Participants

All patients who presented to the EDs

Primary outcome measures

We defined frequent ED user as a patient who visited the ED ≥ 5 times/year. The main outcome measures were the proportion of frequent ED users among all ED users and the proportion of health care expenditures by the frequent ED users among all ED expenditures.

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7 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043
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9 visits—0.66% of all ED users, comprised 4.1% of all ED visits, and accounted for 1.9%
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11 of total health care expenditures. Median ED visits per one frequent ED user was 7.9.
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15 At the patient-level, after adjusting for age, gender, and receiving public assistance,
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17 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving
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19 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED
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21 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:
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23 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology
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25 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.
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33 **Conclusions**

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36 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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38 them—while still in the low end of the distribution of published ranges—are lower in this
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40 study from Japan than in reports from many other countries.
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51 **Strengths and limitations of this study**

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54 • This is the first study to investigate health care expenditures for frequent ED users
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57 in Japan.
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- This is the first study comparing the characteristics of frequent ED users in a secondary and a tertiary hospital.
- This study only included one secondary hospital and one tertiary hospital.
- This study did not assess for the severity of condition or diseases of the participants

Introduction

Frequent emergency department (ED) use is associated with higher mortality rates¹ and financial burden.² In a previous systematic review, frequent ED users comprised 0.1-50% of all ED users and accounted for 1.9-20.5% of all ED visits in the U.S.³ Also, the top 20% of frequent ED users account for 84% of all health care expenditures and “hot spots” have been identified where many frequent ED users live.⁴ A study by Gross and colleagues published in 2013 demonstrated that interventions for individual frequent ED users or hot spots by multidisciplinary teams (such as family physicians, nurses, care managers, and administrative officers) are associated with a reduction of the number of ED visits and expenditures.⁴ Similarly, in three regions in the U.S., multidisciplinary team interventions decreased hospitalization rates by 34% and health care expenditures by 1.2 million dollars.⁵ However, a recent clinical trial examining the effect of complex care transition programs using a multidisciplinary team found no significant differences in hospital readmission between the intervention and control groups.⁶ High rates of frequent ED users have been reported in North America, Europe, and Oceania.⁷ In Asian countries, frequent ED users in Taiwan comprised 3.5% of all ED users and accounted for 14.3% of all ED visits.⁸ In Korea, 3.1% of all ED visitors were frequent ED users and occupied 14.0% of total ED visits.⁹ Among frequent ED users, low

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6 socioeconomic status and mental health problems are known predictors of frequent ED
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9 use based on research in 9 countries.^{7,10} Despite this international literature, research on
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12 frequent ED use in countries with well-developed comprehensive national health
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15 insurance such as Japan.

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18 In Japan, research on frequent ED users has been investigated in only one single center
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21 study.¹¹ In that study, they found frequent ED users comprised 1.4% of all ED users and
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24 occupied 6.8% of all ED visits.¹¹ Frequent ED users were older and more often
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27 receiving governmental welfare in comparison with non-frequent ED users.¹¹ The study
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30 has an important limitation; the effect of frequent ED user on the utilized health care
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33 expenditures was not reported. Additionally, since the study was conducted at a tertiary
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36 referral hospital, external validity of the findings to other hospital settings is limited. As
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39 the number of ED visits by ambulances has been annually increasing by 72 thousand
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42 per a year in Japan,¹² a better understanding of the patterns and costs associated with
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45 frequent ED users in Japan would be indispensable for developing interventions to
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48 reduce unnecessary visit burdens on EDs and mitigate unnecessary costs.

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51 Understanding the current status of frequent ED users in Japan could inform policy-
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54 making that optimizes the use of EDs and leads efficiency in health care expenditures.

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57 Hence the study aims of this research were to: 1) document the proportion of ED visits
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6 that are by frequent users, and 2) describe the differences in characteristics of frequent
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9 ED users and other ED users between a secondary and a tertiary hospital in Japan. We
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12 hypothesized that a few frequent ED users would account for the major proportion of all
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15 ED users and for significant health care expenditure in Japan.
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21 **Methods**

22 **Design**

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27 This study team utilized a retrospective chart review for a period of one year ranging
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30 from January 1 to December 31, 2017.
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33 **Setting**

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36 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary
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38 hospital) in central Japan served as the sites for study. The size of these two hospitals
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40 are generally comparable with other secondary and tertiary care hospitals in Japan.¹³
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42
43 Each hospital is the only general public hospital serving the local municipality. The
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45 characteristics of these hospitals are described in Table 1. In Japan, secondary hospitals
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47 provide emergency care for a patient who potentially requires admission and tertiary
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49 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple
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51 injury.¹⁴ The secondary hospital in this study serves a catchment area of about 48
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6 thousand people, but does not provide inpatient care for children due to the lack of
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9 pediatricians. It serves as the single public institution providing inpatient care for mental
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12 health in this region. Like the majority of hospitals in Japan, nurses triage patients
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15 presenting to the ED based on the patient's chief complaint for evaluation by one of the
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18 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This
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21 differs from the typical US-model of emergency care where nurses triage for acuity of
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24 need, but emergency physicians provide the first evaluation of all patients coming to the
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27 ED.¹⁵

30 **Patient and Public Involvement**

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33 This research was conducted without patient involvement. Patients were not invited to
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36 comment on the study design, and they were not consulted in the development of relevant
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39 patient outcomes or asked to interpret the results. They were not asked to contribute to
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41
42 the writing or editing of this document for readability or accuracy.

45 **Participants**

48 **Inclusion criteria**

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51 All patients who presented to the EDs during the study period were eligible for
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53
54 inclusion. There were no exclusion criteria for the study.

57 **Measures**

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6 To be consistent with previous literature,³ we defined a frequent ED user as a patient
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9 who visited the ED in the same hospital ≥ 5 times/year during 2017. The study's main
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12 outcome measures were the proportion of the frequent ED users among all ED users and
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15 the proportion of health care expenditures by the frequent ED users among all ED
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18 expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10
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21 times, 10-14 times and ≥ 15) and explored the characteristics of the frequent ED users
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24 by age, gender, receipt of public assistance (governmental welfare), ambulance use,
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27 hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,
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30 psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.
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33 **Statistical analysis**

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36 To analyze for differences in the characteristics between the frequent ED users and non-
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39 frequent ED users, we used chi-square tests. We employed two multivariable models,
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42 changing the units of analyses: patient-level and visit-level. In the patient-level analysis,
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45 we used logistic regression and adjusted age (as a continuous variable), gender (male
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47
48 was the reference group), and receiving public assistance. In the visit-level analysis, we
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51 used a mixed-effect model to include a random effect for hospital and individual
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54 covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in
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57 the ED, and hospitalization. Covariates were selected based on a literature review.^{7,8} For
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6 the statistical analysis, we used STATA 15 with statistical significance defined by a P-
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9 value <0.05.
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11 12 13 14 15 **Results**

16 17 18 **Frequency of visits and expenditures by frequent ED users**

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21 A total of 25,231 ED visits were made by 20,388 patients (male: 10,746) to the two
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24 hospitals during the study period. The median age (interquartile range) was 51 (range
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27 23-75) and the total health care expenditure was 3,774 million yen (\approx 35.2 million
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30 dollars). Health care expenditures in the ED of the secondary hospital totalled 188
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33 million yen (\approx 1.7 million dollars) and that of the tertiary hospital totalled 3,586 million
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36 yen (\approx 33.0 million dollars). Of all the visits, there were 134 frequent ED users
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39 (male=76). The median of age (interquartile range) was 61.5 years (35-80) and the total
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42 health care expenditure was 74 million yen (\approx 0.69 million dollars). The total number
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45 of visits by the frequent ED users was 1,043 and these comprised 4.1% of all ED visits.
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48 Frequent ED users accounted for 0.66% of all ED users, and 1.9% of total health care
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51 expenditures.
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54 55 **Patient-level analysis**

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57 As shown in Table 2, relative to patient-level characteristics of the frequent ED users,
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6 the proportions of older adults ($65 \geq$) ($p=0.023$) and the patients receiving public
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8 assistance were higher than those of the non-frequent ED users ($p<0.001$). Gender and
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10 in-hospital death were not associated with frequent ED users. In terms of the visit-level
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12 characteristics of the frequent ED users, the proportion of patients evaluated by
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14 psychiatry and obstetrics/gynecology were higher than those of the non-frequent ED
15
16 users (both $p<0.001$). The proportion of the patients who used an ambulance ($p<0.001$),
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18 who were admitted to a hospital ($p<0.006$), or were evaluated by internal medicine
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20 ($p<0.003$), surgery ($p=0.001$), and orthopedics ($p<0.001$) were lower than the non-
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22 frequent ED users.
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32 33 **Comparison of the frequent ED user characteristics in the secondary and tertiary** 34 35 **hospitals** 36 37

38 39 **Patient and visit-level characteristics by number of the ED users** 40

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42 Tables 3-1 and 3-2 illustrate patient-level and visit-level characteristics of ED users
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44 according to the number of visits to the secondary and tertiary hospitals, respectively.
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48 Although many patients from either hospital used the ED only one time in the study
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50 period, 4 patients (2 in the secondary hospital and 2 in the tertiary hospital) used the ED
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52 16 times or more. For factors such as in-hospital death, receiving public assistance, use
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54 of ambulance and hospitalization, the majority were accounted for by the non-frequent
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6 ED users (1-4 visits)
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9 Table 4 provides a comparison of frequent ED users' characteristics between the
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12 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of
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15 frequent ED users who were evaluated by psychiatry ($p<0.001$) and
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18 obstetrics/gynecology ($p<0.001$) was higher than those in the tertiary hospital. In the
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21 tertiary hospital, the proportion of patients who were aged 14 years and younger
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24 ($p<0.004$), evaluated by internal medicine ($p<0.001$), pediatrics ($p<0.001$) and surgery
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27 ($p<0.001$) was higher than those in the tertiary hospital.
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30 After adjusting for age, gender, and receiving public assistance, older age (odds ratio
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32 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02, $p=0.004$) and receiving public
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34 assistance (OR: 7.19, 95% CI: 2.87-18.07, $p<0.001$) were associated with frequent ED
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36
37 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine
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40 (OR: 1.27, 95% CI: 1.02-1.57, $p=0.032$), psychiatry (OR: 124.69, 95% CI: 85.89-
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43 181.01, $p<0.001$), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67, $p<0.001$)
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45
46 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,
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49 $p=0.011$) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84, $p=0.002$) were
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52 negatively associated with frequent ED visits. The details of the results are shown in the
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55 supplementary file.
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Discussion

Proportion of frequent ED users and health care expenditures

These combined findings from a tertiary hospital and secondary hospital in a largely urban area found that less than one percent of ED users (0.66%) accounted for nearly one in 25 visits (4.1%) and nearly 1.9% of health care expenditures. These findings contrast with the previous Japanese study where 1.39% frequent ED users (≥ 4 visits/year) occupied 6.75% of all ED visits.¹¹ The differences may be attributable to a different setting as the latter is from an ED in a single tertiary hospital serving a population of 170,000 near metropolitan Tokyo. The proportions of frequent ED users in both Japanese studies were less by a half to a quarter than the ranges from countries described in a systematic review (frequent ED users: 4.5-8% of all ED users). The ED visits of frequent users are roughly a third to a tenth less than other countries (21-28% of all ED visits).⁷ Compared to the Asian countries in the previous literature, the proportion of frequent ED visits was almost one third in Japan.^{8,9} In a previous US study, 1% of ED users accounted for 29% of costs⁴—a stark contrast to just less than 1% of ED users in the current study accounting for about 2% of expenditures. In addition, the proportion of the health care expenditures by frequent ED users from both studies in Japan is much lower than found in several previous studies in the US.^{4,16,17}

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6 As reported in an international literature review, the problem of frequent ED visits has
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9 been observed in multiple countries including Asian countries.⁷ Multi-disciplinary
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12 interventions such as case management, care plan and information sharing has been
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15 found to be effective to reduce the frequent ED users.^{2,18} *Kaigo Hoken*, Japan's long-
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18 term care insurance program was introduced to provide long-term care support for older
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21 adults since 2000.¹⁹ Under *Kaigo Hoken*, care managers coordinate multiple care
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24 services for older adults.¹⁹ The care management financed under *Kaigo Hoken* may
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27 contribute to the low proportion of frequent ED users in the study compared to other
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30 international settings due to proactive care for limitations in activities of daily living.
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33 This support can also help mitigate social problems. Also, free-access and universal
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36 health care coverage in Japan may contribute to the results as well. Patients can access
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39 health-care services regardless of their income, living place and types of hospitals.¹⁹ In
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42 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more
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45 timely manner, compared to those in the US.^{20,21}

46 47 48 **Characteristics of the frequent ED users**

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51 Characteristics of frequent ED users found in the current study, older age, low
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54 socioeconomic status, and mental health problems, are consistent with previous studies
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57 in other countries.^{3,22} For example, findings from the UK, US, Canada and Taiwan
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6 similarly identified older age²³ and mental problems.^{7,22,24,25} While previous studies
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9 have also identified homelessness²² and substance abuse^{7,24,26} as predictors for frequent
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12 ED use, the rate of homelessness in Japan is very low compared to the US, 0.004% vs
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15 0.17%^{27,28}, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of
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18 methamphetamine and 0.3% vs 14.3% in use of cocaine.²⁹ Thus, it was not surprising
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21 for these factors not to be predictors of frequent ED use.
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24 In the previous study conducted in Japan, mental health issues were not related to
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27 frequent ED visits but this may be attributable to the absence of full-time psychiatric
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30 providers in that hospital.¹¹ While a difference was noted in the proportion of frequent
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33 ED visits for pediatric problems between the secondary and tertiary hospital, this
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36 finding was not surprising given the lack of a full-time paediatrician in the secondary
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39 hospital in our study. Because characteristics of frequent ED users are heterogeneous⁷,
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42 analysis of characteristics of frequent ED users in each hospital is important to reduce
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45 frequent ED visits. For example, case management including insurance coverage and
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48 access to support services has been shown to reduce ED visits among low-income
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51 adults.³⁰ Moreover, multidisciplinary intervention with mental health and substance-
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54 abuse professionals decrease ED visits and health care cost.³¹ These factors, namely,
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57 low socioeconomic status and mental issues, are of particular importance for attention
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6 of health care providers and policy makers seeking to develop effective interventions to
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9 reduce unnecessary visits and reduce costs.
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12 Future research could include a multicentre or nation-wide study in Japan to further
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14 characterize frequent ED users across the nation. Despite the much lower rate of frequent
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16 ED users, visits, and associated costs in our study compared to other countries, research
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18 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as
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20 an area ripe for future research.
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26 27 **Study strengths**

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30 This is the first study to investigate health care expenditures for frequent ED users in
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32 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a
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34 secondary and a tertiary hospital. A possible explanation for the low proportion of
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36 frequent ED users, could come from inadequate accounting for the actual number of ED
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38 visits. In the current study, we counted ED visits in each hospital. If patients attended
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40 multiple EDs, it is possible we would not capture the actual number of ED visits, and
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42 underestimate the total number of frequent ED users. However, this seems unlikely to
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44 have a substantial impact as both hospitals serve as the primary hospitals in their
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46 catchment areas.
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56 57 **Study limitations**

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6 First, because this study only included one secondary hospital and one tertiary hospital,
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9 the results need to be confirmed through examination of other Japanese hospitals. Both
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12 studies occurred in a single prefecture which is predominantly rural. While not necessarily
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15 reflective of major metropolitan areas in Japan such as Tokyo, the prefecture of Shizuoka
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18 is probably similar to a majority of other prefectures in Japan which have a predominance
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21 of rural areas dotted with a few larger cities with tertiary care hospitals. Second, this study
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24 did not assess for the severity of condition or diseases of the participants. Thus,
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27 appropriateness of the ED visits was not evaluated directly.
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33 **Conclusions**

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36 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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39 them are lower in this study from Japan than the distribution of published ranges in reports
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42 from many other countries. Future research on a larger scale will be required to determine
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45 if these lower rates are consistent across Japan and to fully explain these differences and
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48 understand potential lessons for other countries.
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Competing interests

There are no potential competing interests to declare that are relevant to this work.

Contributors

MK designed the study and participated in the implementation, data collection, data analysis, and writing of the manuscript. MK also served as the guarantor. MI, MO, BC and MF contributed to the design of the study and critically reviewed the manuscript. MK and AF analyzed the data. All authors had full access to the data and take responsibility for the integrity and accuracy of the analyses.

Ethical Approval

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9 This study was approved by the Research Ethics Committee of Hamamatsu University
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11 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata
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13 City Hospital. We were not required to obtain individual informed consent from the
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15 patients included in the study. However, the research team displayed a poster in the
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17 waiting room of the hospitals to provide information about the collection and use of
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19 data for this research, and about the protection of personal information.
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26 27 **Transparency**

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29 All authors had full access to all of the data (including statistical reports and tables) in the
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31 study and take responsibility for its integrity and the accuracy of the data analyses. The
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33 lead author affirms that the manuscript is an honest, accurate, and gives a transparent
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35 account of the study being reported, and that no important aspects of the study have been
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37 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)
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39 have been explained.
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48 **Data sharing**

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50 Data sharing is not applicable because we did not receive informed consent concerning
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52 data sharing from the participants.
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Table 1. Characteristics of the study secondary and tertiary hospitals

	Secondary hospital	Tertiary hospital
Catchment area served	4,800 people	167,000 people
Total number of beds	260	500
Total number of emergency department visits	5,914	19,317
Number of psychiatric beds	58**	0
Number of beds in the emergency room	2	24
Number of infectious diseases beds.	0	2
Number of pediatric beds*	0	20

*The secondary hospital does not provide inpatient care for children due to the lack of pediatricians.

**The secondary hospital is only public institution for providing inpatient care for mental health in the area

Table 2. Comparison of frequent and non-frequent ED users for both the secondary and tertiary hospitals

	Total	Frequent ED users	Non-frequent ED users	p-value
Patient-level n=20,388 (number of patients)				
Age				
14<	3,728	19	3,709	0.217
15-64	8,862	51	8,811	0.205
65≥	7,798	64	7,734	0.023*
Gender				
male	9,642	58	9,584	0.351
female	10,746	76	10,670	
In-hospital death				
no	19,825	131	19,694	0.771
yes	563	3	560	
Receiving public assistance				

no	20,257	128	20,129	<0.001*
yes	110	5	105	
<hr/>				
Visit-level n=25,231				
(number of visits)				
<hr/>				
Use of ambulance				
no	18,496	834	17,662	<0.001*
yes	6,735	209	6,526	
Hospitalization				
no	20,256	872	19,384	p=0.006*
yes	4,975	171	4,804	
Results of triage in the emergency department				
Internal medicine	11,762	439	1,1323	p=0.003*
Surgery	1,312	30	1,282	p=0.001*
Orthopedics	4,412	84	4,328	<0.001*
Psychiatry	236	189	47	<0.001*
Pediatrics	2,817	98	2,719	p=0.064
OB/GYN	1,181	95	1,086	<0.001

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For peer review only

Table 3-1. The patient-level and visit-level characteristics of ED users based on the number of visits in the secondary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16≥
<hr/>						
Patient-level						
Number of patients (%):						
n=4,760						
<hr/>						
Age						
14<	439 (91.6)	38 (7.9)	1 (0.2)	1 (0.2)	0 (0)	0 (0)
15-64	1,879 (86.8)	267 (12.3)	11 (0.5)	6 (0.3)	0 (0)	2 (0.1)

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65≥	1,670 (78.9)	426 (20.1)	18 (0.9)	1 (0)	1 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	1 (0)	1 (0)
female	2,094 (85.2)	341 (13.9)	18 (0.7)	3 (0.1)	0 (0)	1 (0)
In-hospital						
death						
no	3,832 (83.3)	727 (15.8)	30 (0.7)	8 (0.2)	1 (0)	2 (0)
yes	156 (97.5)	4 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Receiving						
public						
assistance						

no	3,980 (83.8)	731 (15.4)	29 (0.6)	7 (0.1)	1(0)	2 (0)
yes	8 (80.0)	0 (0)	1 (10.0)	1 (10.0)	0 (0)	0 (0)

Visit-level

Number of visits

(%): n=6,122

Use of

ambulance

no	2,921 (63.7)	1,300 (28.4)	138 (3.0)	44 (0.1)	13 (0.3)	169 (3.7)
yes	1,068 (69.5)	399 (26.0)	33 (2.1)	28 (1.8)	1 (0)	8 (0.5)

Hospitalization

no	3,052 (65.0)	1,264 (26.9)	127 (2.7)	66 (1.4)	8 (0.2)	175 (3.7)
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yes	937 (65.5)	435 (30.4)	44 (3.1)	6 (0.4)	6 (0.4)	2 (0.1)
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For peer review only

Table 3-2. The patient-level and visit-level characteristics of ED users based on the number of visits in the tertiary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16\geq
visits						
<hr/>						
Patient-level						
Number of						
patients (%):						
n=15,628						
<hr/>						
Age						
14<	2,685 (82.7)	547 (16.8)	12 (0.4)	5 (0.2)	0 (0)	0 (0)
15-64	5,937 (88.7)	728 (10.9)	24 (0.4)	4 (0.1)	2 (0)	2 (0)
65 \geq	14,576 (92.9)	1,062 (6.8)	37 (0.2)	5 (0)	2 (0)	0(0)

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5	Gender						
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8	male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)	2 (0)
9							
10							
11	female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)	0 (0)
12							
13							
14	In-hospital						
15							
16							
17	death						
18							
19							
20	no	12,880 (84.6)	2,255 (14.8)	71 (0.5)	13 (0.1)	4 (0)	2 (0)
21							
22							
23	yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)	0 (0)
24							
25							
26	Receiving						
27							
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29	public						
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32	assistance						
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35	no	13,103 (84.5)	2,315 (14.9)	72 (0.5)	14 (0.1)	2 (0)	1 (0)
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8 Visit-level

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10 Number of

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12 visits (%):

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17 n=19,109
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20 Use of

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26 no 9,358 (68.2) 3,903 (28.4) 300 (2.2) 109 (0.8) 37 (0.3) 24 (0.2)

27
28
29 yes 3,661 (70.4) 1,398 (26.9) 94 (1.8) 17 (0.3) 14 (0.3) 14 (0.3)

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32 Hospitalization

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35 no 10,850 (69.7) 4,218 (27.1) 322 (2.1) 86 (0.6) 50 (0.3) 38 (0.2)

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yes	2,349 (66.3)	1,083 (30.6)	72 (2.0)	40 (1.1)	1 (0)	0 (0)
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For peer review only

Table 4. Differences in frequent ED users' characteristics between secondary and tertiary hospitals

	Total	Secondary hospital	Tertiary hospital	p-value
Patient-level	134	41	93	
Number of patients (%): n=134				
Age				
14<	19	2 (10.5)	17 (89.5)	0.004*
15-64	51	19 (37.3)	32 (62.7)	0.190
65≥	64	20 (31.2)	44 (68.8)	0.875
Gender				
male	58	39 (67.2)	19 (32.8)	0.635
female	76	54 (71.1)	22 (28.9)	
In-hospital death				
no	131	41 (31.3)	90 (68.7)	0.245
yes	3	0 (0)	3 (100.0)	
Receiving public				

assistance

no	128	39 (30.5)	89 (69.5)	0.651
yes	5	2 (40.0)	3 (60.0)	

Visit-level

Number of visits (%):

n=1,043

Use of ambulance

no	834	364 (43.6)	470 (56.4)	p=0.008*
yes	209	70 (33.5)	139 (66.5)	

Hospitalization

no	872	376 (43.1)	496 (56.9)	p=0.026
yes	171	58 (33.9)	113 (69.0)	

Evaluating service in the

ED

Internal medicine	439	114 (26.0)	325 (74.0)	<0.001*
Surgery	30	0 (0)	30 (100.0)	<0.001*
Orthopedics	84	25 (29.8)	59 (70.2)	p=0.022
Psychiatry	189	189 (100.0)	0 (0)	<0.001*

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6	Pediatrics	98	10 (10.2)	88 (89.8)	<0.001*
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9	Obstetrics/Gynecology	95	85 (89.	10 (1.1)	<0.001
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Supplementary file

Factors associated with frequent ED visits at the patient level (n = 20,388)

Factors	Odds Ratio (95% CI)	P value
age	1.01 (1.00-1.02)	.004
gender	1.27 (.90-1.79)	.179
receiving Public Assistance	7.19 (2.87-18.07)	<0.001

ED: Emergency Department

Factors associated with frequent ED visits at the visit level (n = 25,231)

Factors	Odds Ratio (95% CI)	P value
use of ambulance	.81 (1.00-1.02)	.011
evaluating service in the ED		
Internal medicine	1.27 (1.02-1.57)	.032
Surgery	0.74 (.49-1.11)	.144
Orthopaedics	0.63 (.47-0.84)	.002
Psychiatry	124.69 (85.89-181.01)	<0.001
Paediatrics	1.12 (.85-1.47)	.44
Obstetrics/Gynecology	2.77 (2.09-3.67)	<0.001

ED: Emergency Department

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <input checked="" type="checkbox"/> Pages 1 and 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 3-4
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported <input checked="" type="checkbox"/> Pages 6-8
Objectives	3	State specific objectives, including any prespecified hypotheses <input checked="" type="checkbox"/> Pages 7-8
Methods		
Study design	4	Present key elements of study design early in the paper <input checked="" type="checkbox"/> Page 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <input checked="" type="checkbox"/> Page 8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <input checked="" type="checkbox"/> Pages 8-9
		(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable <input checked="" type="checkbox"/> Page 10
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 <input checked="" type="checkbox"/> Pages 8-10
Bias	9	Describe any efforts to address potential sources of bias <input checked="" type="checkbox"/> Pages 9-10
Study size	10	Explain how the study size was arrived at <input checked="" type="checkbox"/> Pages 9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why <input checked="" type="checkbox"/> Pages 8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding <input checked="" type="checkbox"/> Pages 10-11
		(b) Describe any methods used to examine subgroups and interactions
		(c) Explain how missing data were addressed
		(d) If applicable, explain how loss to follow-up was addressed
		(e) Describe any sensitivity analyses
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 <input checked="" type="checkbox"/>

		Page 11
		(b) Give reasons for non-participation at each stage
		(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
	<input checked="" type="checkbox"/>	Page 11
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
	<input checked="" type="checkbox"/>	Pages 11-13
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
	<input checked="" type="checkbox"/>	Pages 11-13
		(b) Report category boundaries when continuous variables were categorized
		(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
Discussion		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	Page 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
	<input checked="" type="checkbox"/>	Pages 16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
	<input checked="" type="checkbox"/>	Pages 14-18
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	Pages 14-18
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
	<input checked="" type="checkbox"/>	Page 19

*Give information separately for exposed and unexposed groups.

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 <http://www.strobe-statement.org>.

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Differences between frequent emergency department users in a secondary rural hospital and a tertiary suburban hospital in central Japan: a retrospective chart review

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7 **1 Differences between frequent emergency department users in a secondary rural**
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9 **2 hospital and a tertiary suburban hospital in central Japan: a retrospective chart**
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12 **3 review**
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16 **4**

17
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51 34 secondary and tertiary hospital, health care utilization

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Abstract

40 **Objectives**

41 Although frequent Emergency Department (ED) use is a global issue, little research has
42 been conducted in a country like Japan where universal health insurance is available. The
43 study aims to: 1) document the proportion of ED visits that are by frequent users, and 2)
44 describe the differences in characteristics of frequent ED users and other ED users
45 including expenditures between a secondary and a tertiary hospital.

46 **Design**

47 A retrospective chart review for a period of one year

48 **Setting**

49 A secondary hospital and a tertiary hospital in central Japan

50 **Participants**

51 All patients who presented to the EDs

52 **Primary outcome measures**

53 We defined frequent ED user as a patient who visited the ED ≥ 5 times/year. The main
54 outcome measures were the proportion of frequent ED users among all ED users and the

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7 55 proportion of health care expenditures by the frequent ED users among all ED
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9 56 expenditures.

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12 57 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043
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15 58 visits—0.66% of all ED users, comprised 4.1% of all ED visits, and accounted for 1.9%
16
17
18 59 of total health care expenditures. Median ED visits per one frequent ED user was 7.9.

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21 60 At the patient-level, after adjusting for age, gender, and receiving public assistance,
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24 61 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving
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27 62 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED
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29
30 63 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:
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33 64 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology
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36 65 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.

37 38 39 66 **Conclusions**

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42 67 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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45 68 them—while still in the low end of the distribution of published ranges—are lower in this
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48 69 study from Japan than in reports from many other countries.

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55 56 57 72 **Strengths and limitations of this study**

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7 73 • All patients who visited the emergency department (ED) during the study period
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9 74 were included.
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12 75 • The study evaluated not only the numbers of visits but also the health care
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15 76 expenditures of frequent ED visitors.
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18 77 • This study only included one secondary hospital and one tertiary hospital.
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21 78 • This study did not assess for the severity of condition or diseases of the
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24 79 participants
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82 Introduction

83 Frequent emergency department (ED) use is associated with higher mortality rates¹ and
84 financial burden.² In a previous systematic review, frequent ED users comprised 0.1-
85 50% of all ED users and accounted for 1.9-20.5% of all ED visits in the U.S.³ Also, the
86 top 20% of frequent ED users account for 84% of all health care expenditures and “hot
87 spots” have been identified where many frequent ED users live.⁴ A study by Gross and
88 colleagues published in 2013 demonstrated that interventions for individual frequent ED
89 users or hot spots by multidisciplinary teams (such as family physicians, nurses, care
90 managers, and administrative officers) are associated with a reduction of the number of
91 ED visits and expenditures.⁴ Similarly, in three regions in the U.S., multidisciplinary
92 team interventions decreased hospitalization rates by 34% and health care expenditures
93 by 1.2 million dollars.⁵ However, a recent clinical trial examining the effect of complex
94 care transition programs using a multidisciplinary team found no significant differences
95 in hospital readmission between the intervention and control groups.⁶ High rates of
96 frequent ED users have been reported in North America, Europe, and Oceania.⁷ In
97 Asian countries, frequent ED users in Taiwan comprised 3.5% of all ED users and
98 accounted for 14.3% of all ED visits.⁸ In Korea, 3.1% of all ED visitors were frequent
99 ED users and occupied 14.0% of total ED visits.⁹ Among frequent ED users, low

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6 100 socioeconomic status and mental health problems are known predictors of frequent ED
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9 101 use based on research in 9 countries.^{7,10} Although such studies about frequent ED use
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12 102 were conducted , research on frequent ED use is little in countries with well-developed
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15 103 comprehensive national health insurance such as Japan.
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18 104 In Japan, research on frequent ED users has been investigated in single center
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21 105 studies.^{11,12} Also, there is no research about health care expenditure of frequent ED
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24 106 users in Japan. For example, in the study by Takeuchi et al., they found frequent ED
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27 107 users comprised 1.4% of all ED users and occupied 6.8% of all ED visits.¹¹ Frequent
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30 108 ED users were older and more often receiving governmental welfare in comparison with
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33 109 non-frequent ED users.¹¹ As the number of ED visits by ambulances has been
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36 110 annually increasing by 72 thousand per a year in Japan,¹³ a better understanding of the
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39 111 patterns and costs associated with frequent ED users in Japan would be indispensable
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42 112 for developing interventions to reduce unnecessary visit burdens on EDs and mitigate
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45 113 unnecessary costs.
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48 114 Understanding the current status of frequent ED users in Japan could inform policy-
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51 115 making that optimizes the use of EDs and leads efficiency in health care expenditures.
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54 116 Hence the study aims of this research were to: 1) document the proportion of ED visits
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57 117 that are by frequent users, and 2) describe the differences in characteristics of frequent
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6 118 ED users and other ED users between a secondary and a tertiary hospital in Japan. We
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9 119 hypothesized that a few frequent ED users would account for the major proportion of all
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12 120 ED users and for significant health care expenditure in Japan.
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17 18 122 **Methods**

19 20 21 123 **Design**

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24 124 This study team utilized a retrospective chart review for a period of one year ranging
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27 125 from January 1 to December 31, 2017. In the present study, we followed the
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30 126 Strengthening the Reporting of Observational studies in Epidemiology. (STROBE)
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32
33 127 statement.¹⁴

34 35 36 128 **Setting**

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39 129 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary
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42 130 hospital) in central Japan served as the sites for study. The size of these two hospitals
43
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45 131 are generally comparable with other secondary and tertiary care hospitals in Japan.¹⁵
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48 132 Each hospital is the only general public hospital serving the local municipality. The
49
50
51 133 characteristics of these hospitals are described in Table 1. In Japan, secondary hospitals
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54 134 provide emergency care for a patient who potentially requires admission and tertiary
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57 135 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple
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6 136 injury.¹⁶ The secondary hospital in this study serves a catchment area of about 48
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9 137 thousand people, but does not provide inpatient care for children due to the lack of
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12 138 pediatricians. It serves as the single public institution providing inpatient care for mental
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15 139 health in this region. Like the majority of hospitals in Japan, nurses triage patients
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18 140 presenting to the ED based on the patient's chief complaint for evaluation by one of the
19
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21 141 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This
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24 142 differs from the typical US-model of emergency care where nurses triage for acuity of
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27 143 need, but emergency physicians provide the first evaluation of all patients coming to the
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30 144 ED.¹⁷

33 145 **Patient and Public Involvement**

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36 146 This research was conducted without patient involvement. Patients were not invited to
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39 147 comment on the study design, and they were not consulted in the development of relevant
40
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42 148 patient outcomes or asked to interpret the results. They were not asked to contribute to
43
44
45 149 the writing or editing of this document for readability or accuracy.

48 150 **Participants**

51 151 **Inclusion criteria**

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54 152 All patients who presented to the EDs during the study period were eligible for
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57 153 inclusion. There were no exclusion criteria for the study.
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6 154 **Measures**
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9 155 To be consistent with previous literature,³ we defined a frequent ED user as a patient
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12 156 who visited the ED in the same hospital ≥ 5 times/year during 2017. The study's main
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15 157 outcome measures were the proportion of the frequent ED users among all ED users and
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18 158 the proportion of health care expenditures by the frequent ED users among all ED
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21 159 expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10
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24 160 times, 10-14 times and ≥ 15) and explored the characteristics of the frequent ED users
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27 161 by age, gender, receipt of public assistance (governmental welfare), ambulance use,
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30 162 hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,
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33 163 psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.
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36 164 **Statistical analysis**
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39 165 To analyze for differences in the characteristics between the frequent ED users and non-
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42 166 frequent ED users, we used chi-square tests. We employed two multivariable models,
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45 167 changing the units of analyses: patient-level and visit-level. In the patient-level analysis,
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48 168 we used logistic regression and adjusted age (as a continuous variable), gender (male
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50
51 169 was the reference group), and receiving public assistance. In the visit-level analysis, we
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54 170 used a mixed-effect model to include a random effect for hospital and individual
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57 171 covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in
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6 172 the ED, and hospitalization. Covariates were selected based on a literature review.^{7,8} For
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9 173 the statistical analysis, we used STATA 15 with statistical significance defined by a P-
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12 174 value <0.05.
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17 176 **Results**

18 177 **Frequency of visits and expenditures by frequent ED users**

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24 178 A total of 25,231 ED visits were made by 20,388 patients (male: 10,746) to the two
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27 179 hospitals during the study period. We did not have missing data for each reported
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30 180 variable. The median age (interquartile range) was 51 (range 23-75) and the total health
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33 181 care expenditure was 3,774 million yen (\approx 35.2 million dollars). Health care
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36 182 expenditures in the ED of the secondary hospital totalled 188 million yen (\approx 1.7 million
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39 183 dollars) and that of the tertiary hospital totalled 3,586 million yen (\approx 33.0 million
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42 184 dollars). Of all the visits, there were 134 frequent ED users (male=76). The median of
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45 185 age (interquartile range) was 61.5 years (35-80) and the total health care expenditure
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48 186 was 74 million yen (\approx 0.69 million dollars). The total number of visits by the frequent
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51 187 ED users was 1,043 and these comprised 4.1% of all ED visits. Frequent ED users
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54 188 accounted for 0.66% of all ED users, and 1.9% of total health care expenditures. Figure
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57 189 1 shows summary of the results.
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190 **Patient-level analysis**

191 As shown in Table 2, relative to patient-level characteristics of the frequent ED users,
192 the proportions of older adults ($65 \geq$) ($p=0.023$) and the patients receiving public
193 assistance were higher than those of the non-frequent ED users ($p<0.001$). Gender and
194 in-hospital death were not associated with frequent ED users. In terms of the visit-level
195 characteristics of the frequent ED users, the proportion of patients evaluated by
196 psychiatry and obstetrics/gynecology were higher than those of the non-frequent ED
197 users (both $p<0.001$). The proportion of the patients among frequent ED users who used
198 an ambulance ($p<0.001$), who were admitted to a hospital ($p=0.006$), or were evaluated
199 by internal medicine ($p=0.003$), surgery ($p=0.001$), and orthopedics ($p<0.001$) were
200 lower than those of the non-frequent ED users.

201 **Comparison of the frequent ED user characteristics in the secondary and tertiary** 202 **hospitals**

203 **Patient and visit-level characteristics by number of the ED users**

204 Tables 3-1 and 3-2 illustrate patient-level and visit-level characteristics of ED users
205 according to the number of visits to the secondary and tertiary hospitals, respectively.
206 Although many patients from either hospital used the ED only one time in the study
207 period, 4 patients (2 in the secondary hospital and 2 in the tertiary hospital) used the ED

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6 208 16 times or more. For factors such as in-hospital death, receiving public assistance, use
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9 209 of ambulance and hospitalization, the majority were accounted for by the non-frequent
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12 210 ED users (1-4 visits).

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15 211 Table 4 provides a comparison of frequent ED users' characteristics between the
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18 212 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of
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21 213 frequent ED users who were evaluated by psychiatry ($p<0.001$) and
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24 214 obstetrics/gynecology ($p<0.001$) was higher than those in the tertiary hospital. In the
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27 215 tertiary hospital, the proportion of patients who were aged 14 years and younger
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30 216 ($p<0.004$), evaluated by internal medicine ($p<0.001$), pediatrics ($p<0.001$) and surgery
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33 217 ($p<0.001$) was higher than those in the tertiary hospital.

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36 218 After adjusting for age, gender, and receiving public assistance, older age (odds ratio
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39 219 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02, $p=0.004$) and receiving public
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42 220 assistance (OR: 7.19, 95% CI: 2.87-18.07, $p<0.001$) were associated with frequent ED
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45 221 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine
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48 222 (OR: 1.27, 95% CI: 1.02-1.57, $p=0.032$), psychiatry (OR: 124.69, 95% CI: 85.89-
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51 223 181.01, $p<0.001$), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67, $p<0.001$)
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53
54 224 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,
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57 225 $p=0.011$) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84, $p=0.002$) were
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226 negatively associated with frequent ED visits. The details of the results are shown in the
227 supplementary file.

For peer review only

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Discussion

229 Proportion of frequent ED users and health care expenditures

230 These combined findings from a tertiary hospital and secondary hospital in a largely
231 urban area found that less than one percent of ED users (0.66%) accounted for nearly
232 one in 25 visits (4.1%) and nearly 1.9% of health care expenditures. These findings
233 contrast with the previous Japanese study conducted near Tokyo where 1.39% frequent
234 ED users (≥ 4 visits/year) occupied 6.75% of all ED visits and the previous study did not
235 report the utilized health care expenditures.¹¹ The differences may be attributable to a
236 different setting as the latter is from an ED in a single tertiary hospital serving a
237 population of 170,000 near metropolitan Tokyo. Because this tertiary hospital was
238 located near a metropolitan area, the patients might visit the hospital from a wider range
239 of areas compared with the present study's setting. The proportions of frequent ED
240 users in both Japanese studies were less by a half to a quarter than the ranges from
241 countries described in a systematic review (frequent ED users: 4.5-8% of all ED users).
242 The ED visits of frequent users are roughly a third to a tenth less than other countries
243 (21-28% of all ED visits).⁷ Compared to the Asian countries in the previous literature,
244 the proportion of frequent ED visits was almost one third in Japan.^{8,9} In a previous US
245 study, 1% of ED users accounted for 29% of costs⁴—a stark contrast to just less than

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6 246 1% of ED users in the current study accounting for about 2% of expenditures. In
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9 247 addition, the proportion of the health care expenditures by frequent ED users from both
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12 248 studies in Japan is much lower than found in several previous studies in the US.^{4,18,19}
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15 249 As reported in an international literature review, the problem of frequent ED visits has
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18 250 been observed in multiple countries including Asian countries.⁷ Multi-disciplinary
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21 251 interventions such as case management, care plan and information sharing has been
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24 252 found to be effective to reduce the frequent ED users.^{2,20} *Kaigo Hoken*, Japan's long-
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27 253 term care insurance program was introduced to provide long-term care support for older
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30 254 adults since 2000.²¹ Under *Kaigo Hoken*, care managers coordinate multiple care
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33 255 services for older adults.²¹ The care management financed under *Kaigo Hoken* may
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36 256 contribute to the low proportion of frequent ED users in the study compared to other
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39 257 international settings due to proactive care for limitations in activities of daily living.
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42 258 This support can also help mitigate social problems. Also, free-access and universal
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45 259 health care coverage in Japan may contribute to the results as well. Patients can access
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48 260 health-care services regardless of their income, living place and types of hospitals.²¹ In
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51 261 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more
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54 262 timely manner, compared to those in the US.^{22,23}

263 **Characteristics of the frequent ED users**

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6 264 Characteristics of frequent ED users found in the current study, older age, low
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9 265 socioeconomic status, and mental health problems, are consistent with previous studies
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12 266 in other countries.^{3,24} For example, findings from the UK, US, Canada and Taiwan
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15 267 similarly identified older age²⁵ and mental problems.^{7,24,26,27} In our study, the proportion
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18 268 of patients who were older than or equal to 65 years among all ED visitors was 38.2%.
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21 269 This is relatively higher than those in the previous studies in other countries such as
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24 270 16.6%-22.1% (US)^{28,29}, 25.1% (Canada)³⁰ and 34.5% (Taiwan)⁸. Therefore, older
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27 271 patients could not explain the low rate of frequent ED users in our study. Thus, as we
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29
30 272 discussed above, the Japanese health care systems such as Kaigo Hoken or universal
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33 273 health care coverage could explain our results. While previous studies have also
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36 274 identified homelessness²⁴ and substance abuse^{7,26,30} as predictors for frequent ED use,
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38
39 275 the rate of homelessness in Japan is very low compared to the US, 0.004% vs
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42 276 0.17%^{31,32}, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of
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45 277 methamphetamine and 0.3% vs 14.3% in use of cocaine.³³ Thus, it was not surprising
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48 278 for these factors not to be predictors of frequent ED use.
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51 279 In the previous study conducted in Japan, mental health issues were not related to
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54 280 frequent ED visits but this may be attributable to the absence of full-time psychiatric
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57 281 providers in that hospital.¹¹ While a difference was noted in the proportion of frequent
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6 282 ED visits for pediatric problems between the secondary and tertiary hospital, this
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9 283 finding was not surprising given the lack of a full-time paediatrician in the secondary
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12 284 hospital in our study. Because characteristics of frequent ED users are heterogeneous⁷,
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15 285 analysis of characteristics of frequent ED users in each hospital is important to reduce
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18 286 frequent ED visits. For example, case management including insurance coverage and
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21 287 access to support services has been shown to reduce ED visits among low-income
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24 288 adults.³⁴ Moreover, multidisciplinary intervention with mental health and substance-
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27 289 abuse professionals decrease ED visits and health care cost.³⁵ These factors, namely,
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30 290 low socioeconomic status and mental issues, are of particular importance for attention
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33 291 of health care providers and policy makers seeking to develop effective interventions to
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36 292 reduce unnecessary visits and reduce costs.
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39 293 Future research could include a multicentre or nation-wide study in Japan to further
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42 294 characterize frequent ED users across the nation. Despite the much lower rate of frequent
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45 295 ED users, visits, and associated costs in our study compared to other countries, research
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48 296 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as
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51 297 an area ripe for future research.

54 298 **Study strengths**

57 299 This is the first study to investigate health care expenditures for frequent ED users in

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6 300 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a
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9 301 secondary and a tertiary hospital. A possible explanation for the low proportion of
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12 302 frequent ED users, could come from inadequate accounting for the actual number of ED
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15 303 visits. In the current study, we counted ED visits in each hospital. If patients attended
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18 304 multiple EDs, it is possible we would not capture the actual number of ED visits, and
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21 305 underestimate the total number of frequent ED users. However, this seems unlikely to
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24 306 have a substantial impact as both hospitals serve as the primary hospitals in their
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27 307 catchment areas.

308 **Study limitations**

309 First, because this study only included one secondary hospital and one tertiary hospital,
310 the results need to be confirmed through examination of other Japanese hospitals. Both
311 studies occurred in a single prefecture which is predominantly rural. While not necessarily
312 reflective of major metropolitan areas in Japan such as Tokyo, the prefecture of Shizuoka
313 is probably similar to a majority of other prefectures in Japan which have a predominance
314 of rural areas dotted with a few larger cities with tertiary care hospitals. Second, this study
315 did not assess for the severity of condition or diseases of the participants. Thus,
316 appropriateness of the ED visits was not evaluated directly.

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6 318 **Conclusions**

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9 319 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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12 320 them are lower in this study from Japan than the distribution of published ranges in reports
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15 321 from many other countries. Future research on a larger scale will be required to determine
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18 322 if these lower rates are consistent across Japan and to fully explain these differences and
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21 323 understand potential lessons for other countries.
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32
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57 335 of the report, or the decision to submit this article for publication.
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6 336 **Competing interests**
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9 337 There are no potential competing interests to declare that are relevant to this work.
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12 338 **Contributors**
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15 339 MK designed the study and participated in the implementation, data collection, data
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17 340 analysis, and writing of the manuscript. MK also served as the guarantor. MI, MO, BC
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19 341 and MF contributed to the design of the study and critically reviewed the manuscript. MK
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21 342 and AF analyzed the data. All authors had full access to the data and take responsibility
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23 343 for the integrity and accuracy of the analyses.
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30 344 **Ethical Approval**
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33 345 This study was approved by the Research Ethics Committee of Hamamatsu University
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35 346 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata
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37 347 City Hospital. We were not required to obtain individual informed consent from the
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39 348 patients included in the study. However, the research team displayed a poster in the
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41 349 waiting room of the hospitals to provide information about the collection and use of
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43 350 data for this research, and about the protection of personal information.
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51 351 **Transparency**
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54 352 All authors had full access to all of the data (including statistical reports and tables) in the
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56 353 study and take responsibility for its integrity and the accuracy of the data analyses. The
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6 354 lead author affirms that the manuscript is an honest, accurate, and gives a transparent
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9 355 account of the study being reported, and that no important aspects of the study have been
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12 356 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)
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15 357 have been explained.

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18 358 **Data sharing**

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21 359 Data sharing is not applicable because we did not receive informed consent concerning
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24 360 data sharing from the participants.

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30 362 **References**

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460 Table 1. Characteristics of the study secondary and tertiary hospitals

	Secondary hospital	Tertiary hospital
Catchment area served	4,800 people	167,000 people
Total number of beds	260	500
Total number of emergency department visits	5,914	19,317
Number of psychiatric beds	58**	0
Number of beds in the emergency room	2	24
Number of infectious diseases beds.	0	2
Number of pediatric beds*	0	20
Proportion of the population aged 65 years and over in the city (%) ³⁶	25.0	26.1
Unemployment rate in the	2.9	3.6

city (%)³⁶

461 *The secondary hospital does not provide inpatient care for children due to the lack of
 462 pediatricians.

463 **The secondary hospital is the only public institution for providing inpatient care for
 464 mental health in the area.

465

466 Table 2. Comparison of frequent and non-frequent ED users for both the secondary and
 467 tertiary hospitals

	Total	Frequent ED users	Non-frequent ED users	p-value
Patient-level n=20,388				
(number of patients)				
Age				
14<	3,728	19	3,709	0.217
15-64	8,862	51	8,811	0.205
65≥	7,798	64	7,734	0.023*
Gender				
male	9,642	58	9,584	0.351

29

female	10,746	76	10,670	
In-hospital death				
no	19,825	131	19,694	0.771
yes	563	3	560	
Receiving public assistance				
no	20,257	128	20,129	<0.001*
yes	110	5	105	
Visit-level n=25,231 (number of visits)				
Use of ambulance				
no	18,496	834	17,662	<0.001*
yes	6,735	209	6,526	
Hospitalization				
no	20,256	872	19,384	p=0.006*
yes	4,975	171	4,804	
Results of triage in the emergency department				

Internal medicine	11,762	439	1,1323	p=0.003*
Surgery	1,312	30	1,282	p=0.001*
Orthopedics	4,412	84	4,328	<0.001*
Psychiatry	236	189	47	<0.001*
Pediatrics	2,817	98	2,719	p=0.064
OB/GYN	1,181	95	1,086	<0.001

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470 Table 3-1. The patient-level and visit-level characteristics of ED users based on the number of visits in the secondary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16≥
<hr/>						
Patient-level						
Number of patients (%):						
n=4,760						
<hr/>						
Age						
14<	439 (91.6)	38 (7.9)	1 (0.2)	1 (0.2)	0 (0)	0 (0)
15-64	1,879 (86.8)	267 (12.3)	11 (0.5)	6 (0.3)	0 (0)	2 (0.1)

32

65≥	1,670 (78.9)	426 (20.1)	18 (0.9)	1 (0)	1 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	1 (0)	1 (0)
female	2,094 (85.2)	341 (13.9)	18 (0.7)	3 (0.1)	0 (0)	1 (0)
In-hospital						
death						
no	3,832 (83.3)	727 (15.8)	30 (0.7)	8 (0.2)	1 (0)	2 (0)
yes	156 (97.5)	4 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Receiving						
public						
assistance						

no	3,980 (83.8)	731 (15.4)	29 (0.6)	7 (0.1)	1(0)	2 (0)
yes	8 (80.0)	0 (0)	1 (10.0)	1 (10.0)	0 (0)	0 (0)

Visit-level

Number of visits

(%): n=6,122

Use of

ambulance

no	2,921 (63.7)	1,300 (28.4)	138 (3.0)	44 (0.1)	13 (0.3)	169 (3.7)
yes	1,068 (69.5)	399 (26.0)	33 (2.1)	28 (1.8)	1 (0)	8 (0.5)

Hospitalization

no	3,052 (65.0)	1,264 (26.9)	127 (2.7)	66 (1.4)	8 (0.2)	175 (3.7)
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yes	937 (65.5)	435 (30.4)	44 (3.1)	6 (0.4)	6 (0.4)	2 (0.1)
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For peer review only

472 Table 3-2. The patient-level and visit-level characteristics of ED users based on the number of visits in the tertiary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16\geq
visits						
<hr/>						
Patient-level						
Number of patients (%):						
n=15,628						
<hr/>						
Age						
14<	2,685 (82.7)	547 (16.8)	12 (0.4)	5 (0.2)	0 (0)	0 (0)
15-64	5,937 (88.7)	728 (10.9)	24 (0.4)	4 (0.1)	2 (0)	2 (0)
65 \geq	14,576 (92.9)	1,062 (6.8)	37 (0.2)	5 (0)	2 (0)	0(0)

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5	Gender						
6							
7							
8	male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)	2 (0)
9							
10							
11	female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)	0 (0)
12							
13							
14	In-hospital						
15							
16							
17	death						
18							
19							
20	no	12,880 (84.6)	2,255 (14.8)	71 (0.5)	13 (0.1)	4 (0)	2 (0)
21							
22							
23	yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)	0 (0)
24							
25							
26	Receiving						
27							
28							
29	public						
30							
31							
32	assistance						
33							
34							
35	no	13,103 (84.5)	2,315 (14.9)	72 (0.5)	14 (0.1)	2 (0)	1 (0)
36							
37							

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5 yes 76 (76.0) 21 (21.0) 0 (0) 0 (0) 2 (2.0) 1 (1.0)
6
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8 Visit-level

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10 Number of

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12 visits (%):

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14
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17 n=19,109
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20 Use of

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22 ambulance

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26 no 9,358 (68.2) 3,903 (28.4) 300 (2.2) 109 (0.8) 37 (0.3) 24 (0.2)

27
28
29 yes 3,661 (70.4) 1,398 (26.9) 94 (1.8) 17 (0.3) 14 (0.3) 14 (0.3)

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32 Hospitalization

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34
35 no 10,850 (69.7) 4,218 (27.1) 322 (2.1) 86 (0.6) 50 (0.3) 38 (0.2)

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473	yes	2,349 (66.3)	1,083 (30.6)	72 (2.0)	40 (1.1)	1 (0)	0 (0)
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474 Table 4. Differences in frequent ED users' characteristics between secondary and
 475 tertiary hospitals

	Total	Secondary hospital	Tertiary hospital	p-value
Patient-level	134	41	93	
Number of patients (%): n=134				
Age				
14<	19	2 (10.5)	17 (89.5)	0.004*
15-64	51	19 (37.3)	32 (62.7)	0.190
65≥	64	20 (31.2)	44 (68.8)	0.875
Gender				
male	58	39 (67.2)	19 (32.8)	0.635
female	76	54 (71.1)	22 (28.9)	
In-hospital death				
no	131	41 (31.3)	90 (68.7)	0.245
yes	3	0 (0)	3 (100.0)	
Receiving public				

assistance

no	128	39 (30.5)	89 (69.5)	0.651
yes	5	2 (40.0)	3 (60.0)	

Visit-level

Number of visits (%):

n=1,043

Use of ambulance

no	834	364 (43.6)	470 (56.4)	p=0.008*
yes	209	70 (33.5)	139 (66.5)	

Hospitalization

no	872	376 (43.1)	496 (56.9)	p=0.026
yes	171	58 (33.9)	113 (69.0)	

Evaluating service in the

ED

Internal medicine	439	114 (26.0)	325 (74.0)	<0.001*
Surgery	30	0 (0)	30 (100.0)	<0.001*
Orthopedics	84	25 (29.8)	59 (70.2)	p=0.022
Psychiatry	189	189 (100.0)	0 (0)	<0.001*

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Pediatrics	98	10 (10.2)	88 (89.8)	<0.001*
Obstetrics/Gynecology	95	85 (89.	10 (1.1)	<0.001

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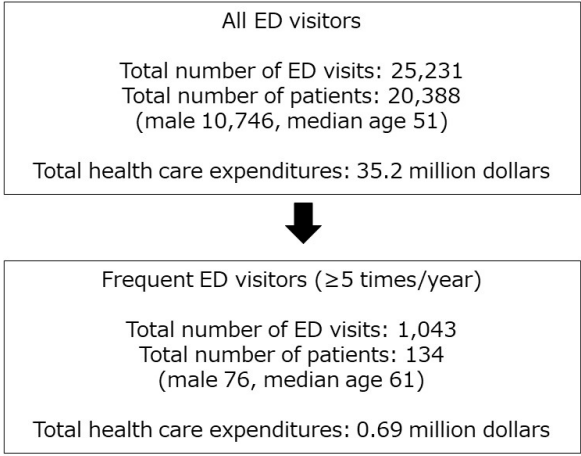
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Figure 1

108x60mm (300 x 300 DPI)

Supplementary file

Factors associated with frequent ED visits at the patient level (n = 20,388)

Factors	Odds Ratio (95% CI)	P value
age	1.01 (1.00-1.02)	.004
gender	1.27 (.90-1.79)	.179
receiving Public Assistance	7.19 (2.87-18.07)	<0.001

ED: Emergency Department

Factors associated with frequent ED visits at the visit level (n = 25,231)

Factors	Odds Ratio (95% CI)	P value
use of ambulance	.81 (1.00-1.02)	.011
evaluating service in the ED		
Internal medicine	1.27 (1.02-1.57)	.032
Surgery	0.74 (.49-1.11)	.144
Orthopaedics	0.63 (.47-0.84)	.002
Psychiatry	124.69 (85.89-181.01)	<0.001
Paediatrics	1.12 (.85-1.47)	.44
Obstetrics/Gynecology	2.77 (2.09-3.67)	<0.001

ED: Emergency Department

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
	<input checked="" type="checkbox"/>	Pages 1 and 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found
		Page 3-4
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
	<input checked="" type="checkbox"/>	Pages 6-8
Objectives	3	State specific objectives, including any prespecified hypotheses
	<input checked="" type="checkbox"/>	Pages 7-8
Methods		
Study design	4	Present key elements of study design early in the paper
	<input checked="" type="checkbox"/>	Page 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
	<input checked="" type="checkbox"/>	Page 8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
	<input checked="" type="checkbox"/>	Pages 8-9
		(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
	<input checked="" type="checkbox"/>	Page 10
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
	<input checked="" type="checkbox"/>	Pages 8-10
Bias	9	Describe any efforts to address potential sources of bias
	<input checked="" type="checkbox"/>	Pages 9-10
Study size	10	Explain how the study size was arrived at
	<input checked="" type="checkbox"/>	Pages 9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
	<input checked="" type="checkbox"/>	Pages 8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
	<input checked="" type="checkbox"/>	Pages 10-11
		(b) Describe any methods used to examine subgroups and interactions
		(c) Explain how missing data were addressed
		(d) If applicable, explain how loss to follow-up was addressed
		(e) Describe any sensitivity analyses
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
	<input checked="" type="checkbox"/>	

		Page 11
		(b) Give reasons for non-participation at each stage
		(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
	<input checked="" type="checkbox"/>	Page 11
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
	<input checked="" type="checkbox"/>	Pages 11-13
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
	<input checked="" type="checkbox"/>	Pages 11-13
		(b) Report category boundaries when continuous variables were categorized
		(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
Discussion		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	Page 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
	<input checked="" type="checkbox"/>	Pages 16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
	<input checked="" type="checkbox"/>	Pages 14-18
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	Pages 14-18
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
	<input checked="" type="checkbox"/>	Page 19

*Give information separately for exposed and unexposed groups.

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 <http://www.strobe-statement.org>.

BMJ Open

Differences between frequent emergency department users in a secondary rural hospital and a tertiary suburban hospital in central Japan: a prevalence study

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1 **Differences between frequent emergency department users in a secondary rural**
2 **hospital and a tertiary suburban hospital in central Japan: a prevalence study**

3
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45 32 **Keywords:** emergency department, frequent users, health care expenditure, Japan,
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47 33 secondary and tertiary hospital, health care utilization
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Abstract

10 11 12 39 **Objectives**

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15 40 Although frequent Emergency Department (ED) use is a global issue, little research has
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18 41 been conducted in a country like Japan where universal health insurance is available. The
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21 42 study aims to: 1) document the proportion of ED visits that are by frequent users, and 2)
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24 43 describe the differences in characteristics of frequent ED users and other ED users
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27 44 including expenditures between a secondary and a tertiary hospital.

28 29 30 45 **Design**

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33 46 A prevalence study for a period of one year

34 35 36 47 **Setting**

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39 48 A secondary hospital and a tertiary hospital in central Japan

40 41 42 49 **Participants**

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45 50 All patients who presented to the EDs

46 47 48 51 **Primary outcome measures**

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51 52 We defined frequent ED user as a patient who visited the ED ≥ 5 times/year. The main
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55 53 outcome measures were the proportion of frequent ED users among all ED users and the
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58 54 proportion of health care expenditures by the frequent ED users among all ED

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6 55 expenditures.

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9 56 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043
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12 57 visits—0.66% of all ED users, comprised 4.1% of all ED visits, and accounted for 1.9%
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15 58 of total health care expenditures. Median ED visits per one frequent ED user was 7.9.

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18 59 At the patient-level, after adjusting for age, gender, and receiving public assistance,
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21 60 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving
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24 61 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED
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26
27 62 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:
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30 63 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology
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33 64 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.

34 35 36 65 **Conclusions**

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39 66 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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42 67 them—while still in the low end of the distribution of published ranges—are lower in this
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45 68 study from Japan than in reports from many other countries.

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52 53 54 71 **Strengths and limitations of this study**

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57 72 • This study was an exhaustive investigation that evaluated all emergency
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6 73 department (ED) visitors over one year in the two hospitals. Including the entire
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9 74 population of eligible individuals precludes the need for inferential statistics and
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12 75 inherent risks of extrapolation had only a sample of eligible participants been
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15 76 chosen for investigation.
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18 77 • The study evaluated not only the numbers of visits but also the health care
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21 78 expenditures of frequent ED visitors.
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24 79 • This study only included one secondary hospital and one tertiary hospital.
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27 80 • This study did not assess for the severity of condition or diseases of the
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30 81 participants
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Introduction

85 Frequent emergency department (ED) use is associated with higher mortality rates¹ and
86 financial burden.² In a previous systematic review, frequent ED users comprised 0.1-
87 50% of all ED users and accounted for 1.9-20.5% of all ED visits in the U.S.³ Also, the
88 top 20% of frequent ED users account for 84% of all health care expenditures and “hot
89 spots” have been identified where many frequent ED users live.⁴ A study by Gross and
90 colleagues published in 2013 demonstrated that interventions for individual frequent ED
91 users or hot spots by multidisciplinary teams (such as family physicians, nurses, care
92 managers, and administrative officers) are associated with a reduction of the number of
93 ED visits and expenditures.⁴ Similarly, in three regions in the U.S., multidisciplinary
94 team interventions decreased hospitalization rates by 34% and health care expenditures
95 by 1.2 million dollars.⁵ However, a recent clinical trial examining the effect of complex
96 care transition programs using a multidisciplinary team found no significant differences
97 in hospital readmission between the intervention and control groups.⁶ High rates of
98 frequent ED users have been reported in North America, Europe, and Oceania.⁷ In
99 Asian countries, frequent ED users in Taiwan comprised 3.5% of all ED users and
100 accounted for 14.3% of all ED visits.⁸ In Korea, 3.1% of all ED visitors were frequent
101 ED users and occupied 14.0% of total ED visits.⁹ Among frequent ED users, low

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6 102 socioeconomic status and mental health problems are known predictors of frequent ED
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9 103 use based on research in 9 countries.^{7,10} Although such studies about frequent ED use
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12 104 were conducted , research on frequent ED use is little in countries with well-developed
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15 105 comprehensive national health insurance such as Japan.

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18 106 In Japan, research on frequent ED users has been investigated in single center
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21 107 studies.^{11,12} Also, there is no research about health care expenditure of frequent ED
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24 108 users in Japan. For example, in the study by Takeuchi et al., they found frequent ED
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27 109 users comprised 1.4% of all ED users and occupied 6.8% of all ED visits.¹¹ Frequent
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30 110 ED users were older and more often receiving governmental welfare in comparison with
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33 111 non-frequent ED users.¹¹ As the number of ED visits by ambulances has been
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36 112 annually increasing by 72 thousand per a year in Japan,¹³ a better understanding of the
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39 113 patterns and costs associated with frequent ED users in Japan would be indispensable
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42 114 for developing interventions to reduce unnecessary visit burdens on EDs and mitigate
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45 115 unnecessary costs.

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48 116 Understanding the current status of frequent ED users in Japan could inform policy-
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51 117 making that optimizes the use of EDs and leads efficiency in health care expenditures.
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54 118 Hence the study aims of this research were to: 1) document the proportion of ED visits
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57 119 that are by frequent users, and 2) describe the differences in characteristics of frequent
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6 120 ED users and other ED users between a secondary and a tertiary hospital in Japan. We
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9 121 hypothesized that a few frequent ED users would account for the major proportion of all
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12 122 ED users and for significant health care expenditure in Japan.
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18 124 **Methods**

21 125 **Design**

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24 126 This study team conducted a prevalence study by utilizing a retrospective chart review
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27 127 for a period of one year ranging from January 1 to December 31, 2017. In the present
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30 128 study, we followed the Strengthening the Reporting of Observational studies in
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33 129 Epidemiology (STROBE) statement.¹⁴
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36 130 **Setting**

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39 131 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary
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42 132 hospital) in central Japan served as the sites for study. The size of these two hospitals
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45 133 are generally comparable with other secondary and tertiary care hospitals in Japan.¹⁵
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48 134 Each hospital is the only general public hospital serving the local municipality. The
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51 135 characteristics of these hospitals are described in Table 1. In Japan, secondary hospitals
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54 136 provide emergency care for a patient who potentially requires admission and tertiary
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57 137 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple
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6 138 injury.¹⁶ The secondary hospital in this study serves a catchment area of about 48
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9 139 thousand people, but does not provide inpatient care for children due to the lack of
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12 140 pediatricians. It serves as the single public institution providing inpatient care for mental
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15 141 health in this region. Like the majority of hospitals in Japan, nurses triage patients
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18 142 presenting to the ED based on the patient's chief complaint for evaluation by one of the
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21 143 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This
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24 144 differs from the typical US-model of emergency care where nurses triage for acuity of
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27 145 need, but emergency physicians provide the first evaluation of all patients coming to the
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30 146 ED.¹⁷

33 147 **Patient and Public Involvement**

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36 148 This research was conducted without patient involvement. Patients were not invited to
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39 149 comment on the study design, and they were not consulted in the development of relevant
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42 150 patient outcomes or asked to interpret the results. They were not asked to contribute to
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45 151 the writing or editing of this document for readability or accuracy.

48 152 **Participants**

51 153 **Inclusion criteria**

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54 154 All patients who presented to the EDs during the study period were eligible for
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57 155 inclusion. There were no exclusion criteria for the study.
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6 **156 Measures**
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9 **157** To be consistent with previous literature,³ we defined a frequent ED user as a patient
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12 **158** who visited the ED in the same hospital ≥ 5 times/year during 2017. The study's main
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15 **159** outcome measures were the proportion of the frequent ED users among all ED users and
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18 **160** the proportion of health care expenditures by the frequent ED users among all ED
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21 **161** expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10
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24 **162** times, 10-14 times and ≥ 15) and explored the characteristics of the frequent ED users
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27 **163** by age, gender, receipt of public assistance (governmental welfare), ambulance use,
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30 **164** hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,
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33 **165** psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.
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36 **166 Statistical analysis**
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39 **167** To analyze for differences in the characteristics between the frequent ED users and non-
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42 **168** frequent ED users, we used chi-square tests. We employed two multivariable models,
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45 **169** changing the units of analyses: patient-level and visit-level. In the patient-level analysis,
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48 **170** we used logistic regression and adjusted age (as a continuous variable), gender (male
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51 **171** was the reference group), and receiving public assistance. In the visit-level analysis, we
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54 **172** used a mixed-effect model to include a random effect for hospital and individual
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57 **173** covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in
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6 174 the ED, and hospitalization. Covariates were selected based on a literature review.^{7,8} For
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9 175 the statistical analysis, we used STATA 15 with statistical significance defined by a P-
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178 **Results**

179 **Frequency of visits and expenditures by frequent ED users**

180 A total of 25,231 ED visits were made by 20,388 patients (male: 10,746) to the two
181 hospitals during the study period. We did not have missing data for each reported
182 variable. The median age (interquartile range) was 51 (range 23-75) and the total health
183 care expenditure was 3,774 million yen (\approx 35.2 million dollars). Health care
184 expenditures in the ED of the secondary hospital totalled 188 million yen (\approx 1.7 million
185 dollars) and that of the tertiary hospital totalled 3,586 million yen (\approx 33.0 million
186 dollars). Of all the visits, there were 134 frequent ED users (male=76). The median of
187 age (interquartile range) was 61.5 years (35-80) and the total health care expenditure
188 was 74 million yen (\approx 0.69 million dollars). The total number of visits by the frequent
189 ED users was 1,043 and these comprised 4.1% of all ED visits. Frequent ED users
190 accounted for 0.66% of all ED users, and 1.9% of total health care expenditures. Figure
191 1 shows summary of the results.

192 **Patient-level analysis**

193 As shown in Table 2, relative to patient-level characteristics of the frequent ED users,
194 the proportions of older adults ($65 \geq$) ($p=0.023$) and the patients receiving public
195 assistance were higher than those of the non-frequent ED users ($p<0.001$). Gender and
196 in-hospital death were not associated with frequent ED users. In terms of the visit-level
197 characteristics of the frequent ED users, the proportion of patients evaluated by
198 psychiatry and obstetrics/gynecology were higher than those of the non-frequent ED
199 users (both $p<0.001$). The proportion of the patients among frequent ED users who used
200 an ambulance ($p<0.001$), who were admitted to a hospital ($p=0.006$), or were evaluated
201 by internal medicine ($p=0.003$), surgery ($p=0.001$), and orthopedics ($p<0.001$) were
202 lower than those of the non-frequent ED users.

203 **Comparison of the frequent ED user characteristics in the secondary and tertiary** 204 **hospitals**

205 **Patient and visit-level characteristics by number of the ED users**

206 Tables 3-1 and 3-2 illustrate patient-level and visit-level characteristics of ED users
207 according to the number of visits to the secondary and tertiary hospitals, respectively.
208 Although many patients from either hospital used the ED only one time in the study
209 period, 4 patients (2 in the secondary hospital and 2 in the tertiary hospital) used the ED

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6 210 16 times or more. For factors such as in-hospital death, receiving public assistance, use
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9 211 of ambulance and hospitalization, the majority were accounted for by the non-frequent
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12 212 ED users (1-4 visits).

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14
15 213 Table 4 provides a comparison of frequent ED users' characteristics between the
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18 214 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of
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21 215 frequent ED users who were evaluated by psychiatry ($p<0.001$) and
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24 216 obstetrics/gynecology ($p<0.001$) was higher than those in the tertiary hospital. In the
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27 217 tertiary hospital, the proportion of patients who were aged 14 years and younger
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30 218 ($p<0.004$), evaluated by internal medicine ($p<0.001$), pediatrics ($p<0.001$) and surgery
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33 219 ($p<0.001$) was higher than those in the tertiary hospital.

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36 220 After adjusting for age, gender, and receiving public assistance, older age (odds ratio
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39 221 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02, $p=0.004$) and receiving public
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42 222 assistance (OR: 7.19, 95% CI: 2.87-18.07, $p<0.001$) were associated with frequent ED
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45 223 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine
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48 224 (OR: 1.27, 95% CI: 1.02-1.57, $p=0.032$), psychiatry (OR: 124.69, 95% CI: 85.89-
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51 225 181.01, $p<0.001$), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67, $p<0.001$)
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54 226 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,
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57 227 $p=0.011$) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84, $p=0.002$) were
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228 negatively associated with frequent ED visits. The details of the results are shown in the
229 supplementary file.

For peer review only

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Discussion

231 **Proportion of frequent ED users and health care expenditures**

232 These combined findings from a tertiary hospital and secondary hospital in a largely
233 urban area found that less than one percent of ED users (0.66%) accounted for nearly
234 one in 25 visits (4.1%) and nearly 1.9% of health care expenditures. These findings
235 contrast with the previous Japanese study conducted near Tokyo where 1.39% frequent
236 ED users (≥ 4 visits/year) occupied 6.75% of all ED visits and the previous study did not
237 report the utilized health care expenditures.¹¹ The differences may be attributable to a
238 different setting as the latter is from an ED in a single tertiary hospital serving a
239 population of 170,000 near metropolitan Tokyo. Because this tertiary hospital was
240 located near a metropolitan area, the patients might visit the hospital from a wider range
241 of areas compared with the present study's setting. The proportions of frequent ED
242 users in both Japanese studies were less by a half to a quarter than the ranges from
243 countries described in a systematic review (frequent ED users: 4.5-8% of all ED users).
244 The ED visits of frequent users are roughly a third to a tenth less than other countries
245 (21-28% of all ED visits).⁷ Compared to the Asian countries in the previous literature,
246 the proportion of frequent ED visits was almost one third in Japan.^{8,9} In a previous US
247 study, 1% of ED users accounted for 29% of costs⁴—a stark contrast to just less than

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6 248 1% of ED users in the current study accounting for about 2% of expenditures. In
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9 249 addition, the proportion of the health care expenditures by frequent ED users from both
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12 250 studies in Japan is much lower than found in several previous studies in the US.^{4,18,19}
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15 251 As reported in an international literature review, the problem of frequent ED visits has
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18 252 been observed in multiple countries including Asian countries.⁷ Multi-disciplinary
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21 253 interventions such as case management, care plan and information sharing has been
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24 254 found to be effective to reduce the frequent ED users.^{2,20} *Kaigo Hoken*, Japan's long-
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27 255 term care insurance program was introduced to provide long-term care support for older
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30 256 adults since 2000.²¹ Under *Kaigo Hoken*, care managers coordinate multiple care
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33 257 services for older adults.²¹ The care management financed under *Kaigo Hoken* may
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36 258 contribute to the low proportion of frequent ED users in the study compared to other
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39 259 international settings due to proactive care for limitations in activities of daily living.
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42 260 This support can also help mitigate social problems. Also, free-access and universal
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45 261 health care coverage in Japan may contribute to the results as well. Patients can access
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48 262 health-care services regardless of their income, living place and types of hospitals.²¹ In
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51 263 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more
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54 264 timely manner, compared to those in the US.^{22,23}

265 **Characteristics of the frequent ED users**

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6 266 Characteristics of frequent ED users found in the current study, older age, low
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9 267 socioeconomic status, and mental health problems, are consistent with previous studies
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12 268 in other countries.^{3,24} For example, findings from the UK, US, Canada and Taiwan
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15 269 similarly identified older age²⁵ and mental problems.^{7,24,26,27} In our study, the proportion
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18 270 of patients who were older than or equal to 65 years among all ED visitors was 38.2%.
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21 271 This is relatively higher than those in the previous studies in other countries such as
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24 272 16.6%-22.1% (US)^{28,29}, 25.1% (Canada)³⁰ and 34.5% (Taiwan)⁸. Therefore, older
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27 273 patients could not explain the low rate of frequent ED users in our study. Thus, as we
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30 274 discussed above, the Japanese health care systems such as Kaigo Hoken or universal
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33 275 health care coverage could explain our results. While previous studies have also
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36 276 identified homelessness²⁴ and substance abuse^{7,26,30} as predictors for frequent ED use,
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39 277 the rate of homelessness in Japan is very low compared to the US, 0.004% vs
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42 278 0.17%^{31,32}, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of
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45 279 methamphetamine and 0.3% vs 14.3% in use of cocaine.³³ Thus, it was not surprising
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48 280 for these factors not to be predictors of frequent ED use.
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51 281 In the previous study conducted in Japan, mental health issues were not related to
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54 282 frequent ED visits but this may be attributable to the absence of full-time psychiatric
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57 283 providers in that hospital.¹¹ While a difference was noted in the proportion of frequent
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6 284 ED visits for pediatric problems between the secondary and tertiary hospital, this
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9 285 finding was not surprising given the lack of a full-time paediatrician in the secondary
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12 286 hospital in our study. Because characteristics of frequent ED users are heterogeneous⁷,
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15 287 analysis of characteristics of frequent ED users in each hospital is important to reduce
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18 288 frequent ED visits. For example, case management including insurance coverage and
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21 289 access to support services has been shown to reduce ED visits among low-income
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24 290 adults.³⁴ Moreover, multidisciplinary intervention with mental health and substance-
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27 291 abuse professionals decrease ED visits and health care cost.³⁵ These factors, namely,
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30 292 low socioeconomic status and mental issues, are of particular importance for attention
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33 293 of health care providers and policy makers seeking to develop effective interventions to
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36 294 reduce unnecessary visits and reduce costs.
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39 295 Future research could include a multicentre or nation-wide study in Japan to further
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42 296 characterize frequent ED users across the nation. Despite the much lower rate of frequent
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45 297 ED users, visits, and associated costs in our study compared to other countries, research
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48 298 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as
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51 299 an area ripe for future research.

300 **Study strengths**

301 This is the first study to investigate health care expenditures for frequent ED users in

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6 302 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a
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9 303 secondary and a tertiary hospital. A possible explanation for the low proportion of
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12 304 frequent ED users, could come from inadequate accounting for the actual number of ED
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15 305 visits. In the current study, we counted ED visits in each hospital. If patients attended
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18 306 multiple EDs, it is possible we would not capture the actual number of ED visits, and
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21 307 underestimate the total number of frequent ED users. However, this seems unlikely to
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24 308 have a substantial impact as both hospitals serve as the primary hospitals in their
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27 309 catchment areas.

30 **Study limitations**

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33 311 First, because this study only included one secondary hospital and one tertiary hospital,
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36 312 the results need to be confirmed through examination of other Japanese hospitals. Both
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39 313 studies occurred in a single prefecture which is predominantly rural. While not necessarily
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42 314 reflective of major metropolitan areas in Japan such as Tokyo, the prefecture of Shizuoka
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45 315 is probably similar to a majority of other prefectures in Japan which have a predominance
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48 316 of rural areas dotted with a few larger cities with tertiary care hospitals. Second, this study
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51 317 did not assess for the severity of condition or diseases of the participants. Thus,
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54 318 appropriateness of the ED visits was not evaluated directly.

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6 320 **Conclusions**

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9 321 The proportion of frequent ED users, of total visits, and of expenditures attributable to
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12 322 them are lower in this study from Japan than the distribution of published ranges in reports
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15 323 from many other countries. Future research on a larger scale will be required to determine
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18 324 if these lower rates are consistent across Japan and to fully explain these differences and
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21 325 understand potential lessons for other countries.
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27 327 Figure 1. Summary of frequent emergency department visitors.
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56
57 337 interpretation, writing of the report, or the decision to submit this article for publication.
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6 338 **Competing interests**
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9 339 There are no potential competing interests to declare that are relevant to this work.
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12 340 **Contributors**
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15 341 MK designed the study and participated in the implementation, data collection, data
16
17 342 analysis, and writing of the manuscript. MK also served as the guarantor. MI, MO, BC
18
19 343 and MF contributed to the design of the study and critically reviewed the manuscript. MK
20
21 344 and AF analyzed the data. All authors had full access to the data and take responsibility
22
23 345 for the integrity and accuracy of the analyses.
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30 346 **Ethical Approval**
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33 347 This study was approved by the Research Ethics Committee of Hamamatsu University
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35 348 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata
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37 349 City Hospital. We were not required to obtain individual informed consent from the
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39 350 patients included in the study. However, the research team displayed a poster in the
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41 351 waiting room of the hospitals to provide information about the collection and use of
42
43 352 data for this research, and about the protection of personal information.
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51 353 **Transparency**
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54 354 All authors had full access to all of the data (including statistical reports and tables) in the
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56 355 study and take responsibility for its integrity and the accuracy of the data analyses. The
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6 356 lead author affirms that the manuscript is an honest, accurate, and gives a transparent
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9 357 account of the study being reported, and that no important aspects of the study have been
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11
12 358 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)
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15 359 have been explained.
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17 18 360 **Data sharing**

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21 361 Data sharing is not applicable because we did not receive informed consent concerning
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24 362 data sharing from the participants.
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28 29 30 364 **References**

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462 Table 1. Characteristics of the study secondary and tertiary hospitals

	Secondary hospital	Tertiary hospital
Catchment area served	4,800 people	167,000 people
Total number of beds	260	500
Total number of emergency department visits	5,914	19,317
Number of psychiatric beds	58**	0
Number of beds in the emergency room	2	24
Number of infectious diseases beds.	0	2
Number of pediatric beds*	0	20
Proportion of the population aged 65 years and over in the city (%) ³⁶	25.0	26.1
Unemployment rate in the	2.9	3.6

city (%)³⁶

463 *The secondary hospital does not provide inpatient care for children due to the lack of
 464 pediatricians.

465 **The secondary hospital is the only public institution for providing inpatient care for
 466 mental health in the area.

467

468 Table 2. Comparison of frequent and non-frequent ED users for both the secondary and
 469 tertiary hospitals

	Total	Frequent ED users	Non-frequent ED users	p-value
Patient-level n=20,388				
(number of patients)				
Age				
14<	3,728	19	3,709	0.217
15-64	8,862	51	8,811	0.205
65≥	7,798	64	7,734	0.023*
Gender				
male	9,642	58	9,584	0.351

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female	10,746	76	10,670	
In-hospital death				
no	19,825	131	19,694	0.771
yes	563	3	560	
Receiving public assistance				
no	20,257	128	20,129	<0.001*
yes	110	5	105	
Visit-level n=25,231 (number of visits)				
Use of ambulance				
no	18,496	834	17,662	<0.001*
yes	6,735	209	6,526	
Hospitalization				
no	20,256	872	19,384	p=0.006*
yes	4,975	171	4,804	
Results of triage in the emergency department				

Internal medicine	11,762	439	1,1323	p=0.003*
Surgery	1,312	30	1,282	p=0.001*
Orthopedics	4,412	84	4,328	<0.001*
Psychiatry	236	189	47	<0.001*
Pediatrics	2,817	98	2,719	p=0.064
OB/GYN	1,181	95	1,086	<0.001

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471

472 Table 3-1. The patient-level and visit-level characteristics of ED users based on the number of visits in the secondary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16≥
visits						
<hr/>						
Patient-level						
Number of						
patients (%):						
n=4,760						
<hr/>						
Age						
14<	439 (91.6)	38 (7.9)	1 (0.2)	1 (0.2)	0 (0)	0 (0)
15-64	1,879 (86.8)	267 (12.3)	11 (0.5)	6 (0.3)	0 (0)	2 (0.1)

32

65≥	1,670 (78.9)	426 (20.1)	18 (0.9)	1 (0)	1 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	1 (0)	1 (0)
female	2,094 (85.2)	341 (13.9)	18 (0.7)	3 (0.1)	0 (0)	1 (0)
In-hospital						
death						
no	3,832 (83.3)	727 (15.8)	30 (0.7)	8 (0.2)	1 (0)	2 (0)
yes	156 (97.5)	4 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Receiving						
public						
assistance						

no	3,980 (83.8)	731 (15.4)	29 (0.6)	7 (0.1)	1(0)	2 (0)
yes	8 (80.0)	0 (0)	1 (10.0)	1 (10.0)	0 (0)	0 (0)

Visit-level

Number of visits

(%): n=6,122

Use of

ambulance

no	2,921 (63.7)	1,300 (28.4)	138 (3.0)	44 (0.1)	13 (0.3)	169 (3.7)
yes	1,068 (69.5)	399 (26.0)	33 (2.1)	28 (1.8)	1 (0)	8 (0.5)

Hospitalization

no	3,052 (65.0)	1,264 (26.9)	127 (2.7)	66 (1.4)	8 (0.2)	175 (3.7)
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5 yes 937 (65.5) 435 (30.4) 44 (3.1) 6 (0.4) 6 (0.4) 2 (0.1)
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474 Table 3-2. The patient-level and visit-level characteristics of ED users based on the number of visits in the tertiary hospital.

Number of ED visits	1	2-4	5-7	8-10	11-15	16\geq
visits						
<hr/>						
Patient-level						
Number of patients (%):						
n=15,628						
<hr/>						
Age						
14<	2,685 (82.7)	547 (16.8)	12 (0.4)	5 (0.2)	0 (0)	0 (0)
15-64	5,937 (88.7)	728 (10.9)	24 (0.4)	4 (0.1)	2 (0)	2 (0)
65 \geq	14,576 (92.9)	1,062 (6.8)	37 (0.2)	5 (0)	2 (0)	0(0)

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5	Gender						
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7							
8	male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)	2 (0)
9							
10							
11	female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)	0 (0)
12							
13							
14	In-hospital						
15							
16							
17	death						
18							
19							
20	no	12,880 (84.6)	2,255 (14.8)	71 (0.5)	13 (0.1)	4 (0)	2 (0)
21							
22							
23	yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)	0 (0)
24							
25							
26	Receiving						
27							
28							
29	public						
30							
31							
32	assistance						
33							
34							
35	no	13,103 (84.5)	2,315 (14.9)	72 (0.5)	14 (0.1)	2 (0)	1 (0)
36							
37							

yes	76 (76.0)	21 (21.0)	0 (0)	0 (0)	2 (2.0)	1 (1.0)
<hr/>						
Visit-level						
Number of						
visits (%):						
n=19,109						
<hr/>						
Use of						
ambulance						
no	9,358 (68.2)	3,903 (28.4)	300 (2.2)	109 (0.8)	37 (0.3)	24 (0.2)
yes	3,661 (70.4)	1,398 (26.9)	94 (1.8)	17 (0.3)	14 (0.3)	14 (0.3)
Hospitalization						
no	10,850 (69.7)	4,218 (27.1)	322 (2.1)	86 (0.6)	50 (0.3)	38 (0.2)

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475	yes	2,349 (66.3)	1,083 (30.6)	72 (2.0)	40 (1.1)	1 (0)	0 (0)
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476 Table 4. Differences in frequent ED users' characteristics between secondary and
 477 tertiary hospitals

	Total	Secondary hospital	Tertiary hospital	p-value
Patient-level	134	41	93	
Number of patients (%): n=134				
Age				
14<	19	2 (10.5)	17 (89.5)	0.004*
15-64	51	19 (37.3)	32 (62.7)	0.190
65≥	64	20 (31.2)	44 (68.8)	0.875
Gender				
male	58	39 (67.2)	19 (32.8)	0.635
female	76	54 (71.1)	22 (28.9)	
In-hospital death				
no	131	41 (31.3)	90 (68.7)	0.245
yes	3	0 (0)	3 (100.0)	
Receiving public				

assistance

no	128	39 (30.5)	89 (69.5)	0.651
yes	5	2 (40.0)	3 (60.0)	

Visit-level

Number of visits (%):

n=1,043

Use of ambulance

no	834	364 (43.6)	470 (56.4)	p=0.008*
yes	209	70 (33.5)	139 (66.5)	

Hospitalization

no	872	376 (43.1)	496 (56.9)	p=0.026
yes	171	58 (33.9)	113 (69.0)	

Evaluating service in the

ED

Internal medicine	439	114 (26.0)	325 (74.0)	<0.001*
Surgery	30	0 (0)	30 (100.0)	<0.001*
Orthopedics	84	25 (29.8)	59 (70.2)	p=0.022
Psychiatry	189	189 (100.0)	0 (0)	<0.001*

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Pediatrics	98	10 (10.2)	88 (89.8)	<0.001*
Obstetrics/Gynecology	95	85 (89.	10 (1.1)	<0.001

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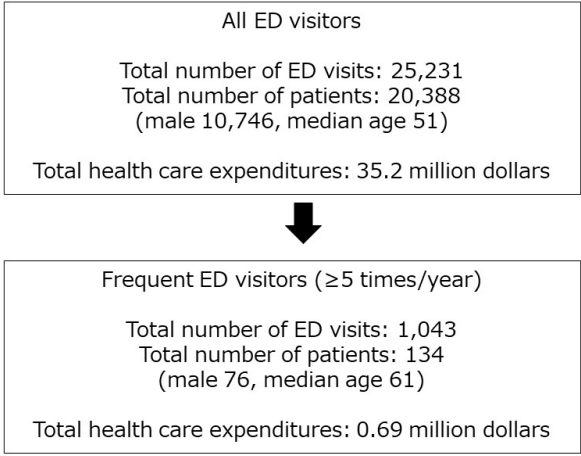
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Figure 1

108x60mm (300 x 300 DPI)

Supplementary file

Factors associated with frequent ED visits at the patient level (n = 20,388)

Factors	Odds Ratio (95% CI)	P value
age	1.01 (1.00-1.02)	.004
gender	1.27 (.90-1.79)	.179
receiving Public Assistance	7.19 (2.87-18.07)	<0.001

ED: Emergency Department

Factors associated with frequent ED visits at the visit level (n = 25,231)

Factors	Odds Ratio (95% CI)	P value
use of ambulance	.81 (1.00-1.02)	.011
evaluating service in the ED		
Internal medicine	1.27 (1.02-1.57)	.032
Surgery	0.74 (.49-1.11)	.144
Orthopaedics	0.63 (.47-0.84)	.002
Psychiatry	124.69 (85.89-181.01)	<0.001
Paediatrics	1.12 (.85-1.47)	.44
Obstetrics/Gynecology	2.77 (2.09-3.67)	<0.001

ED: Emergency Department

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract
	<input checked="" type="checkbox"/>	Pages 1 and 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found
		Page 3-4
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
	<input checked="" type="checkbox"/>	Pages 6-8
Objectives	3	State specific objectives, including any prespecified hypotheses
	<input checked="" type="checkbox"/>	Pages 7-8
Methods		
Study design	4	Present key elements of study design early in the paper
	<input checked="" type="checkbox"/>	Page 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
	<input checked="" type="checkbox"/>	Page 8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
	<input checked="" type="checkbox"/>	Pages 8-9
		(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
	<input checked="" type="checkbox"/>	Page 10
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
	<input checked="" type="checkbox"/>	Pages 8-10
Bias	9	Describe any efforts to address potential sources of bias
	<input checked="" type="checkbox"/>	Pages 9-10
Study size	10	Explain how the study size was arrived at
	<input checked="" type="checkbox"/>	Pages 9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
	<input checked="" type="checkbox"/>	Pages 8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
	<input checked="" type="checkbox"/>	Pages 10-11
		(b) Describe any methods used to examine subgroups and interactions
		(c) Explain how missing data were addressed
		(d) If applicable, explain how loss to follow-up was addressed
		(e) Describe any sensitivity analyses
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
	<input checked="" type="checkbox"/>	

		Page 11
		(b) Give reasons for non-participation at each stage
		(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
	<input checked="" type="checkbox"/>	Page 11
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
	<input checked="" type="checkbox"/>	Pages 11-13
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
	<input checked="" type="checkbox"/>	Pages 11-13
		(b) Report category boundaries when continuous variables were categorized
		(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
Discussion		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	Page 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
	<input checked="" type="checkbox"/>	Pages 16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
	<input checked="" type="checkbox"/>	Pages 14-18
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	Pages 14-18
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
	<input checked="" type="checkbox"/>	Page 19

*Give information separately for exposed and unexposed groups.

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 <http://www.strobe-statement.org>.