

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-039030
Article Type:	Original research
Date Submitted by the Author:	01-Apr-2020
Complete List of Authors:	Kaneko, Makoto; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program, Inoue, Machiko; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program Okubo, Masashi; University of Pittsburgh, Department of Emergency Medicine Furgal, Allison; University of Michigan Medical School, Department of Family Medicine Crabtree, Benjamin; Rutgers Robert Wood Johnson Medical School, Department of Family Medicine and Community Health, Research Division Fetters, Micheal; University of Michigan Medical School, Department of Family Medicine; University of Michigan, Mixed Methods Program and Department of Family Medicine
Keywords:	ACCIDENT & EMERGENCY MEDICINE, HEALTH ECONOMICS, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

Makoto Kaneko, MD, PhD<sup>1,2</sup>; Machiko Inoue, MD, MPH, PhD<sup>1,2</sup>; Masashi Okubo, MD, MS<sup>3</sup>; Allison K. Cullen Furgal, BS, MS, MA<sup>4</sup>; Benjamin F. Crabtree, PhD<sup>5</sup>; and Michael D Fetters, MD, MPH, MA<sup>4,7</sup>

<sup>1</sup> Department of Family and Community Medicine, Hamamatsu University School of Medicine, 1-20-1, Handayama, Higashi-ku, Hamamatsu, 431-3192, Japan

<sup>2</sup> Shizuoka Family Medicine Program, 1055-1, Akatsuchi, Kikugawa, Shizuoka, 437-1507, Japan

<sup>3</sup> Department of Emergency Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

<sup>4</sup> Department of Family Medicine, University of Michigan Medical School, Michigan, USA

<sup>5</sup> Department of Family Medicine and Community Health, Research Division Rutgers Robert Wood Johnson Medical School, New Jersey, USA

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

<sup>6</sup>Mixed Methods Program and Department of Family Medicine, University of Michigan

Medical School, Michigan, USA

Corresponding author: Makoto Kaneko

Department of Family and Community Medicine, Hamamatsu University School of

Medicine, 1-20-1, Handayama, Higashi-ku, Hamamatsu, 431-3192, Japan

Tel: +81 53 435 2416; Fax: +81 53 435 2417

E-mail: [makotok@hama-med.ac.jp](mailto:makotok@hama-med.ac.jp)

Word count of main text: 2,707

Number of tables and figures: 4 tables and 1 supplementary file

**Keywords:** emergency department, frequent users, health care expenditure, Japan, secondary and tertiary hospital, health care utilization

## 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  $\geq 5$  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.

1  
2  
3  
4  
5  
6 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043  
7  
8 visits—0.66% of all ED users, comprised 4.1% of all ED visits, and accounted for 1.9%  
9  
10 of total health care expenditures. Median ED visits per one frequent ED user was 7.9.  
11  
12

13  
14  
15 At the patient-level, after adjusting for age, gender, and receiving public assistance,  
16  
17 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving  
18  
19 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED  
20  
21 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:  
22  
23 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology  
24  
25 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.  
26  
27  
28  
29  
30  
31  
32

### 33 **Conclusions**

34  
35  
36 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
37  
38 them—while still in the low end of the distribution of published ranges—are lower in this  
39  
40 study from Japan than in reports from many other countries.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50

### 51 **Strengths and limitations of this study**

- 52  
53  
54 • This is the first study to investigate health care expenditures for frequent ED users  
55  
56 in Japan.  
57  
58  
59  
60

- 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 rates<sup>1</sup> and financial burden.<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> High rates of frequent ED users have been reported in North America, Europe, and Oceania.<sup>7</sup> In Asian countries, frequent ED users in Taiwan comprised 3.5% of all ED users and accounted for 14.3% of all ED visits.<sup>8</sup> In Korea, 3.1% of all ED visitors were frequent ED users and occupied 14.0% of total ED visits.<sup>9</sup> Among frequent ED users, low

1  
2  
3  
4  
5  
6 socioeconomic status and mental health problems are known predictors of frequent ED  
7  
8  
9 use based on research in 9 countries.<sup>7,10</sup> Despite this international literature, research on  
10  
11  
12 frequent ED use in countries with well-developed comprehensive national health  
13  
14  
15 insurance such as Japan.  
16

17  
18 In Japan, research on frequent ED users has been investigated in only one single center  
19  
20  
21 study.<sup>11</sup> In that study, they found frequent ED users comprised 1.4% of all ED users and  
22  
23  
24 occupied 6.8% of all ED visits.<sup>11</sup> Frequent ED users were older and more often  
25  
26  
27 receiving governmental welfare in comparison with non-frequent ED users.<sup>11</sup> The study  
28  
29  
30 has an important limitation; the effect of frequent ED user on the utilized health care  
31  
32  
33 expenditures was not reported. Additionally, since the study was conducted at a tertiary  
34  
35  
36 referral hospital, external validity of the findings to other hospital settings is limited. As  
37  
38  
39 the number of ED visits by ambulances has been annually increasing by 72 thousand  
40  
41  
42 per a year in Japan,<sup>12</sup> a better understanding of the patterns and costs associated with  
43  
44  
45 frequent ED users in Japan would be indispensable for developing interventions to  
46  
47  
48 reduce unnecessary visit burdens on EDs and mitigate unnecessary costs.  
49

50  
51 Understanding the current status of frequent ED users in Japan could inform policy-  
52  
53  
54 making that optimizes the use of EDs and leads efficiency in health care expenditures.  
55  
56  
57 Hence the study aims of this research were to: 1) document the proportion of ED visits  
58  
59  
60

1  
2  
3  
4  
5  
6 that are by frequent users, and 2) describe the differences in characteristics of frequent  
7  
8  
9 ED users and other ED users between a secondary and a tertiary hospital in Japan. We  
10  
11  
12 hypothesized that a few frequent ED users would account for the major proportion of all  
13  
14  
15 ED users and for significant health care expenditure in Japan.  
16  
17  
18  
19  
20  
21

## 22 **Methods**

### 23 **Design**

24  
25  
26  
27 This study team utilized a retrospective chart review for a period of one year ranging  
28  
29  
30 from January 1 to December 31, 2017.  
31  
32

### 33 **Setting**

34  
35  
36 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary  
37  
38 hospital) in central Japan served as the sites for study. The size of these two hospitals  
39  
40 are generally comparable with other secondary and tertiary care hospitals in Japan.<sup>13</sup>  
41  
42  
43 Each hospital is the only general public hospital serving the local municipality. The  
44  
45 characteristics of these hospitals are described in Table 1. In Japan, secondary hospitals  
46  
47 provide emergency care for a patient who potentially requires admission and tertiary  
48  
49 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple  
50  
51 injury.<sup>14</sup> The secondary hospital in this study serves a catchment area of about 48  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 thousand people, but does not provide inpatient care for children due to the lack of  
7  
8  
9 pediatricians. It serves as the single public institution providing inpatient care for mental  
10  
11  
12 health in this region. Like the majority of hospitals in Japan, nurses triage patients  
13  
14  
15 presenting to the ED based on the patient's chief complaint for evaluation by one of the  
16  
17  
18 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This  
19  
20  
21 differs from the typical US-model of emergency care where nurses triage for acuity of  
22  
23  
24 need, but emergency physicians provide the first evaluation of all patients coming to the  
25  
26  
27 ED.<sup>15</sup>

### 30 **Patient and Public Involvement**

31  
32  
33 This research was conducted without patient involvement. Patients were not invited to  
34  
35  
36 comment on the study design, and they were not consulted in the development of relevant  
37  
38  
39 patient outcomes or asked to interpret the results. They were not asked to contribute to  
40  
41  
42 the writing or editing of this document for readability or accuracy.

### 45 **Participants**

#### 48 **Inclusion criteria**

49  
50  
51 All patients who presented to the EDs during the study period were eligible for  
52  
53  
54 inclusion. There were no exclusion criteria for the study.

#### 57 **Measures**

1  
2  
3  
4  
5  
6 To be consistent with previous literature,<sup>3</sup> we defined a frequent ED user as a patient  
7  
8  
9 who visited the ED in the same hospital  $\geq 5$  times/year during 2017. The study's main  
10  
11  
12 outcome measures were the proportion of the frequent ED users among all ED users and  
13  
14  
15 the proportion of health care expenditures by the frequent ED users among all ED  
16  
17  
18 expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10  
19  
20  
21 times, 10-14 times and  $\geq 15$ ) and explored the characteristics of the frequent ED users  
22  
23  
24 by age, gender, receipt of public assistance (governmental welfare), ambulance use,  
25  
26  
27 hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,  
28  
29  
30 psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.  
31  
32

### 33 **Statistical analysis**

34  
35  
36 To analyze for differences in the characteristics between the frequent ED users and non-  
37  
38  
39 frequent ED users, we used chi-square tests. We employed two multivariable models,  
40  
41  
42 changing the units of analyses: patient-level and visit-level. In the patient-level analysis,  
43  
44  
45 we used logistic regression and adjusted age (as a continuous variable), gender (male  
46  
47  
48 was the reference group), and receiving public assistance. In the visit-level analysis, we  
49  
50  
51 used a mixed-effect model to include a random effect for hospital and individual  
52  
53  
54 covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in  
55  
56  
57 the ED, and hospitalization. Covariates were selected based on a literature review.<sup>7,8</sup> For  
58  
59  
60

1  
2  
3  
4  
5  
6 the statistical analysis, we used STATA 15 with statistical significance defined by a P-  
7  
8  
9 value <0.05.  
10

## 11 12 13 14 15 **Results**

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

19  
20  
21 A total of 25,231 ED visits were made by 20,388 patients (male: 10,746) to the two  
22  
23 hospitals during the study period. The median age (interquartile range) was 51 (range  
24  
25 23-75) and the total health care expenditure was 3,774 million yen ( $\approx$  35.2 million  
26  
27 dollars). Health care expenditures in the ED of the secondary hospital totalled 188  
28  
29 million yen ( $\approx$  1.7 million dollars) and that of the tertiary hospital totalled 3,586 million  
30  
31 yen ( $\approx$  33.0 million dollars). Of all the visits, there were 134 frequent ED users  
32  
33 (male=76). The median of age (interquartile range) was 61.5 years (35-80) and the total  
34  
35 health care expenditure was 74 million yen ( $\approx$  0.69 million dollars). The total number  
36  
37 of visits by the frequent ED users was 1,043 and these comprised 4.1% of all ED visits.  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
Frequent ED users accounted for 0.66% of all ED users, and 1.9% of total health care  
expenditures.

### 54 55 **Patient-level analysis**

56  
57  
58  
59  
60  
As shown in Table 2, relative to patient-level characteristics of the frequent ED users,

1  
2  
3  
4  
5  
6 the proportions of older adults ( $65 \geq$ ) ( $p=0.023$ ) and the patients receiving public  
7  
8 assistance were higher than those of the non-frequent ED users ( $p<0.001$ ). Gender and  
9  
10 in-hospital death were not associated with frequent ED users. In terms of the visit-level  
11  
12 characteristics of the frequent ED users, the proportion of patients evaluated by  
13  
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 ( $p<0.001$ ),  
17  
18 who were admitted to a hospital ( $p<0.006$ ), or were evaluated by internal medicine  
19  
20 ( $p<0.003$ ), surgery ( $p=0.001$ ), and orthopedics ( $p<0.001$ ) were lower than the non-  
21  
22 frequent ED users.  
23  
24  
25  
26  
27  
28  
29  
30  
31

### 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

41  
42 Tables 3-1 and 3-2 illustrate patient-level and visit-level characteristics of ED users  
43  
44 according to the number of visits to the secondary and tertiary hospitals, respectively.  
45  
46

47  
48 Although many patients from either hospital used the ED only one time in the study  
49  
50 period, 4 patients (2 in the secondary hospital and 2 in the tertiary hospital) used the ED  
51  
52 16 times or more. For factors such as in-hospital death, receiving public assistance, use  
53  
54 of ambulance and hospitalization, the majority were accounted for by the non-frequent  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 ED users (1-4 visits)  
7  
8

9 Table 4 provides a comparison of frequent ED users' characteristics between the  
10 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of  
11  
12 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of  
13 frequent ED users who were evaluated by psychiatry ( $p<0.001$ ) and  
14  
15 obstetrics/gynecology ( $p<0.001$ ) was higher than those in the tertiary hospital. In the  
16  
17 tertiary hospital, the proportion of patients who were aged 14 years and younger  
18  
19 ( $p<0.004$ ), evaluated by internal medicine ( $p<0.001$ ), pediatrics ( $p<0.001$ ) and surgery  
20  
21 ( $p<0.001$ ) was higher than those in the tertiary hospital.  
22  
23  
24  
25  
26  
27  
28

29 After adjusting for age, gender, and receiving public assistance, older age (odds ratio  
30  
31 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02,  $p=0.004$ ) and receiving public  
32  
33 assistance (OR: 7.19, 95% CI: 2.87-18.07,  $p<0.001$ ) were associated with frequent ED  
34  
35 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine  
36  
37 (OR: 1.27, 95% CI: 1.02-1.57,  $p=0.032$ ), psychiatry (OR: 124.69, 95% CI: 85.89-  
38  
39 181.01,  $p<0.001$ ), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67,  $p<0.001$ )  
40  
41 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,  
42  
43  $p=0.011$ ) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84,  $p=0.002$ ) were  
44  
45 negatively associated with frequent ED visits. The details of the results are shown in the  
46  
47 supplementary file.  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

13



## 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 ( $\geq 4$  visits/year) occupied 6.75% of all ED visits.<sup>11</sup> 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).<sup>7</sup> Compared to the Asian countries in the previous literature, the proportion of frequent ED visits was almost one third in Japan.<sup>8,9</sup> In a previous US study, 1% of ED users accounted for 29% of costs<sup>4</sup>—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.<sup>4,16,17</sup>

1  
2  
3  
4  
5  
6 As reported in an international literature review, the problem of frequent ED visits has  
7  
8  
9 been observed in multiple countries including Asian countries.<sup>7</sup> Multi-disciplinary  
10  
11  
12 interventions such as case management, care plan and information sharing has been  
13  
14  
15 found to be effective to reduce the frequent ED users.<sup>2,18</sup> *Kaigo Hoken*, Japan's long-  
16  
17  
18 term care insurance program was introduced to provide long-term care support for older  
19  
20  
21 adults since 2000.<sup>19</sup> Under *Kaigo Hoken*, care managers coordinate multiple care  
22  
23  
24 services for older adults.<sup>19</sup> The care management financed under *Kaigo Hoken* may  
25  
26  
27 contribute to the low proportion of frequent ED users in the study compared to other  
28  
29  
30 international settings due to proactive care for limitations in activities of daily living.  
31  
32  
33 This support can also help mitigate social problems. Also, free-access and universal  
34  
35  
36 health care coverage in Japan may contribute to the results as well. Patients can access  
37  
38  
39 health-care services regardless of their income, living place and types of hospitals.<sup>19</sup> In  
40  
41  
42 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more  
43  
44  
45 timely manner, compared to those in the US.<sup>20,21</sup>

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

49  
50  
51 Characteristics of frequent ED users found in the current study, older age, low  
52  
53  
54 socioeconomic status, and mental health problems, are consistent with previous studies  
55  
56  
57 in other countries.<sup>3,22</sup> For example, findings from the UK, US, Canada and Taiwan  
58  
59  
60

1  
2  
3  
4  
5  
6 similarly identified older age<sup>23</sup> and mental problems.<sup>7,22,24,25</sup> While previous studies  
7  
8  
9 have also identified homelessness<sup>22</sup> and substance abuse<sup>7,24,26</sup> as predictors for frequent  
10  
11  
12 ED use, the rate of homelessness in Japan is very low compared to the US, 0.004% vs  
13  
14  
15 0.17%<sup>27,28</sup>, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of  
16  
17  
18 methamphetamine and 0.3% vs 14.3% in use of cocaine.<sup>29</sup> Thus, it was not surprising  
19  
20  
21 for these factors not to be predictors of frequent ED use.  
22

23  
24 In the previous study conducted in Japan, mental health issues were not related to  
25  
26  
27 frequent ED visits but this may be attributable to the absence of full-time psychiatric  
28  
29  
30 providers in that hospital.<sup>11</sup> While a difference was noted in the proportion of frequent  
31  
32  
33 ED visits for pediatric problems between the secondary and tertiary hospital, this  
34  
35  
36 finding was not surprising given the lack of a full-time paediatrician in the secondary  
37  
38  
39 hospital in our study. Because characteristics of frequent ED users are heterogeneous<sup>7</sup>,  
40  
41  
42 analysis of characteristics of frequent ED users in each hospital is important to reduce  
43  
44  
45 frequent ED visits. For example, case management including insurance coverage and  
46  
47  
48 access to support services has been shown to reduce ED visits among low-income  
49  
50  
51 adults.<sup>30</sup> Moreover, multidisciplinary intervention with mental health and substance-  
52  
53  
54 abuse professionals decrease ED visits and health care cost.<sup>31</sup> These factors, namely,  
55  
56  
57 low socioeconomic status and mental issues, are of particular importance for attention  
58  
59  
60

1  
2  
3  
4  
5  
6 of health care providers and policy makers seeking to develop effective interventions to  
7  
8  
9 reduce unnecessary visits and reduce costs.  
10

11  
12 Future research could include a multicentre or nation-wide study in Japan to further  
13  
14 characterize frequent ED users across the nation. Despite the much lower rate of frequent  
15  
16 ED users, visits, and associated costs in our study compared to other countries, research  
17  
18 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as  
19  
20 an area ripe for future research.  
21  
22  
23  
24  
25

### 26 27 **Study strengths**

28  
29 This is the first study to investigate health care expenditures for frequent ED users in  
30  
31 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a  
32  
33 secondary and a tertiary hospital. A possible explanation for the low proportion of  
34  
35 frequent ED users, could come from inadequate accounting for the actual number of ED  
36  
37 visits. In the current study, we counted ED visits in each hospital. If patients attended  
38  
39 multiple EDs, it is possible we would not capture the actual number of ED visits, and  
40  
41 underestimate the total number of frequent ED users. However, this seems unlikely to  
42  
43 have a substantial impact as both hospitals serve as the primary hospitals in their  
44  
45 catchment areas.  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

### 56 57 **Study limitations**

1  
2  
3  
4  
5  
6 First, because this study only included one secondary hospital and one tertiary hospital,  
7  
8  
9 the results need to be confirmed through examination of other Japanese hospitals. Both  
10  
11  
12 studies occurred in a single prefecture which is predominantly rural. While not necessarily  
13  
14  
15 reflective of major metropolitan areas in Japan such as Tokyo, the prefecture of Shizuoka  
16  
17  
18 is probably similar to a majority of other prefectures in Japan which have a predominance  
19  
20  
21 of rural areas dotted with a few larger cities with tertiary care hospitals. Second, this study  
22  
23  
24 did not assess for the severity of condition or diseases of the participants. Thus,  
25  
26  
27 appropriateness of the ED visits was not evaluated directly.  
28  
29  
30  
31  
32

### 33 **Conclusions**

34  
35  
36 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
37  
38  
39 them are lower in this study from Japan than the distribution of published ranges in reports  
40  
41  
42 from many other countries. Future research on a larger scale will be required to determine  
43  
44  
45 if these lower rates are consistent across Japan and to fully explain these differences and  
46  
47  
48 understand potential lessons for other countries.  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Acknowledgments

We appreciate the assistance of Dr. Hajime Futami and Yuko Okada of Kikugawa General Hospital, Dr. Masahiko Terada and Naoki Ohta of Iwata City Hospital. We also thank Dr. Koichiro Gibo for his warm support. We would like to thank Editage (www.editage.com) for English language editing.

## Funding

This study was supported by a Grant-in-Aid for Research Activity Start-up. The study's sponsor had no role in the study design, data collection, analysis, interpretation, writing of the report, or the decision to submit this article for publication.

## 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

1  
2  
3  
4  
5  
6  
7  
8  
9 This study was approved by the Research Ethics Committee of Hamamatsu University  
10  
11 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata  
12  
13 City Hospital. We were not required to obtain individual informed consent from the  
14  
15 patients included in the study. However, the research team displayed a poster in the  
16  
17 waiting room of the hospitals to provide information about the collection and use of  
18  
19 data for this research, and about the protection of personal information.  
20  
21  
22  
23  
24  
25

### 26 27 **Transparency**

28  
29 All authors had full access to all of the data (including statistical reports and tables) in the  
30  
31 study and take responsibility for its integrity and the accuracy of the data analyses. The  
32  
33 lead author affirms that the manuscript is an honest, accurate, and gives a transparent  
34  
35 account of the study being reported, and that no important aspects of the study have been  
36  
37 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)  
38  
39 have been explained.  
40  
41  
42  
43  
44  
45  
46  
47

### 48 **Data sharing**

49  
50 Data sharing is not applicable because we did not receive informed consent concerning  
51  
52 data sharing from the participants.  
53  
54  
55  
56  
57  
58  
59  
60

## References

1. Moe J, Kirkland S, Ospina MB, et al. Mortality, admission rates and outpatient use among frequent users of emergency departments : a systematic review. *Emerg Med J.* 2016;**33**:230-236.
2. Soril LJJ, Leggett LE, Lorenzetti DL, et al. Reducing frequent visits to the emergency department : A systematic review of interventions. *PLoS One.* 2015;**10**(4):1-18.
3. Scott J, Strickland AP, Warner K, et al. Frequent callers to and users of emergency medical systems : A systematic review. *Emerg Med J.* 2014;**31**:684–691.
4. Gross K, Brenner JC, Truchil A et al. Building a citywide, all-payer, hospital claims database to improve health care delivery in a low-income, urban community. *Popul Health Manag.* 2013;**16** Suppl 1:S20-5.
5. Warning W, Wood J, Letcher A et al. Working with super-utilizer population: The experience and recommendations. Super utilizer population: Recommendations of five South Central Pennsylvania High Utilizer.  
[http://www.aligning4healthpa.org/pdf/High\\_Utilizer\\_report.pdf](http://www.aligning4healthpa.org/pdf/High_Utilizer_report.pdf) (accessed March 1, 2020.)
6. Finkelstein A, Zhou A, Taubman S, et al. Health Care Hotspotting: A randomized, controlled trial. *N Engl J Med.* 2020 Jan 9;**382**(2):152-162.



- 1  
2  
3  
4  
5  
6  
7 7. Lacalle E, Rabin E. Frequent users of emergency departments: The myths, the data ,  
8  
9 and the policy implications. *Ann Emerg Med.* 2010;**56**(1):42-48.  
10  
11  
12 8. Huang J, Tsai WC, Chen YC, et al. Factors associated with frequent use of  
13  
14 emergency services in a medical center. *J Formos Med Assoc.* 2003;**102**(4):222-228.  
15  
16  
17 9. Woo JH, Grinspan Z, Shapiro J, et al. Frequent users of hospital emergency  
18  
19 departments in Korea characterized by claims data from the national health insurance: A  
20  
21 cross sectional study. *PLoS One.* 2016;**11**(1):e0147450.  
22  
23  
24  
25 10. Krieg C, Hudon C, Chouinard M, et al. Individual predictors of frequent emergency  
26  
27 department use: A scoping review. *BMC Health Serv Res.* 2016 Oct 20;**16**(1):594  
28  
29  
30  
31 11. Takeuchi S, Funakoshi H, Nakashima Y, et al. Unique characteristics of frequent  
32  
33 presenters to the emergency department in a Japanese population: A retrospective  
34  
35 analysis. *Acute Med Surg.* 2019:145-151.  
36  
37  
38  
39  
40  
41  
42 12. Ministry of Internal Affairs and Communication. A summary of current status of  
43  
44 emergency rescue 2016. 2016.  
45  
46  
47  
48 [http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220\\_houdou\\_2.pdf](http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220_houdou_2.pdf). (in  
49  
50 Japanese) (accessed March 1, 2020).  
51  
52  
53  
54 13. Ministry of Health, Labor and Welfare. A current status and a challenge of  
55  
56 emergency medicine. 2000. <https://www.mhlw.go.jp/content/10802000/000328610.pdf>.  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 (in Japanese) (accessed March 1, 2020)  
7  
8

9 14. Ministry of Health, Labor and Welfare. A current situation of emergency medicine.

10  
11  
12 2013. <http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2->

13  
14  
15 [att/2r9852000002ummz.pdf](http://www.mhlw.go.jp/stf/shingi/2r9852000002ummz.pdf). Published 2013. (in Japanese) (accessed March 1, 2020)  
16  
17

18 15. Hibino S, Hori S. Emergency Medicine in the US and the US model Emergency  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
Medicine in Japan. *JJAAM*. 2010;**21**:925-934. (in Japanese)

16. U.S. Department of Health and Human Services. The high concentration of U.S.  
health care expenditures. 2006.

[https://meps.ahrq.gov/data\\_files/publications/ra19/ra19.pdf](https://meps.ahrq.gov/data_files/publications/ra19/ra19.pdf). (accessed March 1)

17. Billings J, Raven MC. Dispelling an urban legend: Frequent emergency department  
users have substantial burden of disease. *Health Aff*. 2013;**32**(12):2099-2108.

18. Moe J, Kirkland SW, Rawe E, et al. Effectiveness of Interventions to Decrease  
Emergency Department Visits by Adult Frequent Users : A Systematic Review.  
2017:40-52.

19. Sakamoto H, Rahman M, Nomura S, et al. *Japan Health System Review*. Vol. 8  
No.1. World Heal Organ Reg Off South-East Asia. 2018;**8**(1).

20. Fukui T, Rhaman M, Takahashi M, et al. The ecology of medical care in Japan.  
*JMAJ*. 2005;**48**.4: 163-167.

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
21. Green LA, Fryer GE Jr, Yawn BP, et al. The ecology of medical care revisited. *N Engl J Med*. 2001;**344**:2021–5
22. Doran KM, Raven MC, Rosenheck RA. What drives frequent emergency department use in an integrated health system? National data from the veterans health administration. *Ann Emerg Med*. 2013;**62**(2):151-159.
23. Chi CH, Lee HL, Wang SM et al. Characteristics of repeated ambulance use in an urban emergency medical service system. *J Formos Med Assoc*. 2001;Jan;**100**(1):14-9
24. Broxterman K, Sapien R, Fullerton L, et al. Repeat ambulance use by pediatric patients. *Acad Emerg Med*. 2000 Jan;**7**(1):36-41.
25. Deana Hays, Barbara Penprase, Suha K. Risk factors for frequent users of the emergency department among adults aged 55 and older. *JNEP*. 2018;**8**(9):96-101
26. Malcolm BD, Palatnick W, Day S, et al. Frequent users of emergency departments: Developing standard definitions and defining prominent risk factors. *Ann Emerg Med*. 2012 Jul;**60**(1):24-32
27. Ministry of Health, Labor and Welfare. Nationwide survey of approximate number of homeless people. 2018. <https://www.mhlw.go.jp/content/12003000/000330962.pdf>. (in Japanese) (accessed March 1, 2020)
28. US Department of Housing and Urban Development. The 2018 Annual Homeless

1  
2  
3  
4  
5  
6 Assessment Report (AHAR) to Congress. 2018. Accessed March 1, 2020.

7  
8  
9 <https://files.hudexchange.info/resources/documents/2018-AHAR-Part-1.pdf>

10  
11  
12 29. Ministry of Health, Labor and Welfare. Lifetime experience rate of illegal drugs in  
13  
14 major countries. 2017.

15  
16  
17 <https://www.mhlw.go.jp/bunya/iyakuhin/yakubuturanyou/torikumi/dl/index-05.pdf>. (in  
18  
19 Japanese) (accessed March 1, 2020)

20  
21  
22 30. Shah R, Chen C, O'Rourke S, et al. Evaluation of care management for the  
23  
24 uninsured. *Med Care*. 2011;Feb;**49**(2):166-71.

25  
26  
27 31. Murphy SM, Neven D. Cost-effective: emergency department care coordination  
28  
29 with a regional hospital information system. *J Emerg Med*. 2014 Aug;**47**(2):223-31.

Table 1. Characteristics of the study secondary and tertiary hospitals

	<b>Secondary hospital</b>	<b>Tertiary hospital</b>
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

	<b>Total</b>	<b>Frequent ED users</b>	<b>Non-frequent ED users</b>	<b>p-value</b>
Patient-level n=20,388				
(number of patients)				
<b>Age</b>				
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*
<b>Gender</b>				
male	9,642	58	9,584	0.351
female	10,746	76	10,670	
<b>In-hospital death</b>				
no	19,825	131	19,694	0.771
yes	563	3	560	
<b>Receiving public assistance</b>				

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

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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.

<b>Number of ED visits</b>	<b>1</b>	<b>2-4</b>	<b>5-7</b>	<b>8-10</b>	<b>11-15</b>	<b>16≥</b>
<b>visits</b>						
<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)

65≥	1,670 (78.9)	426 (20.1)	18 (0.9)	1 (0)	0 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	0 (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)	0 (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)	7 (0.1)	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)
----	--------------	--------------	-----------	----------	---------	-----------

1							
2							
3							
4							
5	yes	937 (65.5)	435 (30.4)	44 (3.1)	6 (0.4)	6 (0.4)	2 (0.1)
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							

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.

<b>Number of ED visits</b>	<b>1</b>	<b>2-4</b>	<b>5-7</b>	<b>8-10</b>	<b>11-15</b>	<b>16<math>\geq</math></b>
<b>visits</b>						
<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)

1						
2						
3						
4						
5	Gender					
6						
7						
8	male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)
9						2 (0)
10						
11	female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)
12						0 (0)
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)
21						2 (0)
22						
23	yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)
24						0 (0)
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)
36						1 (0)
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						

yes	76 (76.0)	21 (21.0)	0 (0)	0 (0)	7 (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)	7 (0.3)	24 (0.2)
yes	3,661 (70.4)	1,398 (26.9)	94 (1.8)	17 (0.3)	4 (0.3)	14 (0.3)
Hospitalization						
no	10,850 (69.7)	4,218 (27.1)	322 (2.1)	86 (0.6)	10 (0.3)	38 (0.2)

1  
2  
3  
4  
5 yes 2,349 (66.3) 1,083 (30.6) 72 (2.0) 40 (1.1) 1 (0) 0 (0)  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

For peer review only

bmjopen-2020-039030 on 7 September 2020. Downloaded from <http://bmjopen.bmj.com/> on April 23, 2024 by guest. Protected by copyright.



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

	<b>Total</b>	<b>Secondary hospital</b>	<b>Tertiary hospital</b>	<b>p-value</b>
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*

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only

## 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
<b>Title and abstract</b>	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
<b>Introduction</b>		
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
<b>Methods</b>		
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
<b>Results</b>		
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"/>	

		<a href="#">Page 11</a>
		(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"/>	<a href="#">Page 11</a>
		(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"/>	<a href="#">Pages 11-13</a>
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"/>	<a href="#">Pages 11-13</a>
		(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
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	<a href="#">Page 14</a>
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"/>	<a href="#">Pages 16-17</a>
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"/>	<a href="#">Pages 14-18</a>
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	<a href="#">Pages 14-18</a>
<b>Other information</b>		
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"/>	<a href="#">Page 19</a>

\*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 retrospective chart review

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-039030.R1
Article Type:	Original research
Date Submitted by the Author:	01-Jul-2020
Complete List of Authors:	Kaneko, Makoto; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program, Inoue, Machiko; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program Okubo, Masashi; University of Pittsburgh, Department of Emergency Medicine Furgal, Allison; University of Michigan Medical School, Department of Family Medicine Crabtree, Benjamin; Rutgers Robert Wood Johnson Medical School, Department of Family Medicine and Community Health, Research Division Fetters, Michael; University of Michigan Medical School, Department of Family Medicine; University of Michigan, Mixed Methods Program and Department of Family Medicine
<b>Primary Subject Heading</b>:	Emergency medicine
Secondary Subject Heading:	Public health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, HEALTH ECONOMICS, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.



1  
2  
3  
4  
5  
6  
7 19 <sup>6</sup> Department of Family Medicine and Community Health, Research Division

8  
9  
10 20 Rutgers Robert Wood Johnson Medical School, New Jersey, USA

11  
12 21 <sup>7</sup> Mixed Methods Program and Department of Family Medicine, University of Michigan

13  
14  
15 22 Medical School, Michigan, USA

16  
17  
18 23

19  
20  
21 24 Corresponding author: Makoto Kaneko

22  
23  
24 25 Department of Family and Community Medicine, Hamamatsu University School of

25  
26  
27 26 Medicine, 1-20-1, Handayama, Higashi-ku, Hamamatsu, 431-3192, Japan

28  
29  
30 27 Tel: +81 53 435 2416; Fax: +81 53 435 2417

31  
32  
33 28 E-mail: kanekom@yokohama-cu.ac.jp

34  
35  
36 29

37  
38  
39 30 Word count of main text: 2,856

40  
41  
42 31 Number of tables and figures: 4 tables, 1 figure and 1 supplementary file

43  
44  
45 32

46  
47  
48 33 **Keywords:** emergency department, frequent users, health care expenditure, Japan,

49  
50  
51 34 secondary and tertiary hospital, health care utilization

52  
53  
54 35

55  
56  
57 36

1  
2  
3  
4  
5  
6 377  
8  
9 3810  
11  
12 39

## 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  $\geq 5$  times/year. The main  
54 outcome measures were the proportion of frequent ED users among all ED users and the

1  
2  
3  
4  
5  
6 55 proportion of health care expenditures by the frequent ED users among all ED  
7  
8  
9 56 expenditures.

10  
11  
12 57 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043  
13  
14  
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.

19  
20  
21 60 At the patient-level, after adjusting for age, gender, and receiving public assistance,  
22  
23  
24 61 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving  
25  
26  
27 62 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED  
28  
29  
30 63 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:  
31  
32  
33 64 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology  
34  
35  
36 65 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.

## 37 38 39 66 **Conclusions**

40  
41  
42 67 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
43  
44  
45 68 them—while still in the low end of the distribution of published ranges—are lower in this  
46  
47  
48 69 study from Japan than in reports from many other countries.

50  
51 70

52  
53  
54 71

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

- 1  
2  
3  
4  
5  
6  
7 73 • All patients who visited the emergency department (ED) during the study period  
8  
9 74 were included.  
10  
11  
12 75 • The study evaluated not only the numbers of visits but also the health care  
13  
14  
15 76 expenditures of frequent ED visitors.  
16  
17  
18 77 • This study only included one secondary hospital and one tertiary hospital.  
19  
20  
21 78 • This study did not assess for the severity of condition or diseases of the  
22  
23  
24 79 participants  
25  
26  
27  
28 80  
29  
30 81  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 82 Introduction

83 Frequent emergency department (ED) use is associated with higher mortality rates<sup>1</sup> and  
84 financial burden.<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> High rates of  
96 frequent ED users have been reported in North America, Europe, and Oceania.<sup>7</sup> 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.<sup>8</sup> In Korea, 3.1% of all ED visitors were frequent  
99 ED users and occupied 14.0% of total ED visits.<sup>9</sup> Among frequent ED users, low

1  
2  
3  
4  
5  
6 100 socioeconomic status and mental health problems are known predictors of frequent ED  
7  
8  
9 101 use based on research in 9 countries.<sup>7,10</sup> Although such studies about frequent ED use  
10  
11  
12 102 were conducted , research on frequent ED use is little in countries with well-developed  
13  
14  
15 103 comprehensive national health insurance such as Japan.

16  
17  
18 104 In Japan, research on frequent ED users has been investigated in single center  
19  
20  
21 105 studies.<sup>11,12</sup> Also, there is no research about health care expenditure of frequent ED  
22  
23  
24 106 users in Japan. For example, in the study by Takeuchi et al., they found frequent ED  
25  
26  
27 107 users comprised 1.4% of all ED users and occupied 6.8% of all ED visits.<sup>11</sup> Frequent  
28  
29  
30 108 ED users were older and more often receiving governmental welfare in comparison with  
31  
32  
33 109 non-frequent ED users.<sup>11</sup> As the number of ED visits by ambulances has been  
34  
35  
36 110 annually increasing by 72 thousand per a year in Japan,<sup>13</sup> a better understanding of the  
37  
38  
39 111 patterns and costs associated with frequent ED users in Japan would be indispensable  
40  
41  
42 112 for developing interventions to reduce unnecessary visit burdens on EDs and mitigate  
43  
44  
45 113 unnecessary costs.

46  
47  
48 114 Understanding the current status of frequent ED users in Japan could inform policy-  
49  
50  
51 115 making that optimizes the use of EDs and leads efficiency in health care expenditures.  
52  
53  
54 116 Hence the study aims of this research were to: 1) document the proportion of ED visits  
55  
56  
57 117 that are by frequent users, and 2) describe the differences in characteristics of frequent  
58  
59  
60



1  
2  
3  
4  
5  
6 118 ED users and other ED users between a secondary and a tertiary hospital in Japan. We  
7  
8  
9 119 hypothesized that a few frequent ED users would account for the major proportion of all  
10  
11  
12 120 ED users and for significant health care expenditure in Japan.  
13  
14

15  
16 121

## 17 18 122 **Methods**

### 19 20 21 123 **Design**

22  
23  
24 124 This study team utilized a retrospective chart review for a period of one year ranging  
25  
26  
27 125 from January 1 to December 31, 2017. In the present study, we followed the  
28  
29  
30 126 Strengthening the Reporting of Observational studies in Epidemiology. (STROBE)  
31  
32  
33 127 statement.<sup>14</sup>

### 34 35 36 128 **Setting**

37  
38  
39 129 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary  
40  
41  
42 130 hospital) in central Japan served as the sites for study. The size of these two hospitals  
43  
44  
45 131 are generally comparable with other secondary and tertiary care hospitals in Japan.<sup>15</sup>  
46  
47  
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  
52  
53  
54 134 provide emergency care for a patient who potentially requires admission and tertiary  
55  
56  
57 135 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple  
58  
59  
60

1  
2  
3  
4  
5  
6 136 injury.<sup>16</sup> The secondary hospital in this study serves a catchment area of about 48  
7  
8  
9 137 thousand people, but does not provide inpatient care for children due to the lack of  
10  
11  
12 138 pediatricians. It serves as the single public institution providing inpatient care for mental  
13  
14  
15 139 health in this region. Like the majority of hospitals in Japan, nurses triage patients  
16  
17  
18 140 presenting to the ED based on the patient's chief complaint for evaluation by one of the  
19  
20  
21 141 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This  
22  
23  
24 142 differs from the typical US-model of emergency care where nurses triage for acuity of  
25  
26  
27 143 need, but emergency physicians provide the first evaluation of all patients coming to the  
28  
29  
30 144 ED.<sup>17</sup>

### 33 145 **Patient and Public Involvement**

34  
35  
36 146 This research was conducted without patient involvement. Patients were not invited to  
37  
38  
39 147 comment on the study design, and they were not consulted in the development of relevant  
40  
41  
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**

52  
53  
54 152 All patients who presented to the EDs during the study period were eligible for  
55  
56  
57 153 inclusion. There were no exclusion criteria for the study.  
58  
59  
60

1  
2  
3  
4  
5  
6 154 **Measures**  
7

8  
9 155 To be consistent with previous literature,<sup>3</sup> we defined a frequent ED user as a patient  
10  
11  
12 156 who visited the ED in the same hospital  $\geq 5$  times/year during 2017. The study's main  
13  
14  
15 157 outcome measures were the proportion of the frequent ED users among all ED users and  
16  
17  
18 158 the proportion of health care expenditures by the frequent ED users among all ED  
19  
20  
21 159 expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10  
22  
23  
24 160 times, 10-14 times and  $\geq 15$ ) and explored the characteristics of the frequent ED users  
25  
26  
27 161 by age, gender, receipt of public assistance (governmental welfare), ambulance use,  
28  
29  
30 162 hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,  
31  
32  
33 163 psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.  
34  
35

36 164 **Statistical analysis**  
37

38  
39 165 To analyze for differences in the characteristics between the frequent ED users and non-  
40  
41  
42 166 frequent ED users, we used chi-square tests. We employed two multivariable models,  
43  
44  
45 167 changing the units of analyses: patient-level and visit-level. In the patient-level analysis,  
46  
47  
48 168 we used logistic regression and adjusted age (as a continuous variable), gender (male  
49  
50  
51 169 was the reference group), and receiving public assistance. In the visit-level analysis, we  
52  
53  
54 170 used a mixed-effect model to include a random effect for hospital and individual  
55  
56  
57 171 covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in  
58  
59  
60

1  
2  
3  
4  
5  
6 172 the ED, and hospitalization. Covariates were selected based on a literature review.<sup>7,8</sup> For  
7  
8  
9 173 the statistical analysis, we used STATA 15 with statistical significance defined by a P-  
10  
11  
12 174 value <0.05.

13  
14  
15 175

## 16 17 18 176 **Results**

### 19 20 21 177 **Frequency of visits and expenditures by frequent ED users**

22  
23  
24 178 A total of 25,231 ED visits were made by 20,388 patients (male: 10,746) to the two  
25  
26  
27 179 hospitals during the study period. We did not have missing data for each reported  
28  
29  
30 180 variable. The median age (interquartile range) was 51 (range 23-75) and the total health  
31  
32  
33 181 care expenditure was 3,774 million yen ( $\approx$  35.2 million dollars). Health care  
34  
35  
36 182 expenditures in the ED of the secondary hospital totalled 188 million yen ( $\approx$  1.7 million  
37  
38  
39 183 dollars) and that of the tertiary hospital totalled 3,586 million yen ( $\approx$  33.0 million  
40  
41  
42 184 dollars). Of all the visits, there were 134 frequent ED users (male=76). The median of  
43  
44  
45 185 age (interquartile range) was 61.5 years (35-80) and the total health care expenditure  
46  
47  
48 186 was 74 million yen ( $\approx$  0.69 million dollars). The total number of visits by the frequent  
49  
50  
51 187 ED users was 1,043 and these comprised 4.1% of all ED visits. Frequent ED users  
52  
53  
54 188 accounted for 0.66% of all ED users, and 1.9% of total health care expenditures. Figure  
55  
56  
57 189 1 shows summary of the results.

## 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

1  
2  
3  
4  
5  
6 208 16 times or more. For factors such as in-hospital death, receiving public assistance, use  
7  
8  
9 209 of ambulance and hospitalization, the majority were accounted for by the non-frequent  
10  
11  
12 210 ED users (1-4 visits).  
13  
14  
15 211 Table 4 provides a comparison of frequent ED users' characteristics between the  
16  
17  
18 212 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of  
19  
20  
21 213 frequent ED users who were evaluated by psychiatry ( $p<0.001$ ) and  
22  
23  
24 214 obstetrics/gynecology ( $p<0.001$ ) was higher than those in the tertiary hospital. In the  
25  
26  
27 215 tertiary hospital, the proportion of patients who were aged 14 years and younger  
28  
29  
30 216 ( $p<0.004$ ), evaluated by internal medicine ( $p<0.001$ ), pediatrics ( $p<0.001$ ) and surgery  
31  
32  
33 217 ( $p<0.001$ ) was higher than those in the tertiary hospital.  
34  
35  
36 218 After adjusting for age, gender, and receiving public assistance, older age (odds ratio  
37  
38  
39 219 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02,  $p=0.004$ ) and receiving public  
40  
41  
42 220 assistance (OR: 7.19, 95% CI: 2.87-18.07,  $p<0.001$ ) were associated with frequent ED  
43  
44  
45 221 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine  
46  
47  
48 222 (OR: 1.27, 95% CI: 1.02-1.57,  $p=0.032$ ), psychiatry (OR: 124.69, 95% CI: 85.89-  
49  
50  
51 223 181.01,  $p<0.001$ ), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67,  $p<0.001$ )  
52  
53  
54 224 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,  
55  
56  
57 225  $p=0.011$ ) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84,  $p=0.002$ ) were  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

226 negatively associated with frequent ED visits. The details of the results are shown in the  
227 supplementary file.

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 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 ( $\geq 4$  visits/year) occupied 6.75% of all ED visits and the previous study did not  
235 report the utilized health care expenditures.<sup>11</sup> 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).<sup>7</sup> Compared to the Asian countries in the previous literature,  
244 the proportion of frequent ED visits was almost one third in Japan.<sup>8,9</sup> In a previous US  
245 study, 1% of ED users accounted for 29% of costs<sup>4</sup>—a stark contrast to just less than



1  
2  
3  
4  
5  
6 246 1% of ED users in the current study accounting for about 2% of expenditures. In  
7  
8  
9 247 addition, the proportion of the health care expenditures by frequent ED users from both  
10  
11  
12 248 studies in Japan is much lower than found in several previous studies in the US.<sup>4,18,19</sup>  
13  
14  
15 249 As reported in an international literature review, the problem of frequent ED visits has  
16  
17  
18 250 been observed in multiple countries including Asian countries.<sup>7</sup> Multi-disciplinary  
19  
20  
21 251 interventions such as case management, care plan and information sharing has been  
22  
23  
24 252 found to be effective to reduce the frequent ED users.<sup>2,20</sup> *Kaigo Hoken*, Japan's long-  
25  
26  
27 253 term care insurance program was introduced to provide long-term care support for older  
28  
29  
30 254 adults since 2000.<sup>21</sup> Under *Kaigo Hoken*, care managers coordinate multiple care  
31  
32  
33 255 services for older adults.<sup>21</sup> The care management financed under *Kaigo Hoken* may  
34  
35  
36 256 contribute to the low proportion of frequent ED users in the study compared to other  
37  
38  
39 257 international settings due to proactive care for limitations in activities of daily living.  
40  
41  
42 258 This support can also help mitigate social problems. Also, free-access and universal  
43  
44  
45 259 health care coverage in Japan may contribute to the results as well. Patients can access  
46  
47  
48 260 health-care services regardless of their income, living place and types of hospitals.<sup>21</sup> In  
49  
50  
51 261 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more  
52  
53  
54 262 timely manner, compared to those in the US.<sup>22,23</sup>  
55  
56

### 263 **Characteristics of the frequent ED users**

1  
2  
3  
4  
5  
6 264 Characteristics of frequent ED users found in the current study, older age, low  
7  
8  
9 265 socioeconomic status, and mental health problems, are consistent with previous studies  
10  
11  
12 266 in other countries.<sup>3,24</sup> For example, findings from the UK, US, Canada and Taiwan  
13  
14  
15 267 similarly identified older age<sup>25</sup> and mental problems.<sup>7,24,26,27</sup> In our study, the proportion  
16  
17  
18 268 of patients who were older than or equal to 65 years among all ED visitors was 38.2%.  
19  
20  
21 269 This is relatively higher than those in the previous studies in other countries such as  
22  
23  
24 270 16.6%-22.1% (US)<sup>28,29</sup>, 25.1% (Canada)<sup>30</sup> and 34.5% (Taiwan)<sup>8</sup>. Therefore, older  
25  
26  
27 271 patients could not explain the low rate of frequent ED users in our study. Thus, as we  
28  
29  
30 272 discussed above, the Japanese health care systems such as Kaigo Hoken or universal  
31  
32  
33 273 health care coverage could explain our results. While previous studies have also  
34  
35  
36 274 identified homelessness<sup>24</sup> and substance abuse<sup>7,26,30</sup> as predictors for frequent ED use,  
37  
38  
39 275 the rate of homelessness in Japan is very low compared to the US, 0.004% vs  
40  
41  
42 276 0.17%<sup>31,32</sup>, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of  
43  
44  
45 277 methamphetamine and 0.3% vs 14.3% in use of cocaine.<sup>33</sup> Thus, it was not surprising  
46  
47  
48 278 for these factors not to be predictors of frequent ED use.  
49  
50  
51 279 In the previous study conducted in Japan, mental health issues were not related to  
52  
53  
54 280 frequent ED visits but this may be attributable to the absence of full-time psychiatric  
55  
56  
57 281 providers in that hospital.<sup>11</sup> While a difference was noted in the proportion of frequent  
58  
59  
60

1  
2  
3  
4  
5  
6 282 ED visits for pediatric problems between the secondary and tertiary hospital, this  
7  
8  
9 283 finding was not surprising given the lack of a full-time paediatrician in the secondary  
10  
11  
12 284 hospital in our study. Because characteristics of frequent ED users are heterogeneous<sup>7</sup>,  
13  
14  
15 285 analysis of characteristics of frequent ED users in each hospital is important to reduce  
16  
17  
18 286 frequent ED visits. For example, case management including insurance coverage and  
19  
20  
21 287 access to support services has been shown to reduce ED visits among low-income  
22  
23  
24 288 adults.<sup>34</sup> Moreover, multidisciplinary intervention with mental health and substance-  
25  
26  
27 289 abuse professionals decrease ED visits and health care cost.<sup>35</sup> These factors, namely,  
28  
29  
30 290 low socioeconomic status and mental issues, are of particular importance for attention  
31  
32  
33 291 of health care providers and policy makers seeking to develop effective interventions to  
34  
35  
36 292 reduce unnecessary visits and reduce costs.  
37  
38  
39 293 Future research could include a multicentre or nation-wide study in Japan to further  
40  
41  
42 294 characterize frequent ED users across the nation. Despite the much lower rate of frequent  
43  
44  
45 295 ED users, visits, and associated costs in our study compared to other countries, research  
46  
47  
48 296 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as  
49  
50  
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

1  
2  
3  
4  
5  
6 300 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a  
7  
8  
9 301 secondary and a tertiary hospital. A possible explanation for the low proportion of  
10  
11  
12 302 frequent ED users, could come from inadequate accounting for the actual number of ED  
13  
14  
15 303 visits. In the current study, we counted ED visits in each hospital. If patients attended  
16  
17  
18 304 multiple EDs, it is possible we would not capture the actual number of ED visits, and  
19  
20  
21 305 underestimate the total number of frequent ED users. However, this seems unlikely to  
22  
23  
24 306 have a substantial impact as both hospitals serve as the primary hospitals in their  
25  
26  
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.

317

1  
2  
3  
4  
5  
6 318 **Conclusions**

7  
8  
9 319 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
10  
11  
12 320 them are lower in this study from Japan than the distribution of published ranges in reports  
13  
14  
15 321 from many other countries. Future research on a larger scale will be required to determine  
16  
17  
18 322 if these lower rates are consistent across Japan and to fully explain these differences and  
19  
20  
21 323 understand potential lessons for other countries.  
22

23  
24 324

25  
26  
27 325

28  
29  
30 326

31  
32  
33 327 **Acknowledgments**

34  
35  
36 328 We appreciate the assistance of Dr. Hajime Futami and Yuko Okada of Kikugawa  
37  
38  
39 329 General Hospital, Dr. Masahiko Terada and Naoki Ohta of Iwata City Hospital. We also  
40  
41  
42 330 thank Dr. Koichiro Gibo for his warm support. We would like to thank Editage  
43  
44  
45 331 (www.editage.com) for English language editing.  
46  
47

48 332 **Funding**

49  
50  
51 333 This study was supported by a Grant-in-Aid for Research Activity Start-up. The study's  
52  
53  
54 334 sponsor had no role in the study design, data collection, analysis, interpretation, writing  
55  
56  
57 335 of the report, or the decision to submit this article for publication.  
58  
59  
60

1  
2  
3  
4  
5  
6 336 **Competing interests**  
7

8  
9 337 There are no potential competing interests to declare that are relevant to this work.  
10  
11

12 338 **Contributors**  
13

14  
15 339 MK designed the study and participated in the implementation, data collection, data  
16  
17 340 analysis, and writing of the manuscript. MK also served as the guarantor. MI, MO, BC  
18  
19 341 and MF contributed to the design of the study and critically reviewed the manuscript. MK  
20  
21 342 and AF analyzed the data. All authors had full access to the data and take responsibility  
22  
23 343 for the integrity and accuracy of the analyses.  
24  
25  
26  
27  
28

29  
30 344 **Ethical Approval**  
31

32  
33 345 This study was approved by the Research Ethics Committee of Hamamatsu University  
34  
35 346 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata  
36  
37 347 City Hospital. We were not required to obtain individual informed consent from the  
38  
39 348 patients included in the study. However, the research team displayed a poster in the  
40  
41 349 waiting room of the hospitals to provide information about the collection and use of  
42  
43 350 data for this research, and about the protection of personal information.  
44  
45  
46  
47  
48  
49

50  
51 351 **Transparency**  
52

53  
54 352 All authors had full access to all of the data (including statistical reports and tables) in the  
55  
56 353 study and take responsibility for its integrity and the accuracy of the data analyses. The  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 354 lead author affirms that the manuscript is an honest, accurate, and gives a transparent  
7  
8  
9 355 account of the study being reported, and that no important aspects of the study have been  
10  
11  
12 356 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)  
13  
14  
15 357 have been explained.

### 18 358 **Data sharing**

21 359 Data sharing is not applicable because we did not receive informed consent concerning  
22  
23  
24 360 data sharing from the participants.  
25  
26  
27  
28 361

### 30 362 **References**

- 33 363 1. Moe J, Kirkland S, Ospina MB, et al. Mortality, admission rates and outpatient use  
34  
35  
36 364 among frequent users of emergency departments: a systematic review. *Emerg Med J.*  
37  
38  
39 365 2016;**33**:230-236.
- 42 366 2. Soril LJJ, Leggett LE, Lorenzetti DL, et al. Reducing frequent visits to the emergency  
43  
44  
45 367 department: A systematic review of interventions. *PLoS One.* 2015;**10**(4):1-18.
- 48 368 3. Scott J, Strickland AP, Warner K, et al. Frequent callers to and users of emergency  
49  
50  
51 369 medical systems : A systematic review. *Emerg Med J.* 2014;**31**:684–691.
- 54 370 4. Gross K, Brenner JC, Truchil A et al. Building a citywide, all-payer, hospital claims  
55  
56  
57 371 database to improve health care delivery in a low-income, urban community. *Popul*

- 1  
2  
3  
4  
5  
6 372 *Health Manag.* 2013;**16** Suppl 1:S20-5.
- 7  
8  
9 373 5. Warning W, Wood J, Letcher A et al. Working with super-utilizer population: The  
10  
11  
12 374 experience and recommendations. Super utilizer population: Recommendations of five  
13  
14  
15 375 South Central Pennsylvania High Utilizer.  
16  
17  
18 376 [http://www.aligning4healthpa.org/pdf/High\\_Utilizer\\_report.pdf](http://www.aligning4healthpa.org/pdf/High_Utilizer_report.pdf) (accessed March 1,  
19  
20  
21 377 2020.)  
22  
23  
24 378 6. Finkelstein A, Zhou A, Taubman S, et al. Health Care Hotspotting: A randomized,  
25  
26  
27 379 controlled trial. *N Engl J Med.* 2020 Jan 9;**382**(2):152-162.  
28  
29  
30 380 7. Lacalle E, Rabin E. Frequent users of emergency departments: The myths, the data,  
31  
32  
33 381 and the policy implications. *Ann Emerg Med.* 2010;**56**(1):42-48.  
34  
35  
36 382 8. Huang J, Tsai WC, Chen YC, et al. Factors associated with frequent use of  
37  
38  
39 383 emergency services in a medical center. *J Formos Med Assoc.* 2003;**102**(4):222-228.  
40  
41  
42 384 9. Woo JH, Grinspan Z, Shapiro J, et al. Frequent users of hospital emergency  
43  
44  
45 385 departments in Korea characterized by claims data from the national health insurance: A  
46  
47  
48 386 cross sectional study. *PLoS One.* 2016;**11**(1):e0147450.  
49  
50  
51 387 10. Krieg C, Hudon C, Chouinard M, et al. Individual predictors of frequent emergency  
52  
53  
54 388 department use: A scoping review. *BMC Health Serv Res.* 2016 Oct 20;**16**(1):594  
55  
56  
57  
58  
59  
60



- 1  
2  
3  
4  
5  
6 389 11. Takeuchi S, Funakoshi H, Nakashima Y, et al. Unique characteristics of frequent  
7  
8  
9 390 presenters to the emergency department in a Japanese population: A retrospective  
10  
11  
12 391 analysis. *Acute Med Surg.* 2019;145-151.  
13  
14  
15 392 12. Ikeda K, Harada T, Tarumi Y, et al. Association between Public Assistance and  
16  
17  
18 393 Frequent Emergency Department Visits in Urban Areas of Japan: A Case-Control  
19  
20  
21 394 Study. *Showa Univ J Med Sci.*2020;**32**(1):73-80  
22  
23  
24 395 13. Ministry of Internal Affairs and Communication. A summary of current status of  
25  
26  
27 396 emergency rescue 2016. 2016.  
28  
29  
30 397 [http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220\\_houdou\\_2.pdf](http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220_houdou_2.pdf). (in  
31  
32  
33 398 Japanese) (accessed March 1, 2020).  
34  
35  
36 399 14. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of  
37  
38  
39 400 Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting  
40  
41  
42 401 observational studies [published correction appears in *Ann Intern Med.* 2008 Jan  
43  
44  
45 402 15;148(2):168]. *Ann Intern Med.* 2007;**147**(8):573-577.  
46  
47  
48 403 15. Ministry of Health, Labor and Welfare. A current status and a challenge of  
49  
50  
51 404 emergency medicine. 2000. <https://www.mhlw.go.jp/content/10802000/000328610.pdf>.  
52  
53  
54 405 (in Japanese) (accessed March 1, 2020)  
55  
56  
57 406 16. Ministry of Health, Labor and Welfare. A current situation of emergency medicine.  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7 407 2013. [http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-](http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-att/2r9852000002ummz.pdf)  
8  
9 408 [att/2r9852000002ummz.pdf](http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-att/2r9852000002ummz.pdf). Published 2013. (in Japanese) (accessed March 1, 2020)  
10  
11  
12 409 17. Hibino S, Hori S. Emergency Medicine in the US and the US model Emergency  
13  
14  
15 410 Medicine in Japan. *JJAAM*. 2010;**21**:925-934. (in Japanese)  
16  
17  
18 411 18. U.S. Department of Health and Human Services. The high concentration of U.S.  
19  
20  
21 412 health care expenditures. 2006.  
22  
23  
24 413 [https://meps.ahrq.gov/data\\_files/publications/ra19/ra19.pdf](https://meps.ahrq.gov/data_files/publications/ra19/ra19.pdf). (accessed March 1)  
25  
26  
27 414 19 Billings J, Raven MC. Dispelling an urban legend: Frequent emergency department  
28  
29  
30 415 users have substantial burden of disease. *Health Aff*. 2013;**32**(12):2099-2108.  
31  
32  
33 416 20. Moe J, Kirkland SW, Rawe E, et al. Effectiveness of Interventions to Decrease  
34  
35  
36 417 Emergency Department Visits by Adult Frequent Users : A Systematic Review.  
37  
38  
39 418 2017:40-52.  
40  
41  
42 419 21. Sakamoto H, Rahman M, Nomura S, et al. *Japan Health System Review*. Vol. 8  
43  
44  
45 420 No.1. World Heal Organ Reg Off South-East Asia. 2018;**8**(1).  
46  
47  
48 421 22. Fukui T, Rhaman M, Takahashi M, et al. The ecology of medical care in Japan.  
49  
50  
51 422 *JMAJ*. 2005;**48**.4: 163-167.  
52  
53  
54 423 23. Green LA, Fryer GE Jr, Yawn BP, et al. The ecology of medical care revisited. *N*  
55  
56  
57 424 *Engl J Med*. 2001;**344**:2021–5  
58  
59  
60

- 1  
2  
3  
4  
5  
6 425 24. Doran KM, Raven MC, Rosenheck RA. What drives frequent emergency  
7  
8  
9 426 department use in an integrated health system? National data from the veterans health  
10  
11  
12 427 administration. *Ann Emerg Med.* 2013;**62**(2):151-159.  
13  
14  
15 428 25. Chi CH, Lee HL, Wang SM et al. Characteristics of repeated ambulance use in an  
16  
17  
18 429 urban emergency medical service system. *J Formos Med Assoc.* 2001;Jan;**100**(1):14-9  
19  
20  
21 430 26. Broxterman K, Sapien R, Fullerton L, et al. Repeat ambulance use by pediatric  
22  
23  
24 431 patients. *Acad Emerg Med.* 2000 Jan;**7**(1):36-41.  
25  
26  
27 432 27. Deana Hays, Barbara Penprase, Suha K. Risk factors for frequent users of the  
28  
29  
30 433 emergency department among adults aged 55 and older. *JNEP.* 2018;**8**(9):96-101  
31  
32  
33 434 28. Hunt KA, Weber EJ, Showstack JA, Colby DC, Callaham ML.Characteristics of  
34  
35  
36 435 Frequent Users of Emergency Departments. *Ann Emerg Med.* 2006;**48**(1):1-8  
37  
38  
39 436 29. Knowlton A, Weir BW, Hughes BS et al. Patient demographic and health factors  
40  
41  
42 437 associated with frequent use of emergency medical services in a midsized city. *Acad*  
43  
44  
45 438 *Emerg Med.*2013;**20**(11):1101–1111  
46  
47  
48 439 30. Malcolm BD, Palatnick W, Day S, et al. Frequent users of emergency departments:  
49  
50  
51 440 Developing standard definitions and defining prominent risk factors. *Ann Emerg Med.*  
52  
53  
54 441 2012 Jul;**60**(1):24-32  
55  
56  
57 442 31. Ministry of Health, Labor and Welfare. Nationwide survey of approximate number  
58  
59  
60

- 1  
2  
3  
4  
5  
6 443 of homeless people. 2018. <https://www.mhlw.go.jp/content/12003000/000330962.pdf>.  
7  
8  
9 444 (in Japanese) (accessed March 1, 2020)  
10  
11  
12 445 32. US Department of Housing and Urban Development. The 2018 Annual Homeless  
13  
14  
15 446 Assessment Report (AHAR) to Congress. 2018. Accessed March 1, 2020.  
16  
17  
18 447 <https://files.hudexchange.info/resources/documents/2018-AHAR-Part-1.pdf>  
19  
20  
21 448 33. Ministry of Health, Labor and Welfare. Lifetime experience rate of illegal drugs in  
22  
23  
24 449 major countries. 2017.  
25  
26  
27 450 <https://www.mhlw.go.jp/bunya/iyakuhin/yakubuturanyou/torikumi/dl/index-05.pdf>. (in  
28  
29  
30 451 Japanese) (accessed March 1, 2020)  
31  
32  
33 452 34. Shah R, Chen C, O'Rourke S, et al. Evaluation of care management for the  
34  
35  
36 453 uninsured. *Med Care*. 2011;Feb;**49**(2):166-71.  
37  
38  
39 454 35. Murphy SM, Neven D. Cost-effective: emergency department care coordination  
40  
41  
42 455 with a regional hospital information system. *J Emerg Med*. 2014 Aug;**47**(2):223-31.  
43  
44  
45 456 36. Statistics of Japan, e-Stat: Portal Site of Official Statistics of Japan. [https://www.e-](https://www.e-stat.go.jp/regional-statistics/ssdsview/municipality)  
46  
47  
48 457 [stat.go.jp/regional-statistics/ssdsview/municipality](https://www.e-stat.go.jp/regional-statistics/ssdsview/municipality). (in Japanese) (accessed July 1,  
49  
50  
51 458 2020)  
52  
53  
54 459  
55  
56  
57  
58  
59  
60

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

	<b>Secondary hospital</b>	<b>Tertiary hospital</b>
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 (%) <sup>36</sup>	25.0	26.1
Unemployment rate in the	2.9	3.6

city (%)<sup>36</sup>

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

	<b>Total</b>	<b>Frequent ED users</b>	<b>Non-frequent ED users</b>	<b>p-value</b>
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

468



469

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

<b>Number of ED visits</b>	<b>1</b>	<b>2-4</b>	<b>5-7</b>	<b>8-10</b>	<b>11-15</b>	<b>16≥</b>
<b>visits</b>						
<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)	0 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	0 (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)	0 (0)	2 (0)
yes	156 (97.5)	4 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Receiving public assistance						

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

no	3,980 (83.8)	731 (15.4)	29 (0.6)	7 (0.1)	7 (0)	2 (0)
yes	8 (80.0)	0 (0)	1 (10.0)	1 (10.0)	0 (0)	0 (0)
<hr/>						
Visit-level						
Number of visits						
(%): n=6,122						
<hr/>						
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)

34

1							
2							
3							
4							
5	yes	937 (65.5)	435 (30.4)	44 (3.1)	6 (0.4)	6 (0.4)	2 (0.1)
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41	35						
42							
43							
44							
45							
46							

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.

<b>Number of ED visits</b>	<b>1</b>	<b>2-4</b>	<b>5-7</b>	<b>8-10</b>	<b>11-15</b>	<b>16<math>\geq</math></b>
<b>visits</b>						
<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)

36

Gender						
male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)	2 (0)
female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)	0 (0)
In-hospital death						
no	12,880 (84.6)	2,255 (14.8)	71 (0.5)	13 (0.1)	4 (0)	2 (0)
yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)	0 (0)
Receiving public assistance						
no	13,103 (84.5)	2,315 (14.9)	72 (0.5)	14 (0.1)	2 (0)	1 (0)

37

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

yes	76 (76.0)	21 (21.0)	0 (0)	0 (0)	7 (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)	7 (0.3)	24 (0.2)
yes	3,661 (70.4)	1,398 (26.9)	94 (1.8)	17 (0.3)	4 (0.3)	14 (0.3)
Hospitalization						
no	10,850 (69.7)	4,218 (27.1)	322 (2.1)	86 (0.6)	10 (0.3)	38 (0.2)

For peer review only

38

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

473	yes	2,349 (66.3)	1,083 (30.6)	72 (2.0)	40 (1.1)	1 (0)	0 (0)
-----	-----	--------------	--------------	----------	----------	-------	-------



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

	<b>Total</b>	<b>Secondary hospital</b>	<b>Tertiary hospital</b>	<b>p-value</b>
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*

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

476

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

477

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

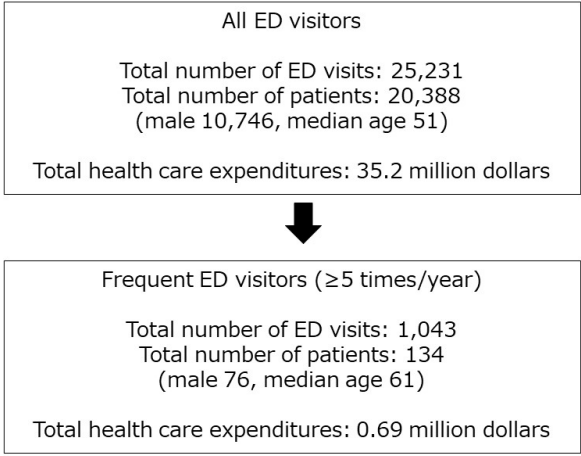


Figure 1

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
<b>Title and abstract</b>	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
<b>Introduction</b>		
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
<b>Methods</b>		
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
<b>Results</b>		
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"/>	

		<a href="#">Page 11</a>
		(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"/>	<a href="#">Page 11</a>
		(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"/>	<a href="#">Pages 11-13</a>
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"/>	<a href="#">Pages 11-13</a>
		(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
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	<a href="#">Page 14</a>
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"/>	<a href="#">Pages 16-17</a>
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"/>	<a href="#">Pages 14-18</a>
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	<a href="#">Pages 14-18</a>
<b>Other information</b>		
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"/>	<a href="#">Page 19</a>

\*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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-039030.R2
Article Type:	Original research
Date Submitted by the Author:	22-Jul-2020
Complete List of Authors:	Kaneko, Makoto; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program, Inoue, Machiko; Hamamatsu University School of Medicine, Department of Family and Community Medicine; Shizuoka Family Medicine Program Okubo, Masashi; University of Pittsburgh, Department of Emergency Medicine Furgal, Allison; University of Michigan Medical School, Department of Family Medicine Crabtree, Benjamin; Rutgers Robert Wood Johnson Medical School, Department of Family Medicine and Community Health, Research Division Fetters, Michael; University of Michigan Medical School, Mixed Methods Program and Department of Family Medicine
<b>Primary Subject Heading</b>:	Emergency medicine
Secondary Subject Heading:	Public health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, HEALTH ECONOMICS, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4  
5  
6  
7 **1 Differences between frequent emergency department users in a secondary rural**  
8  
9 **2 hospital and a tertiary suburban hospital in central Japan: a prevalence study**  
10  
11  
12  
13  
14

15 4 Makoto Kaneko, MD, PhD<sup>1,2,3</sup>; Machiko Inoue, MD, MPH, PhD<sup>1,2</sup>; Masashi Okubo, MD,  
16  
17  
18 5 MS<sup>4</sup>; Allison K. Cullen Furgal, BS, MS, MA<sup>5</sup>; Benjamin F. Crabtree, PhD<sup>6</sup>; and Michael  
19  
20  
21 6 D Fetters, MD, MPH, MA<sup>4,5,7</sup>  
22  
23  
24  
25  
26

27 8 <sup>1</sup> Department of Family and Community Medicine, Hamamatsu University School of  
28  
29  
30 9 Medicine, 1-20-1, Handayama, Higashi-ku, Hamamatsu, 431-3192, Japan  
31  
32

33 10 <sup>2</sup> Shizuoka Family Medicine Program, 1055-1, Akatsuchi, Kikugawa, Shizuoka, 437-  
34  
35  
36 11 1507, Japan  
37  
38

39 12 <sup>3</sup> Primary Care Research Unit, Graduate School of Health Data Science, Yokohama City  
40  
41  
42 13 University.  
43  
44

45 14 <sup>4</sup> Department of Emergency Medicine, University of Pittsburgh School of Medicine,  
46  
47  
48 15 Pittsburgh, PA, USA  
49  
50

51 16 <sup>5</sup> Department of Family Medicine, University of Michigan Medical School, Michigan,  
52  
53  
54 17 USA  
55  
56

57 18 <sup>6</sup> Department of Family Medicine and Community Health, Research Division  
58  
59  
60

1

1  
2  
3  
4  
5  
6  
7 19 Rutgers Robert Wood Johnson Medical School, New Jersey, USA  
8

9  
10 20 <sup>7</sup>Mixed Methods Program and Department of Family Medicine, University of Michigan  
11  
12 21 Medical School, Michigan, USA  
13  
14

15  
16 22

17  
18 23 Corresponding author: Makoto Kaneko  
19

20  
21 24 Department of Family and Community Medicine, Hamamatsu University School of  
22  
23 25 Medicine, 1-20-1, Handayama, Higashi-ku, Hamamatsu, 431-3192, Japan  
24  
25

26  
27 26 Tel: +81 53 435 2416; Fax: +81 53 435 2417  
28

29  
30 27 E-mail: kanekom@yokohama-cu.ac.jp  
31  
32

33  
34 28

35  
36 29 Word count of main text: 2,861  
37

38  
39 30 Number of tables and figures: 4 tables, 1 figure and 1 supplementary file  
40  
41

42  
43 31

44  
45 32 **Keywords:** emergency department, frequent users, health care expenditure, Japan,  
46  
47 33 secondary and tertiary hospital, health care utilization  
48  
49

50  
51 34

52  
53 35

54  
55 36  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7 378  
9 38

## Abstract

### 39 Objectives

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

### 45 Design

46 A prevalence study for a period of one year

### 47 Setting

48 A secondary hospital and a tertiary hospital in central Japan

### 49 Participants

50 All patients who presented to the EDs

### 51 Primary outcome measures

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

59  
60  
3

1  
2  
3  
4  
5  
6 55 expenditures.

7  
8  
9 56 **Results:** Of 25,231 ED visits over one year, 134 frequent ED users accounted for 1,043  
10  
11  
12 57 visits—0.66% of all ED users, comprised 4.1% of all ED visits, and accounted for 1.9%  
13  
14  
15 58 of total health care expenditures. Median ED visits per one frequent ED user was 7.9.

16  
17  
18 59 At the patient-level, after adjusting for age, gender, and receiving public assistance,  
19  
20  
21 60 older age (odds ratio [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02) and receiving  
22  
23  
24 61 public assistance (OR: 7.19, 95% CI: 2.87-18.07) had an association with frequent ED  
25  
26  
27 62 visits. At the visit-level analysis, evaluation by internal medicine (OR: 1.27, 95% CI:  
28  
29  
30 63 1.02-1.57), psychiatry (OR: 124.69, 95% CI: 85.89-181.01), and obstetrics/gynecology  
31  
32  
33 64 (OR: 2.77, 95% CI: 2.09-3.67) were associated with frequent ED visits.

### 34 35 36 65 **Conclusions**

37  
38  
39 66 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
40  
41  
42 67 them—while still in the low end of the distribution of published ranges—are lower in this  
43  
44  
45 68 study from Japan than in reports from many other countries.

46  
47  
48 69

49  
50  
51 70

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

55  
56  
57 72 • This study was an exhaustive investigation that evaluated all emergency  
58  
59  
60

1  
2  
3  
4  
5  
6 73 department (ED) visitors over one year in the two hospitals. Including the entire  
7  
8  
9 74 population of eligible individuals precludes the need for inferential statistics and  
10  
11  
12 75 inherent risks of extrapolation had only a sample of eligible participants been  
13  
14  
15 76 chosen for investigation.

16  
17  
18 77 • The study evaluated not only the numbers of visits but also the health care  
19  
20  
21 78 expenditures of frequent ED visitors.

22  
23  
24 79 • This study only included one secondary hospital and one tertiary hospital.

25  
26  
27 80 • This study did not assess for the severity of condition or diseases of the  
28  
29  
30 81 participants

31  
32  
33 82

34  
35  
36 83  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

84

## Introduction

85 Frequent emergency department (ED) use is associated with higher mortality rates<sup>1</sup> and  
86 financial burden.<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> High rates of  
98 frequent ED users have been reported in North America, Europe, and Oceania.<sup>7</sup> 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.<sup>8</sup> In Korea, 3.1% of all ED visitors were frequent  
101 ED users and occupied 14.0% of total ED visits.<sup>9</sup> Among frequent ED users, low

6



1  
2  
3  
4  
5  
6 102 socioeconomic status and mental health problems are known predictors of frequent ED  
7  
8  
9 103 use based on research in 9 countries.<sup>7,10</sup> Although such studies about frequent ED use  
10  
11  
12 104 were conducted , research on frequent ED use is little in countries with well-developed  
13  
14  
15 105 comprehensive national health insurance such as Japan.

16  
17  
18 106 In Japan, research on frequent ED users has been investigated in single center  
19  
20  
21 107 studies.<sup>11,12</sup> Also, there is no research about health care expenditure of frequent ED  
22  
23  
24 108 users in Japan. For example, in the study by Takeuchi et al., they found frequent ED  
25  
26  
27 109 users comprised 1.4% of all ED users and occupied 6.8% of all ED visits.<sup>11</sup> Frequent  
28  
29  
30 110 ED users were older and more often receiving governmental welfare in comparison with  
31  
32  
33 111 non-frequent ED users.<sup>11</sup> As the number of ED visits by ambulances has been  
34  
35  
36 112 annually increasing by 72 thousand per a year in Japan,<sup>13</sup> a better understanding of the  
37  
38  
39 113 patterns and costs associated with frequent ED users in Japan would be indispensable  
40  
41  
42 114 for developing interventions to reduce unnecessary visit burdens on EDs and mitigate  
43  
44  
45 115 unnecessary costs.

46  
47  
48 116 Understanding the current status of frequent ED users in Japan could inform policy-  
49  
50  
51 117 making that optimizes the use of EDs and leads efficiency in health care expenditures.  
52  
53  
54 118 Hence the study aims of this research were to: 1) document the proportion of ED visits  
55  
56  
57 119 that are by frequent users, and 2) describe the differences in characteristics of frequent  
58  
59  
60

1  
2  
3  
4  
5  
6 120 ED users and other ED users between a secondary and a tertiary hospital in Japan. We  
7  
8  
9 121 hypothesized that a few frequent ED users would account for the major proportion of all  
10  
11  
12 122 ED users and for significant health care expenditure in Japan.  
13  
14

15  
16 123

## 17 18 124 **Methods**

### 19 20 21 125 **Design**

22  
23  
24 126 This study team conducted a prevalence study by utilizing a retrospective chart review  
25  
26  
27 127 for a period of one year ranging from January 1 to December 31, 2017. In the present  
28  
29  
30 128 study, we followed the Strengthening the Reporting of Observational studies in  
31  
32  
33 129 Epidemiology (STROBE) statement.<sup>14</sup>  
34  
35

### 36 130 **Setting**

37  
38  
39 131 Kikugawa General Hospital (a secondary hospital) and Iwata City Hospital (a tertiary  
40  
41  
42 132 hospital) in central Japan served as the sites for study. The size of these two hospitals  
43  
44  
45 133 are generally comparable with other secondary and tertiary care hospitals in Japan.<sup>15</sup>  
46  
47  
48 134 Each hospital is the only general public hospital serving the local municipality. The  
49  
50  
51 135 characteristics of these hospitals are described in Table 1. In Japan, secondary hospitals  
52  
53  
54 136 provide emergency care for a patient who potentially requires admission and tertiary  
55  
56  
57 137 hospitals offer intensive care such as acute myocardial infarction, stroke and multiple  
58  
59  
60

1  
2  
3  
4  
5  
6 138 injury.<sup>16</sup> The secondary hospital in this study serves a catchment area of about 48  
7  
8  
9 139 thousand people, but does not provide inpatient care for children due to the lack of  
10  
11  
12 140 pediatricians. It serves as the single public institution providing inpatient care for mental  
13  
14  
15 141 health in this region. Like the majority of hospitals in Japan, nurses triage patients  
16  
17  
18 142 presenting to the ED based on the patient's chief complaint for evaluation by one of the  
19  
20  
21 143 hospital's subspecialty departments, e.g., internal medicine, surgery or psychiatry. This  
22  
23  
24 144 differs from the typical US-model of emergency care where nurses triage for acuity of  
25  
26  
27 145 need, but emergency physicians provide the first evaluation of all patients coming to the  
28  
29  
30 146 ED.<sup>17</sup>

### 33 147 **Patient and Public Involvement**

34  
35  
36 148 This research was conducted without patient involvement. Patients were not invited to  
37  
38  
39 149 comment on the study design, and they were not consulted in the development of relevant  
40  
41  
42 150 patient outcomes or asked to interpret the results. They were not asked to contribute to  
43  
44  
45 151 the writing or editing of this document for readability or accuracy.

### 48 152 **Participants**

#### 51 153 **Inclusion criteria**

52  
53  
54 154 All patients who presented to the EDs during the study period were eligible for  
55  
56  
57 155 inclusion. There were no exclusion criteria for the study.  
58  
59  
60

1  
2  
3  
4  
5  
6 156 **Measures**

7  
8  
9 157 To be consistent with previous literature,<sup>3</sup> we defined a frequent ED user as a patient  
10  
11  
12 158 who visited the ED in the same hospital  $\geq 5$  times/year during 2017. The study's main  
13  
14  
15 159 outcome measures were the proportion of the frequent ED users among all ED users and  
16  
17  
18 160 the proportion of health care expenditures by the frequent ED users among all ED  
19  
20  
21 161 expenditures. We also counted the frequency of ED visits (1 time/year, 2-4 times, 5-10  
22  
23  
24 162 times, 10-14 times and  $\geq 15$ ) and explored the characteristics of the frequent ED users  
25  
26  
27 163 by age, gender, receipt of public assistance (governmental welfare), ambulance use,  
28  
29  
30 164 hospitalization, service of hospitalization (internal medicine, surgery, orthopedics,  
31  
32  
33 165 psychiatry, pediatrics, and obstetrics/gynecology), and in-hospital death.

34  
35  
36 166 **Statistical analysis**

37  
38  
39 167 To analyze for differences in the characteristics between the frequent ED users and non-  
40  
41  
42 168 frequent ED users, we used chi-square tests. We employed two multivariable models,  
43  
44  
45 169 changing the units of analyses: patient-level and visit-level. In the patient-level analysis,  
46  
47  
48 170 we used logistic regression and adjusted age (as a continuous variable), gender (male  
49  
50  
51 171 was the reference group), and receiving public assistance. In the visit-level analysis, we  
52  
53  
54 172 used a mixed-effect model to include a random effect for hospital and individual  
55  
56  
57 173 covariates as fixed effects. We adjusted for use of ambulance, service of evaluation in  
58  
59  
60

1  
2  
3  
4  
5  
6 174 the ED, and hospitalization. Covariates were selected based on a literature review.<sup>7,8</sup> For  
7  
8  
9 175 the statistical analysis, we used STATA 15 with statistical significance defined by a P-  
10  
11  
12 176 value <0.05.  
13  
14

15  
16 177

## 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

1  
2  
3  
4  
5  
6 210 16 times or more. For factors such as in-hospital death, receiving public assistance, use  
7  
8  
9 211 of ambulance and hospitalization, the majority were accounted for by the non-frequent  
10  
11  
12 212 ED users (1-4 visits).  
13  
14  
15 213 Table 4 provides a comparison of frequent ED users' characteristics between the  
16  
17  
18 214 secondary hospital and the tertiary hospital. In the secondary hospital, the proportion of  
19  
20  
21 215 frequent ED users who were evaluated by psychiatry ( $p<0.001$ ) and  
22  
23  
24 216 obstetrics/gynecology ( $p<0.001$ ) was higher than those in the tertiary hospital. In the  
25  
26  
27 217 tertiary hospital, the proportion of patients who were aged 14 years and younger  
28  
29  
30 218 ( $p<0.004$ ), evaluated by internal medicine ( $p<0.001$ ), pediatrics ( $p<0.001$ ) and surgery  
31  
32  
33 219 ( $p<0.001$ ) was higher than those in the tertiary hospital.  
34  
35  
36 220 After adjusting for age, gender, and receiving public assistance, older age (odds ratio  
37  
38  
39 221 [OR]: 1.01, 95% confidence interval [CI]: 1.00-1.02,  $p=0.004$ ) and receiving public  
40  
41  
42 222 assistance (OR: 7.19, 95% CI: 2.87-18.07,  $p<0.001$ ) were associated with frequent ED  
43  
44  
45 223 visits at the patient-level. In the visit-level analysis, evaluation by internal medicine  
46  
47  
48 224 (OR: 1.27, 95% CI: 1.02-1.57,  $p=0.032$ ), psychiatry (OR: 124.69, 95% CI: 85.89-  
49  
50  
51 225 181.01,  $p<0.001$ ), and obstetrics/gynecology (OR: 2.77, 95% CI: 2.09-3.67,  $p<0.001$ )  
52  
53  
54 226 had associations with frequent ED visits. Ambulance use (OR: 0.81, 95% CI: 0.69-0.95,  
55  
56  
57 227  $p=0.011$ ) and evaluation by orthopedics (OR: 0.63, 95% CI: 0.47-0.84,  $p=0.002$ ) were  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

228 negatively associated with frequent ED visits. The details of the results are shown in the  
229 supplementary file.

For peer review only



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 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 ( $\geq 4$  visits/year) occupied 6.75% of all ED visits and the previous study did not  
237 report the utilized health care expenditures.<sup>11</sup> 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).<sup>7</sup> Compared to the Asian countries in the previous literature,  
246 the proportion of frequent ED visits was almost one third in Japan.<sup>8,9</sup> In a previous US  
247 study, 1% of ED users accounted for 29% of costs<sup>4</sup>—a stark contrast to just less than

1  
2  
3  
4  
5  
6 248 1% of ED users in the current study accounting for about 2% of expenditures. In  
7  
8  
9 249 addition, the proportion of the health care expenditures by frequent ED users from both  
10  
11  
12 250 studies in Japan is much lower than found in several previous studies in the US.<sup>4,18,19</sup>  
13  
14  
15 251 As reported in an international literature review, the problem of frequent ED visits has  
16  
17  
18 252 been observed in multiple countries including Asian countries.<sup>7</sup> Multi-disciplinary  
19  
20  
21 253 interventions such as case management, care plan and information sharing has been  
22  
23  
24 254 found to be effective to reduce the frequent ED users.<sup>2,20</sup> *Kaigo Hoken*, Japan's long-  
25  
26  
27 255 term care insurance program was introduced to provide long-term care support for older  
28  
29  
30 256 adults since 2000.<sup>21</sup> Under *Kaigo Hoken*, care managers coordinate multiple care  
31  
32  
33 257 services for older adults.<sup>21</sup> The care management financed under *Kaigo Hoken* may  
34  
35  
36 258 contribute to the low proportion of frequent ED users in the study compared to other  
37  
38  
39 259 international settings due to proactive care for limitations in activities of daily living.  
40  
41  
42 260 This support can also help mitigate social problems. Also, free-access and universal  
43  
44  
45 261 health care coverage in Japan may contribute to the results as well. Patients can access  
46  
47  
48 262 health-care services regardless of their income, living place and types of hospitals.<sup>21</sup> In  
49  
50  
51 263 Japan, patients tend to visit physician's office and a hospital outpatient clinic in a more  
52  
53  
54 264 timely manner, compared to those in the US.<sup>22,23</sup>

## 265 **Characteristics of the frequent ED users**

1  
2  
3  
4  
5  
6 266 Characteristics of frequent ED users found in the current study, older age, low  
7  
8  
9 267 socioeconomic status, and mental health problems, are consistent with previous studies  
10  
11  
12 268 in other countries.<sup>3,24</sup> For example, findings from the UK, US, Canada and Taiwan  
13  
14  
15 269 similarly identified older age<sup>25</sup> and mental problems.<sup>7,24,26,27</sup> In our study, the proportion  
16  
17  
18 270 of patients who were older than or equal to 65 years among all ED visitors was 38.2%.  
19  
20  
21 271 This is relatively higher than those in the previous studies in other countries such as  
22  
23  
24 272 16.6%-22.1% (US)<sup>28,29</sup>, 25.1% (Canada)<sup>30</sup> and 34.5% (Taiwan)<sup>8</sup>. Therefore, older  
25  
26  
27 273 patients could not explain the low rate of frequent ED users in our study. Thus, as we  
28  
29  
30 274 discussed above, the Japanese health care systems such as Kaigo Hoken or universal  
31  
32  
33 275 health care coverage could explain our results. While previous studies have also  
34  
35  
36 276 identified homelessness<sup>24</sup> and substance abuse<sup>7,26,30</sup> as predictors for frequent ED use,  
37  
38  
39 277 the rate of homelessness in Japan is very low compared to the US, 0.004% vs  
40  
41  
42 278 0.17%<sup>31,32</sup>, and substance abuse also is very low: e.g. 0.5% vs 4.9% in use of  
43  
44  
45 279 methamphetamine and 0.3% vs 14.3% in use of cocaine.<sup>33</sup> Thus, it was not surprising  
46  
47  
48 280 for these factors not to be predictors of frequent ED use.  
49  
50  
51 281 In the previous study conducted in Japan, mental health issues were not related to  
52  
53  
54 282 frequent ED visits but this may be attributable to the absence of full-time psychiatric  
55  
56  
57 283 providers in that hospital.<sup>11</sup> While a difference was noted in the proportion of frequent  
58  
59  
60

1  
2  
3  
4  
5  
6 284 ED visits for pediatric problems between the secondary and tertiary hospital, this  
7  
8  
9 285 finding was not surprising given the lack of a full-time paediatrician in the secondary  
10  
11  
12 286 hospital in our study. Because characteristics of frequent ED users are heterogeneous<sup>7</sup>,  
13  
14  
15 287 analysis of characteristics of frequent ED users in each hospital is important to reduce  
16  
17  
18 288 frequent ED visits. For example, case management including insurance coverage and  
19  
20  
21 289 access to support services has been shown to reduce ED visits among low-income  
22  
23  
24 290 adults.<sup>34</sup> Moreover, multidisciplinary intervention with mental health and substance-  
25  
26  
27 291 abuse professionals decrease ED visits and health care cost.<sup>35</sup> These factors, namely,  
28  
29  
30 292 low socioeconomic status and mental issues, are of particular importance for attention  
31  
32  
33 293 of health care providers and policy makers seeking to develop effective interventions to  
34  
35  
36 294 reduce unnecessary visits and reduce costs.  
37  
38  
39 295 Future research could include a multicentre or nation-wide study in Japan to further  
40  
41  
42 296 characterize frequent ED users across the nation. Despite the much lower rate of frequent  
43  
44  
45 297 ED users, visits, and associated costs in our study compared to other countries, research  
46  
47  
48 298 in Japan on the potential benefit of intervening with a multi-disciplinary team emerges as  
49  
50  
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

1  
2  
3  
4  
5  
6 302 Japan. Also, this is the first study comparing the characteristics of frequent ED users in a  
7  
8  
9 303 secondary and a tertiary hospital. A possible explanation for the low proportion of  
10  
11  
12 304 frequent ED users, could come from inadequate accounting for the actual number of ED  
13  
14  
15 305 visits. In the current study, we counted ED visits in each hospital. If patients attended  
16  
17  
18 306 multiple EDs, it is possible we would not capture the actual number of ED visits, and  
19  
20  
21 307 underestimate the total number of frequent ED users. However, this seems unlikely to  
22  
23  
24 308 have a substantial impact as both hospitals serve as the primary hospitals in their  
25  
26  
27 309 catchment areas.

### 30 **Study limitations**

31  
32  
33 311 First, because this study only included one secondary hospital and one tertiary hospital,  
34  
35  
36 312 the results need to be confirmed through examination of other Japanese hospitals. Both  
37  
38  
39 313 studies occurred in a single prefecture which is predominantly rural. While not necessarily  
40  
41  
42 314 reflective of major metropolitan areas in Japan such as Tokyo, the prefecture of Shizuoka  
43  
44  
45 315 is probably similar to a majority of other prefectures in Japan which have a predominance  
46  
47  
48 316 of rural areas dotted with a few larger cities with tertiary care hospitals. Second, this study  
49  
50  
51 317 did not assess for the severity of condition or diseases of the participants. Thus,  
52  
53  
54 318 appropriateness of the ED visits was not evaluated directly.

55  
56  
57 319

1  
2  
3  
4  
5  
6 320 **Conclusions**

7  
8  
9 321 The proportion of frequent ED users, of total visits, and of expenditures attributable to  
10  
11  
12 322 them are lower in this study from Japan than the distribution of published ranges in reports  
13  
14  
15 323 from many other countries. Future research on a larger scale will be required to determine  
16  
17  
18 324 if these lower rates are consistent across Japan and to fully explain these differences and  
19  
20  
21 325 understand potential lessons for other countries.  
22

23  
24 326

25  
26  
27 327 Figure 1. Summary of frequent emergency department visitors.  
28

29  
30 328

31  
32  
33 329 **Acknowledgments**

34  
35  
36 330 We appreciate the assistance of Dr. Hajime Futami and Yuko Okada of Kikugawa  
37  
38  
39 331 General Hospital, Dr. Masahiko Terada and Naoki Ohta of Iwata City Hospital. We also  
40  
41  
42 332 thank Dr. Koichiro Gibo for his warm support. We would like to thank Editage  
43  
44  
45 333 (www.editage.com) for English language editing.  
46

47  
48 334 **Funding**

49  
50  
51 335 This study was supported by a Grant-in-Aid for Research Activity Start-up (19K21449).  
52  
53  
54 336 The study's sponsor had no role in the study design, data collection, analysis,  
55  
56  
57 337 interpretation, writing of the report, or the decision to submit this article for publication.  
58  
59  
60

1  
2  
3  
4  
5  
6 338 **Competing interests**  
7

8  
9 339 There are no potential competing interests to declare that are relevant to this work.  
10  
11

12 340 **Contributors**  
13

14  
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.  
24  
25  
26  
27  
28

29  
30 346 **Ethical Approval**  
31

32  
33 347 This study was approved by the Research Ethics Committee of Hamamatsu University  
34  
35 348 School of Medicine (approval number 18-061), Kikugawa General Hospital and Iwata  
36  
37 349 City Hospital. We were not required to obtain individual informed consent from the  
38  
39 350 patients included in the study. However, the research team displayed a poster in the  
40  
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.  
44  
45  
46  
47  
48  
49

50  
51 353 **Transparency**  
52

53  
54 354 All authors had full access to all of the data (including statistical reports and tables) in the  
55  
56 355 study and take responsibility for its integrity and the accuracy of the data analyses. The  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 356 lead author affirms that the manuscript is an honest, accurate, and gives a transparent  
7  
8  
9 357 account of the study being reported, and that no important aspects of the study have been  
10  
11  
12 358 omitted, and that any discrepancies from the study as planned (and, if relevant, registered)  
13  
14  
15 359 have been explained.  
16

17  
18 360 **Data sharing**

19  
20  
21 361 Data sharing is not applicable because we did not receive informed consent concerning  
22  
23  
24 362 data sharing from the participants.  
25

26  
27 363

28  
29  
30 364 **References**

- 31  
32  
33 365 1. Moe J, Kirkland S, Ospina MB, et al. Mortality, admission rates and outpatient use  
34  
35  
36 366 among frequent users of emergency departments: a systematic review. *Emerg Med J.*  
37  
38  
39 367 2016;**33**:230-236.  
40  
41  
42 368 2. Soril LJJ, Leggett LE, Lorenzetti DL, et al. Reducing frequent visits to the emergency  
43  
44  
45 369 department: A systematic review of interventions. *PLoS One.* 2015;**10**(4):1-18.  
46  
47  
48 370 3. Scott J, Strickland AP, Warner K, et al. Frequent callers to and users of emergency  
49  
50  
51 371 medical systems : A systematic review. *Emerg Med J.* 2014;**31**:684–691.  
52  
53  
54 372 4. Gross K, Brenner JC, Truchil A et al. Building a citywide, all-payer, hospital claims  
55  
56  
57 373 database to improve health care delivery in a low-income, urban community. *Popul*



- 1  
2  
3  
4  
5  
6 374 *Health Manag.* 2013;**16** Suppl 1:S20-5.  
7  
8  
9 375 5. Warning W, Wood J, Letcher A et al. Working with super-utilizer population: The  
10  
11  
12 376 experience and recommendations. Super utilizer population: Recommendations of five  
13  
14  
15 377 South Central Pennsylvania High Utilizer.  
16  
17  
18 378 [http://www.aligning4healthpa.org/pdf/High\\_Utilizer\\_report.pdf](http://www.aligning4healthpa.org/pdf/High_Utilizer_report.pdf) (accessed March 1,  
19  
20  
21 379 2020.)  
22  
23  
24 380 6. Finkelstein A, Zhou A, Taubman S, et al. Health Care Hotspotting: A randomized,  
25  
26  
27 381 controlled trial. *N Engl J Med.* 2020 Jan 9;**382**(2):152-162.  
28  
29  
30 382 7. Lacalle E, Rabin E. Frequent users of emergency departments: The myths, the data,  
31  
32  
33 383 and the policy implications. *Ann Emerg Med.* 2010;**56**(1):42-48.  
34  
35  
36 384 8. Huang J, Tsai WC, Chen YC, et al. Factors associated with frequent use of  
37  
38  
39 385 emergency services in a medical center. *J Formos Med Assoc.* 2003;**102**(4):222-228.  
40  
41  
42 386 9. Woo JH, Grinspan Z, Shapiro J, et al. Frequent users of hospital emergency  
43  
44  
45 387 departments in Korea characterized by claims data from the national health insurance: A  
46  
47  
48 388 cross sectional study. *PLoS One.* 2016;**11**(1):e0147450.  
49  
50  
51 389 10. Krieg C, Hudon C, Chouinard M, et al. Individual predictors of frequent emergency  
52  
53  
54 390 department use: A scoping review. *BMC Health Serv Res.* 2016 Oct 20;**16**(1):594  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6 391 11. Takeuchi S, Funakoshi H, Nakashima Y, et al. Unique characteristics of frequent  
7  
8  
9 392 presenters to the emergency department in a Japanese population: A retrospective  
10  
11  
12 393 analysis. *Acute Med Surg.* 2019;145-151.  
13  
14  
15 394 12. Ikeda K, Harada T, Tarumi Y, et al. Association between Public Assistance and  
16  
17  
18 395 Frequent Emergency Department Visits in Urban Areas of Japan: A Case-Control  
19  
20  
21 396 Study. *Showa Univ J Med Sci.*2020;**32**(1):73-80  
22  
23  
24 397 13. Ministry of Internal Affairs and Communication. A summary of current status of  
25  
26  
27 398 emergency rescue 2016. 2016.  
28  
29  
30 399 [http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220\\_houdou\\_2.pdf](http://www.fdma.go.jp/neuter/topics/houdou/h28/12/281220_houdou_2.pdf). (in  
31  
32  
33 400 Japanese) (accessed March 1, 2020).  
34  
35  
36 401 14. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of  
37  
38  
39 402 Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting  
40  
41  
42 403 observational studies [published correction appears in *Ann Intern Med.* 2008 Jan  
43  
44  
45 404 15;148(2):168]. *Ann Intern Med.* 2007;**147**(8):573-577.  
46  
47  
48 405 15. Ministry of Health, Labor and Welfare. A current status and a challenge of  
49  
50  
51 406 emergency medicine. 2000. <https://www.mhlw.go.jp/content/10802000/000328610.pdf>.  
52  
53  
54 407 (in Japanese) (accessed March 1, 2020)  
55  
56  
57 408 16. Ministry of Health, Labor and Welfare. A current situation of emergency medicine.  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7 409 2013. [http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-](http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-att/2r9852000002ummz.pdf)  
8  
9 410 [att/2r9852000002ummz.pdf](http://www.mhlw.go.jp/stf/shingi/2r9852000002umg2-att/2r9852000002ummz.pdf). Published 2013. (in Japanese) (accessed March 1, 2020)  
10  
11  
12 411 17. Hibino S, Hori S. Emergency Medicine in the US and the US model Emergency  
13  
14  
15 412 Medicine in Japan. *JJAAM*. 2010;**21**:925-934. (in Japanese)  
16  
17  
18 413 18. U.S. Department of Health and Human Services. The high concentration of U.S.  
19  
20  
21 414 health care expenditures. 2006.  
22  
23  
24 415 [https://meps.ahrq.gov/data\\_files/publications/ra19/ra19.pdf](https://meps.ahrq.gov/data_files/publications/ra19/ra19.pdf). (accessed March 1)  
25  
26  
27 416 19 Billings J, Raven MC. Dispelling an urban legend: Frequent emergency department  
28  
29  
30 417 users have substantial burden of disease. *Health Aff*. 2013;**32**(12):2099-2108.  
31  
32  
33 418 20. Moe J, Kirkland SW, Rawe E, et al. Effectiveness of Interventions to Decrease  
34  
35  
36 419 Emergency Department Visits by Adult Frequent Users : A Systematic Review.  
37  
38  
39 420 2017:40-52.  
40  
41  
42 421 21. Sakamoto H, Rahman M, Nomura S, et al. *Japan Health System Review*. Vol. 8  
43  
44  
45 422 No.1. World Heal Organ Reg Off South-East Asia. 2018;**8**(1).  
46  
47  
48 423 22. Fukui T, Rhaman M, Takahashi M, et al. The ecology of medical care in Japan.  
49  
50  
51 424 *JMAJ*. 2005;**48**.4: 163-167.  
52  
53  
54 425 23. Green LA, Fryer GE Jr, Yawn BP, et al. The ecology of medical care revisited. *N*  
55  
56  
57 426 *Engl J Med*. 2001;**344**:2021–5  
58  
59  
60

- 1  
2  
3  
4  
5  
6 427 24. Doran KM, Raven MC, Rosenheck RA. What drives frequent emergency  
7  
8  
9 428 department use in an integrated health system? National data from the veterans health  
10  
11  
12 429 administration. *Ann Emerg Med.* 2013;**62**(2):151-159.  
13  
14  
15 430 25. Chi CH, Lee HL, Wang SM et al. Characteristics of repeated ambulance use in an  
16  
17  
18 431 urban emergency medical service system. *J Formos Med Assoc.* 2001;Jan;**100**(1):14-9  
19  
20  
21 432 26. Broxterman K, Sapien R, Fullerton L, et al. Repeat ambulance use by pediatric  
22  
23  
24 433 patients. *Acad Emerg Med.* 2000 Jan;**7**(1):36-41.  
25  
26  
27 434 27. Deana Hays, Barbara Penprase, Suha K. Risk factors for frequent users of the  
28  
29  
30 435 emergency department among adults aged 55 and older. *JNEP.* 2018;**8**(9):96-101  
31  
32  
33 436 28. Hunt KA, Weber EJ, Showstack JA, Colby DC, Callaham ML.Characteristics of  
34  
35  
36 437 Frequent Users of Emergency Departments. *Ann Emerg Med.* 2006;**48**(1):1-8  
37  
38  
39 438 29. Knowlton A, Weir BW, Hughes BS et al. Patient demographic and health factors  
40  
41  
42 439 associated with frequent use of emergency medical services in a midsized city. *Acad*  
43  
44  
45 440 *Emerg Med.*2013;**20**(11):1101–1111  
46  
47  
48 441 30. Malcolm BD, Palatnick W, Day S, et al. Frequent users of emergency departments:  
49  
50  
51 442 Developing standard definitions and defining prominent risk factors. *Ann Emerg Med.*  
52  
53  
54 443 2012 Jul;**60**(1):24-32  
55  
56  
57 444 31. Ministry of Health, Labor and Welfare. Nationwide survey of approximate number  
58  
59  
60

- 1  
2  
3  
4  
5  
6 445 of homeless people. 2018. <https://www.mhlw.go.jp/content/12003000/000330962.pdf>.  
7  
8  
9 446 (in Japanese) (accessed March 1, 2020)  
10  
11  
12 447 32. US Department of Housing and Urban Development. The 2018 Annual Homeless  
13  
14  
15 448 Assessment Report (AHAR) to Congress. 2018. Accessed March 1, 2020.  
16  
17  
18 449 <https://files.hudexchange.info/resources/documents/2018-AHAR-Part-1.pdf>  
19  
20  
21 450 33. Ministry of Health, Labor and Welfare. Lifetime experience rate of illegal drugs in  
22  
23  
24 451 major countries. 2017.  
25  
26  
27 452 <https://www.mhlw.go.jp/bunya/iyakuhin/yakubuturanyou/torikumi/dl/index-05.pdf>. (in  
28  
29  
30 453 Japanese) (accessed March 1, 2020)  
31  
32  
33 454 34. Shah R, Chen C, O'Rourke S, et al. Evaluation of care management for the  
34  
35  
36 455 uninsured. *Med Care*. 2011;Feb;**49**(2):166-71.  
37  
38  
39 456 35. Murphy SM, Neven D. Cost-effective: emergency department care coordination  
40  
41  
42 457 with a regional hospital information system. *J Emerg Med*. 2014 Aug;**47**(2):223-31.  
43  
44  
45 458 36. Statistics of Japan, e-Stat: Portal Site of Official Statistics of Japan. [https://www.e-](https://www.e-stat.go.jp/regional-statistics/ssdsview/municipality)  
46  
47  
48 459 [stat.go.jp/regional-statistics/ssdsview/municipality](https://www.e-stat.go.jp/regional-statistics/ssdsview/municipality). (in Japanese) (accessed July 1,  
49  
50  
51 460 2020)  
52  
53  
54 461  
55  
56  
57  
58  
59  
60

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

	<b>Secondary hospital</b>	<b>Tertiary hospital</b>
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 (%) <sup>36</sup>	25.0	26.1
Unemployment rate in the	2.9	3.6

city (%)<sup>36</sup>

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

	<b>Total</b>	<b>Frequent ED users</b>	<b>Non-frequent ED users</b>	<b>p-value</b>
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

470

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.

<b>Number of ED visits</b>	<b>1</b>	<b>2-4</b>	<b>5-7</b>	<b>8-10</b>	<b>11-15</b>	<b>16≥</b>
<b>visits</b>						
<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)	0 (0)	0 (0)
Gender						
male	1,894 (82.2)	390 (16.9)	12 (0.5)	5 (0.2)	0 (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)	0 (0)	2 (0)
yes	156 (97.5)	4 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Receiving						
public						
assistance						

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

no	3,980 (83.8)	731 (15.4)	29 (0.6)	7 (0.1)	7 (0)	2 (0)
yes	8 (80.0)	0 (0)	1 (10.0)	1 (10.0)	0 (0)	0 (0)
<hr/>						
Visit-level						
Number of visits						
(%): n=6,122						
<hr/>						
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)	2 (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)

34

1  
2  
3  
4  
5 yes 937 (65.5) 435 (30.4) 44 (3.1) 6 (0.4) 6 (0.4) 2 (0.1)  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

For peer review only

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 $\geq$
Patient-level						
Number of patients (%):	n=15,628					
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)

36

1						
2						
3						
4						
5	Gender					
6						
7						
8	male	6,210 (84.6)	1,090 (14.9)	30 (0.4)	7 (0.1)	0 (0)
9						2 (0)
10						
11	female	6,988 (84.3)	1,247 (15.0)	43 (0.5)	7 (0.1)	4 (0)
12						0 (0)
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)
21						2 (0)
22						
23	yes	318 (78.9)	82 (20.3)	2 (0.5)	1 (0.2)	0 (0)
24						0 (0)
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)
36						1 (0)
37						
38						
39						
40						
41	37					
42						
43						
44						
45						
46						

yes	76 (76.0)	21 (21.0)	0 (0)	0 (0)	7 (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)	7 (0.3)	24 (0.2)
yes	3,661 (70.4)	1,398 (26.9)	94 (1.8)	17 (0.3)	4 (0.3)	14 (0.3)
Hospitalization						
no	10,850 (69.7)	4,218 (27.1)	322 (2.1)	86 (0.6)	10 (0.3)	38 (0.2)

38



For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

475	yes	2,349 (66.3)	1,083 (30.6)	72 (2.0)	40 (1.1)	1 (0)	0 (0)
-----	-----	--------------	--------------	----------	----------	-------	-------

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

	<b>Total</b>	<b>Secondary hospital</b>	<b>Tertiary hospital</b>	<b>p-value</b>
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*

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

478

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

479

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

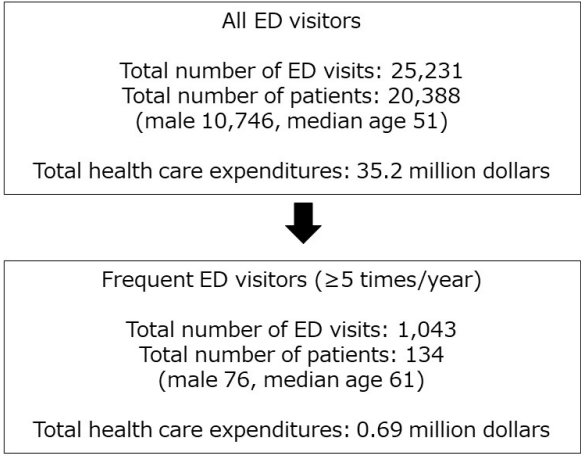


Figure 1

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
<b>Title and abstract</b>	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
<b>Introduction</b>		
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
<b>Methods</b>		
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
<b>Results</b>		
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"/>	



		<a href="#">Page 11</a>
		(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"/>	<a href="#">Page 11</a>
		(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"/>	<a href="#">Pages 11-13</a>
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"/>	<a href="#">Pages 11-13</a>
		(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
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
	<input checked="" type="checkbox"/>	<a href="#">Page 14</a>
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"/>	<a href="#">Pages 16-17</a>
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"/>	<a href="#">Pages 14-18</a>
Generalisability	21	Discuss the generalisability (external validity) of the study results
	<input checked="" type="checkbox"/>	<a href="#">Pages 14-18</a>
<b>Other information</b>		
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"/>	<a href="#">Page 19</a>

\*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>.