

# Identifying Characteristics of Frequent and Highly Frequent Users of the Emergency Department: A Cross-Sectional Observational Study

**Byeung Ki An**

Korean Institute of Health and Welfare policy

**Tiffany Jane Lee**

Vanderbilt University

**Sang Mi Kim**

Ewha Womans University Department of Big Data Analytics

**Suck Ju Cho**

Pusan National University School of Medicine, Department of Emergency Medicine

**Joonbum Park** (✉ [jesumania@gmail.com](mailto:jesumania@gmail.com))

Soonchunhyang University Hospital <https://orcid.org/0000-0003-3052-2339>

---

## Original research

**Keywords:** Emergency department, Overcrowding, Frequent user

**Posted Date:** June 5th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-32780/v1>

**License:** © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

---

# Abstract

## Introduction:

Since the characteristics of frequent emergency department (ED) users are heterogeneous, it is impossible to mitigate the overcrowding of the ED without the basic data of diagnoses and risk factors of frequent ED users. Our study will provide invaluable information that will help predict patient demand for medical resources while also providing important information that can be used to improve emergency medical services.

## Methods

This is the cross-sectional observational study using records from The Korea Health Insurance Review Agency. Frequent ED users were defined as patients who visited an ED more than 7–17 times per calendar year and highly frequent ED users were defined as patients who visited an ED eighteen or more times during the same period. The diseases were ranked by prevalence in each of the three ED frequency groups (less frequent, frequent, and highly frequent ED user groups). Our study then developed two logistic regression models comparing frequent users with less frequent users and highly frequent users with frequent users. Standardized  $\beta$  values were used to rank risk factor importance.

## Results

Although less frequent ED users composed 98.98% of all patients, they only consisted of 92.27% of all ED visits. Compared with less frequent users, a greater proportion of frequent ED users were aged 65 years or older and were insured by Medicaid or Veterans Affairs Health Care Program. Frequent ED users were also most strongly defined by wound dressing follow-up visits and liver diseases (standardized  $\beta$  value of 3.29 and 2.31). However, this study did not show highly frequent ED users differed from frequent ED users in regard to the different disease categories.

## Conclusion

The diagnoses and risk factors related to frequent ED visits in Korea identified in this study will be an important reference for future research aimed at reducing ED overcrowding. By further analyzing the risk factors associated with frequent ED use, non-emergency administrative systems or medical facilities can be utilized to reduce the overload on the ED.

## Background

In the current South Korean emergency medical service system, there are 415 emergency departments (EDs) that are classified according to medical capacity and designated service area; as of 2018 there were 36 tertiary emergency centers, 121 secondary emergency centers and 258 primary emergency facilities.<sup>16</sup> Despite the sufficient number of EDs, the hierarchical regionalism model has not been fully utilized in Korea's emergency medical system. As a result, there is more overcrowding in secondary emergency centers and tertiary emergency centers than in primary emergency facilities.

The national health expenditure in South Korea has increased by an average of \$2.9 billion each year from 2014 and 2018.<sup>1</sup> The number of visitors to the emergency department also increased, and many of these visitors were frequent ED users.<sup>2-4</sup> In South Korea, as well as in other countries, there is a persistent problem of ED overcrowding.<sup>8,9</sup> The correlation between frequent users and ED overcrowding is a topic of interest not only to emergency physicians, but also to financiers, patients and policy makers. Hence, it is important to obtain a clear understanding of the link between frequent users and increasing volumes of ED patients. Further analysis of frequent ED users is necessary to understand the reason behind this increase in ED visits.<sup>5-7</sup>

## Purpose

Although there have been several studies about frequent ED users, most studies only focused on a limited number of diseases or a patient population in a specific region.<sup>10-13</sup> One recent study reported the characteristics of frequent ED users in Korea. However, previous studies did not analyze the frequent diseases found in the EDs in Korea.<sup>14</sup> These previous studies did not provide suitable information to make policies for an emergency medical service system.<sup>10,12,17-25</sup> To remedy these issues, our study conducted a systematic review on the causes of frequent ED visits. Instead of selecting for groups of diagnoses that were of interest, this study included all ED patients. Our study will provide invaluable information that will help predict patient demand for medical resources while also providing important information that can be used to improve emergency medical services.

## Methods

### Study setting and participants

A cross-sectional observational study was conducted using all ED visit records of the Korea Health Insurance Review Agency (HIRA). HIRA is a government organization that reviews and assesses medical claims for the National Health Insurance and maintains a database of medical records for the entire Korean population. HIRA provided identifiable information that was specific to each individual. These identifiable information members anonymously corresponded to record files, which were utilized to provide a comprehensive picture of health care use and patient diseases. HIRA records showed that a total of 10,599,311 patients visited EDs in Korea from 2016 to 2017. It should be noted that HIRA data does not include patients who receive car insurance or worker's compensation. Due to this, the number of ED patients accounted for in this study was less than the actual number of ED patients.

### Definition Of Less-frequent, Frequent, And Highly Frequent ED Users

To measure ED visit frequency, each patient's most recent ED visit during the 2017 fiscal year was used as a reference point. In order to create each patient's total ED visit frequency, the ED visits that preceded the most recent visit were counted, beginning from one calendar year (365 days) before the reference point. "Frequent ED users" were defined as patients who visited an ED more than 7–17 times per calendar year and "highly frequent ED users" were defined as patients who visited an ED eighteen or more times during the same period.<sup>15</sup> Patients who were under 18 years old were excluded in this study, since their diagnoses contributed to less than 100 patients.

# Selection Of Risk Factors

Risk factors associated with ED use were chosen according to a literature review and grouped by patient demographic, illness and disposition. Demographic factors (patient age, sex, insurance status) were also included and classified according to the most recent ED visit. Patient diagnoses were based on the 10th revision of International Statistical Classification of Disease (ICD-10) code algorithms. In the ICD-10, patient death was not classified as a separate group, so it was included in the discharge group.

## Grouping And Ranking Of Patient Diagnoses

Patients were labeled under chronic disease if they had any of the following ICD-10 codes: C22, R18, K70, 74 (for liver diseases); J44, 45 (for lung diseases); I10, 20 (for cardiovascular diseases) or E11, 14, 87, N18 (for renal and endocrine diseases). Similarly, patients were labeled under mental health disorders if they had codes F10, 32, 41 or G47; under trauma-related injury if they had codes S01 (for trauma to the head and face); S22, 33 (for trauma to the thorax and abdomen) and S43, 61, 80, 83, 91, 93, T14 (for trauma to extremities). Patients were categorized as having joint pain-related disorders if emergency physicians reported any of the following ICD-10 codes as the main diagnosis of the ED visit; M10, 13, 17, 19, 25, 75 (for arthritis); M79, 89 (for musculoskeletal disease) and G43, 44, 47, 56, M47, 48, 50, 51, 54 (for neuropathy). Relatively simple diseases were also grouped based on their code and diagnosis: J00, 02, 03, 06, 20, 30, 40 (for upper respiratory infection); K52, 59 (for acute gastroenteritis); L23, 50 (for urticaria/dermatitis) and Z48 (for a follow-up visits including wound dressing changes). Each disease was ranked by prevalence to observe the characteristic diagnoses of each ED frequency group (less frequent, frequent, and highly frequent ED user group).

## Primary Data Analysis

To identify the risk factor of frequent and highly frequent ED visits, two separate logistic regression models were constructed. The first model compared frequent ED users with less frequent ED users, while the second model compared highly frequent ED users with frequent ED users. For logistic regression analyses, patient-level demographic factors such as age, gender, type of insurance and disease categories such as chronic disease, pain-related disease, mental disorder, trauma-related disease, and minor cases were included. Standardized  $\beta$  values were used to rank risk factor importance; this process can directly translate the size of these values by converting the unit  $\beta$  values into standardized units. Assuming equal variance, the standardized odds ratio is affected by the effect and sample size. The methods created by Agresti were used for the standardized odds ratios. All analyses were performed with SPSS (version 18.0; IBM SPSS Statistics, Chicago, IL).

## Results

A total of 4,861,213 patients with 7,562,833 ED visits were analyzed in this study (Table 1). Less frequent ED users composed 98.98% of patients but only 92.27% of the total ED visits. Frequent ED users composed of only 0.62% of all patients but 5.94% of ED visits. Similar to this, highly frequent ED users composed of only 0.09% of all patients but 2.24% of ED visits. Each diagnosis was ranked from 1st to 30th in each group according to their ED visit frequency (Table 2). A total of nineteen diagnoses increased its ranking from the less frequent group to the highly frequent group. Among those, eleven diagnoses - (M54) Radiculopathy, (M25) Other joint disorders, (R52) Pain, unspecified, (S33) Injuries of the lumbar spine, (F41) Anxiety disorders, (G44) Cluster headaches, (M48) Other

spondylopathies, (K70) Alcoholic liver diseases, (M51) Intervertebral disc disorder, (L03) Cellulitis, and (F10) Alcohol related disorders - were not included in the top 30 in the less frequent group, although their ranks increased in frequent and highly frequent groups.

Table 1  
Distribution of ED users and visits by ED visit frequency in Korea for a year.

No. of ED visits	No. of Users			No. of Visits		
	n	%	Cumulative %	n	%	Cumulative %
1	3,416,656	70.28	70.28	3,416,656	45.18	45.18
2	917,396	18.87	89.15	1,834,792	24.26	69.44
3	287,567	5.92	95.07	862,701	11.41	80.85
4	112,377	2.31	97.38	449,508	5.94	86.79
5	50,912	1.05	98.43	254,560	3.37	90.16
6	26,619	0.55	98.98	159,714	2.11	92.27
7	15,221	0.31	99.29	106,547	1.41	93.68
8	9,307	0.19	99.48	74,456	0.98	94.66
9-11	13,276	0.27	99.75	129,677	1.71	96.37
12-14	5,222	0.11	99.86	66,948	0.89	97.26
15-17	2,410	0.05	99.91	38,158	0.50	97.76
18≤	4,250	0.09	100.00	169,116	2.24	100.00
total	4,861,213	100.00	100.00	7,562,833	100.00	100.00

Table 2

Thirty high-ranked diagnosis of Less Frequent, Frequent and Highly Frequent ED visit groups

Rank	1–6 visits group (Less frequent visit)		7–17 visits group (Frequent visit)		≥ 18 visits group (Highly frequent visit)		Change of rank
	Diagnosis (ICD code)	No. of visit	Diagnosis (ICD code)	No. of visit	Diagnosis (ICD code)	No. of visit	
1	(A09) Infectious AGE and colitis	689,365	(A09) Infectious AGE and colitis	11,930	(A09) Infectious AGE and colitis	1,047	1→1→1
2	(R10) Abdomen/Pelvic pain	295,024	(R10) Abdomen/Pelvic pain	7,685	<b>(M79) Myalgia</b>	998	<b>22→7→2</b>
3	(S01) Open wound of head	265,064	(J06) Acute URI	7,382	(R10) Abdomen/Pelvic pain	976	2→2→3
4	(L50) Urticaria	246,739	(J20) Acute bronchitis	6,938	<b>(M54) Radiculopathy</b>	740	<b>37→20→4</b>
5	(S61) Open wound of hand	231,689	(R50) Fever	5,166	<b>(K29) Gastritis and duodenitis</b>	654	<b>9→6→5</b>
6	(J06) Acute URI	210,580	(K29) Gastritis and duodenitis	4,777	(J06) Acute URI	619	6→3→6
7	(R50) Fever	210,189	(M79) Myalgia	4,479	(J20) Acute bronchitis	555	8→4→7
8	(J20) Acute bronchitis	161,450	(L50) Urticaria	4,044	<b>(R51) Headache</b>	544	<b>13→10→8</b>
9	(K29) Gastritis and duodenitis	158,370	(J00) Acute nasopharyngitis	3,774	(R42) Dizziness and giddiness	493	10→11→9
10	(R42) Dizziness and giddiness	152,240	(R51) Headache	3,756	<b>(R07) Chest pain</b>	417	<b>19→17→10</b>
11	(S06) Cerebral concussion	122,481	(R42) Dizziness and giddiness	3,719	<b>(J40) Bronchitis</b>	406	<b>26→13→11</b>
12	(S00) Superficial injury of scalp	114,734	(J18) Pneumonia	3,711	<b>(K59) Constipation</b>	382	<b>20→18→12</b>
13	(R51) Headache	103,992	(J40) Bronchitis	3,371	(L50) Urticaria	381	4→8→13
14	(J03) Acute tonsillitis	100,531	(J02) Streptococcal pharyngitis	3,308	<b>(R06) Dyspnea</b>	376	<b>28→21→14</b>
15	(J02) Streptococcal pharyngitis	92,007	(S61) Open wound of hands	3,126	(J00) Acute nasopharyngitis	355	18→9→15
16	(S93) Injury of foot and ankle	91,867	(S01) Open wound of head	3,079	<b>(M25) Other joint disorder</b>	341	<b>76→41→16</b>
17	(J18) Pneumonia	88,795	(R07) Chest pain	3,064	<b>(R52) Pain, unspecified</b>	340	<b>134→60→17</b>

Rank	1–6 visits group (Less frequent visit)		7–17 visits group (Frequent visit)		≥ 18 visits group (Highly frequent visit)		Change of rank
	Diagnosis (ICD code)	No. of visit	Diagnosis (ICD code)	No. of visit	Diagnosis (ICD code)	No. of visit	
18	(J00) Acute nasopharyngitis	88,593	(K59) Constipation	3,042	<b>(S33) Injury of lumbar spine</b>	338	<b>34→27→18</b>
19	(R07) Chest pain	88,305	(J03) Acute tonsillitis	2,970	<b>(F41) Anxiety disorder</b>	298	<b>86→31→19</b>
20	(K59) Constipation	85,581	(M54) Radiculopathy	2,872	<b>(K52) Noninfective AGE</b>	288	<b>25→24→20</b>
21	(H81) BPPV	84,347	(R06) Dyspnea	2,861	<b>(G44) Cluster headache</b>	284	<b>42→29→21</b>
22	(M79) Myalgia	82,997	(R11) Nausea and vomiting	2,150	<b>(M48) Other spondylopathies</b>	270	<b>136→72→22</b>
23	(N20) Calculus of kidney/ureter	82,448	(S06) Cerebral concussion	2,101	(R50) Fever	264	7→5→23
24	(S60) Contusion of hand	76,814	(K52) Noninfective AGE	2,062	(R11) Nausea and vomiting	257	27→22→24
25	(K52) Noninfective AGE	75,940	(S00) Superficial injury of scalp	1,865	<b>(K70) Alcoholic liver disease</b>	244	<b>118→28→25</b>
26	(J40) Bronchitis	71,279	(N39) Urinary tract infection	1,777	(J18) Pneumonia	233	17→12→26
27	(R11) Nausea and vomiting	64,544	(S33) Injury of lumbar spine	1,697	<b>(M51) Intervertebra disc disorder</b>	230	<b>100→82→27</b>
28	(R06) Dyspnea	59,612	(K70) Alcoholic liver disease	1,685	(J02) Streptococcal pharyngitis	227	15→14→28
29	(I63) Cerebral infarction	58,924	(G44) Cluster headache	1,648	<b>(L03) Cellulitis</b>	218	<b>44→34→29</b>
30	(J10) Influenza, other identified	57,517	(Z48) Wound dressing	1,579	<b>(F10) Alcohol related disorder</b>	216	<b>81→33→30</b>

Compared with less frequent users, a greater proportion of frequent ED users were aged 65 years or older and insured by Medicaid or the Veterans Affairs Health Care Program (VA program) (Table 3). In addition to this, frequent ED users had many more instances of chronic diseases, such as liver, lung and renal/endocrine disease, than less frequent ED users. Similarly, a greater proportion of frequent ED users had pain-related diseases or mental disorders when compared to less frequent ED users. Despite this, the less frequent ED users made up a greater percentage of the trauma-related injury group and minor care disease group. Although these disease groups occupied a high proportion of ED visits, the trauma-related and minor care disease groups were not presumed to exhibit a nature that would induce more frequent visits to the ED.

Table 3  
Description of patient demographic, disposition and illness by ED visit frequency.

ED Risk Factors	ED frequent use category (No. of visits for 1 year)					
	Less frequent (1-6)		Frequent (7-17)		Highly Frequent (18≤)	
<b>No. of patients (column %)</b>	4,811,527	(100.00)	45,436	(100.00)	4,250	(100.00)
<b>Sex</b>						
Male	2,322,960	(48.28)	25,998	(57.22)	2,807	(66.05)
Female	2,488,567	(51.72)	19,438	(42.78)	1,443	(33.95)
<b>Type of beneficiary</b>						
Medical insurance	4,567,995	(94.94)	38,378	(84.47)	3,116	(73.32)
Medicaid	241,006	(5.01)	6,975	(15.35)	1,109	(26.09)
VA Insured	2,526	(0.05)	83	(0.18)	25	(0.59)
<b>Age, y</b>						
17-24	553,176	(11.50)	2,658	(5.84)	133	(3.13)
25-44	1,471,632	(30.58)	11,732	(25.82)	1,115	(26.24)
45-64	1,680,790	(34.93)	16,201	(35.66)	1,750	(41.18)
65-74	515,310	(10.71)	6,755	(14.87)	694	(16.33)
75≤	590,619	(12.28)	8,090	(17.81)	558	(13.12)
<b>No. of admissions (column %)</b>	6,088,093	(100.00)	53,396	(100.00)	4,396	(100.00)
<b>Admission</b>						
No admission	3,923,005	(64.44)	20,332	(38.08)	1,917	(43.61)
Once a year	1,752,132	(28.78)	7,240	(13.56)	575	(13.08)
More than twice a year	412,956	(6.78)	25,824	(48.36)	1,904	(43.31)
<b>No. of visits (column %)</b>	1,443,094	(100.00)	18,444	(100.00)	2,176	(100.00)
<b>Disease categories</b>						
<b>Chronic disease</b>						
Liver disease	25,169	(1.74)	2,036	(11.04)	263	(12.09)
Lung disease	22,020	(1.53)	776	(4.21)	107	(4.92)
Cardiovascular disease	44,967	(3.12)	624	(3.38)	34	(1.56)
Renal and Endocrine disease	42,443	(2.94)	1,152	(6.25)	81	(3.72)
<b>Pain-related disease</b>						
Arthritis	35,945	(2.49)	1,351	(7.32)	283	(13.01)

	ED frequent use category (No. of visits for 1 year)					
Musculoskeletal disease	48,749	(3.38)	892	(4.84)	285	(13.10)
Neuropathy	106,172	(7.36)	1,549	(8.40)	423	(19.44)
<b>Mental disorder</b>						
Major depressive disorder	2,850	(0.20)	83	(0.45)	7	(0.32)
Anxiety	12,652	(0.88)	418	(2.27)	83	(3.81)
Insomnia	1,860	(0.13)	87	(0.47)	17	(0.78)
Alcohol-induced mental disorder	14,513	(1.01)	436	(2.36)	57	(2.62)
<b>Trauma-related disease</b>						
Head and face	133,381	(9.24)	569	(3.09)	15	(0.69)
Thorax and Abdomen	65,977	(4.57)	423	(2.29)	42	(1.93)
Extremities	343,624	(23.81)	1,597	(8.66)	74	(3.40)
<b>Minor care disease</b>						
Upper respiratory infection	318,737	(22.09)	4,202	(22.78)	259	(11.90)
Acute gastroenteritis	82,770	(5.74)	567	(3.07)	55	(2.53)
Urticaria/Dermatitis	137,371	(9.52)	844	(4.58)	62	(2.85)
Dressing follow up	3,894	(0.27)	838	(4.54)	29	(1.33)

In some instances, highly frequent ED users had characteristics that were similar to those of frequent users. Compared to the less frequent ED user group, the highly frequent ED user group had a higher proportion of male patients, a higher proportion of Medicaid or VA insured patients and a higher proportion of patients aged 45 to 74 years old. Compared to the highly frequent ED user group, the less frequent ED user group had a higher proportion of patients with standard health insurance and a higher proportion of patients aged 17 to 44 years old (Table 3). Highly frequent ED users were two or three times as high as frequent users in the pain-related disease group. In addition to this, highly frequent ED users showed a similar pattern when compared with frequent users in the chronic, trauma-related and minor care diseases groups.

The rate of patients hospitalized only once per year was higher for less frequent ED users (28.78%) than the rate for frequent ED users (13.56%) or highly frequent ED users (13.08%). On the other hand, the rate of patients hospitalized more than twice per year was higher in frequent ED users (48.36%) and highly frequent ED users (43.31%) than in less frequent users (6.78%). Overall, highly frequent ED users did not show higher rates of hospitalization than frequent users; however, it should be noted that highly frequent ED users have a relatively low rate of hospitalization.

From these descriptive findings, the logistic regression was extended (Table 4). The logistic regression models showed how various risk factors uniquely influence each group and expressed the importance of these risk factors (standardized  $\beta$  values). Compared with less frequent ED users, frequent ED users were characterized strongly by the wound dressing follow-up group and liver disease groups (standardized  $\beta$  value of 3.29 and 2.31). The odds of being a frequent ED user were 26.86-fold greater for wound dressing follow-ups and 10.10-fold greater for patients

with liver diseases, when compared to less frequent ED users. Additional factors of frequent ED use include lung disease (odds ratio = 4.40) and arthritis (odds ratio = 4.69). Demographics also showed that patients aged more than 65 years old and patients with Medicaid showed a greater odds ratio (2.793 and 3.45, respectively) of frequent ED users than less frequent ED users. Only two factors statistically significantly differentiated highly frequent ED users from frequent ED users (Table 4). The odds of being a frequent ED user were 31 percent lower for males, and 49 percent lower for Medicaid patients. There were no specific disease groups that caused the highly frequent ED user group to visit the emergency department more often than the frequent ED user group.

Table 4

Multivariate modeling: comparisons for frequent versus less frequent users and highly frequent versus frequent users

	Frequent vs Less frequent ED users		Highly frequent vs Frequent ED users	
	Odds ratio (95% CI)	Standardized $\beta$	Odds ratio (95% CI)	Standardized $\beta$
<b>Demographics</b>				
Age, y (reference = 17–24)				
25–64	1.84(1.77–1.92)†	0.61	0.49(0.41–0.58)	*
65≤	2.79(2.68–2.91)†	1.02	0.59(0.49–0.71)	*
Sex (reference = female)				
male	1.43(1.41–1.46)‡	0.35	0.69(0.64–0.74)†	-0.37
Type of beneficiary (reference = NHI)				
Medicaid	3.45(3.36–3.54)†	1.24	0.51(0.48–0.55)†	-0.67
VA Insured	3.92(3.15–4.88)	*	0.27(0.17–0.42)	*
<b>Disease categories</b> (reference = other diseases§)				
<b>Chronic disease</b>				
Liver disease	10.10(9.63–10.58)†	2.31	0.60(0.52–0.68)	*
Lung disease	4.40(4.10–4.73)†	1.48	0.56(0.45–0.69)	*
Cardiovascular disease	1.73(1.60–1.88)†	0.55	1.41(1.00–2.00)	*
Renal and Endocrine disease	3.39(3.19–3.60)†	1.22	1.09(0.87–1.38)	*
<b>Pain-related disease</b>				
Arthritis	4.69(4.44–4.96)†	1.55	0.37(0.32–0.42)	*
Musculoskeletal disease	2.28(2.14–2.44)†	0.83	0.24(0.21–0.28)	*
Neuropathy	1.82(1.73–1.92)†	0.60	0.28(0.25–0.32)	*
<b>Mental disorder</b>				
Major depressive disorder	3.63(2.92–4.52)	*	0.91(0.42–1.97)	*
Anxiety	4.12(3.74–4.55)	*	0.39(0.30–0.49)	*
Insomnia	5.84(4.71–7.24)	*	0.39(0.23–0.66)	*
Alcohol-induced mental disorder	3.75(3.41–4.13)†	1.32	0.59(0.44–0.78)	*
<b>Trauma-related disease</b>				
Head and face	0.53(0.49–0.58)†	-0.63	2.92(1.74–4.88)	*

	Frequent vs Less frequent ED users		Highly frequent vs Frequent ED users	
Thorax and Abdomen	0.80(0.73–0.88)†	-0.22	0.77(0.56–1.07)	*
Extremities	0.58(0.55–0.61)†	-0.54	1.66(1.31–2.10)	*
<b>Minor care disease</b>				
Upper respiratory infection	1.65(1.59–1.70)†	0.50	1.25(1.09–1.42)	*
Acute gastroenteritis	0.86(0.79–0.93)†	-0.16	0.79(0.60–1.05)	*
Urticaria/Dermatitis	0.77(0.72–0.82)†	-0.27	1.05(0.81–1.36)	*
Dressing follow up	26.86(24.90-28.97)†	3.29	2.22(1.53–3.22)	*
CI, Confidence interval ED emergency department NHI national health insurance *Standardized $\beta$ are provided only for significant risk factors. †p < 0.05 ‡p < 0.01 §Other disease: all disease except 80 high-ranked diagnosis of frequent ED users				

## Discussion

This study was conducted using data from the Korea Health Insurance Review Agency. All patients who frequently visited the ED in Korea during one fiscal year were included in the analysis and the data for each patient was categorized by ICD-10 code. This is the first study to include all ED users regardless of their diagnosis. Previous studies have selected disease groups or diagnoses of interest first and then proceeded to analyze their relevance to ED use frequency.<sup>19,20</sup> In our study, frequent ED users were defined as patients who visited the ED 7–17 times during the fiscal year. This is different from other studies, where frequent ED users were defined as a patient who visited the 4 times or more during the fiscal year.<sup>15</sup> In addition to this, patients who visited the ED 18 times or more during the fiscal year were defined as a highly frequent ED user - a patient who was more likely to unnecessarily visit the emergency department than frequent ED user. The top 30 diagnoses of each ED user frequency category (less frequent, frequent and highly frequent) was focused on (Table 2). By knowing the specific types and characteristics of frequent diagnoses in the frequent and highly frequently ED user groups, this study hopes to help mitigate potential emergency department overuse.

Although there is a general perception that frequent users of the emergency department abuse and misuse emergency services, further investigation of the frequent ED user group provides more insight.<sup>26,27</sup> In South Korea, the government employs national health insurance based on the fee-for-service system. The current fee-schedule may incentivize patients to visit the emergency department as opposed to visiting non-emergency medical facilities. This may explain why there is a tendency for frequent ED users to be linked to minor medical conditions, such as wound dressing follow-up. Patients who were insured by Medicaid showed statistically significant differences among the three frequency groups. On the other hand, VA insured patients did not show statistically different differences among three frequency groups.

There is a subset of frequent and highly frequent ED users who had unmet social needs. The majority of these users had ongoing multi-dimensional medical, social, and mental health needs. For instance, patients with minor symptoms in these frequency groups may utilize emergency services as opposed to seeking primary care first because of financial reasons. Primary care requires settling co-pays when a patient receives prescription medications, however, emergency services do not charge co-pays if the patients are escorted via ambulance. Due to the varied and complex medical needs of the patients, it is not suitable to generalize about frequent ED users as a homogeneous group.

It is also noteworthy that individuals in the highly frequent ED user group had a higher number of visits to the emergency department than individuals in the frequent ED user group, despite exhibiting a lower rate of hospitalization than the frequent ED user group. This implied that individuals in the highly frequent ED user group visit the emergency department with milder symptoms than individuals in the frequent ED user group. The highly frequent ED user group was only affected significantly by gender and insurance status when compared to the frequent ED user group, implying that there were no specific medical factors that caused the highly frequent ED user group to visit the emergency department more often than the frequent ED user group.

An interesting finding of this study showed that alcohol-related diagnoses were more noticeable in the frequent ED user group than in less frequent ED user groups. Although our study only included alcohol-related disorders, it should be noted that liver disease and trauma-related diagnoses are often caused by alcohol. Future studies should further investigate different possible alcohol-induced diagnoses in order to analyze emergency department use resulting from alcohol abuse.

The objective of this study was to identify characteristics of frequent and highly frequent users of the emergency department. However, there were the following limitations to our study. The analyses of this study were conducted using data from National Health Insurance users in South Korea. National Health Insurance in South Korea does not cover medical conditions resulting from traffic accidents, worker's compensation, and suicide attempts. In addition to this, our data from NHI did not include patients under the age of 17. Due to these limitations, our findings cannot be generalized to a more niche population, for instance pediatric patients or accident-related patient groups. In addition to this, it is possible that the diagnosis rate in this study may have been more conservative due to utilization of the main physician diagnostic code that was used to categorize each emergency department visit. This study also defined the frequent ED user group as individuals who visited the emergency department 7 to 17 times during a fiscal year. It should be noted that since there is no standard for "frequent ED use", a sensitivity analysis can be conducted to better define the frequent ED user group. Overall, this study allowed for the comprehensive identification of diagnoses related to frequent ED visits in Korea. The findings of this study can serve as an important reference for future research aimed at reducing the strain placed on emergency departments by extraneous usage. In order to improve the overload on the emergency departments, non-emergency medical facilities should be utilized for minor illnesses.

## Conclusion

Future studies should focus on identifying factors specific to the social and medical needs of patients, so that patients may be directed to the appropriate care facility. More specific information on patient characteristics is important for many reasons. In countries that adopt the fee-for-service health insurance system, the findings from this study would provide implications for future restructuring of healthcare management and policies. However, it should also be noted that the tendency to use emergency departments may differ from country to country,

depending on the healthcare system that is employed. Consequently, the results of this study could also be compared to similar studies in other countries. This could potentially provide deeper insights into the relationships between different healthcare systems and health outcomes of different patient populations.

## Abbreviations

ED: emergency department; HIRA: Health Insurance Review Agency; ICD-10: 10th revision of the International Statistical Classification of Diseases; VA program: Veterans Affairs Health Care Program

## Declarations

### Acknowledgement

This work was supported by Soonchunhyang University Research Fund.

### Authors' contributions

Byeung Ki An and Suck Ju Cho managed all processes of data collection.

Sang Mi Kim took part in the statistical analysis.

Tiffany Jane Lee drafted this manuscript and suggested revisions to statistical analyses.

Joon Bum Park supervised the whole study, especially to control data processing and to correct study design and statistical errors.

### Availability of data and materials

The data of this study is not available due to security policy of Korean Health Insurance Review Agency.

### Ethics approval and consent to participate

This study protocol was reviewed and approved by the Institutional Review Board (IRB) of Public Institutional Bioethics Committee designated by the Ministry of Health and Welfare (IRB No. P01-201808-21-004).

### Consent for publication

Not applicable

### Competing interests

The authors declare that they have no competing interests.

## References

1. Medical Insurance Financial Status [http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx\\_cd=2763](http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=2763) [accessed 29 May 2020]
2. Brown EM, Goel V. Factors related to emergency department use: results from the Ontario health survey 1990. *Ann Emerg Med* 1994;24:1083-91. <https://doi.org/10.1166/as.1994.24.5.1083>

3. Hunt KA, Weber EJ, Showstack JA, et al. Characteristics of frequent users of emergency departments. *Ann Emerg Med* 2006;48:1-8. <https://doi.org/10.1016/j.semerg.2018.05.009>
4. Ovens HJ, Chan BT. Heavy users of emergency services: a population-based review. *CMAJ* 2001;165:1049-50.
5. Malone RE. Heavy users of emergency services: social construction of a policy problem. *Soc Sci Med* 1995;40:469-77. [https://doi.org/10.1016/0277-9536\(94\)e0116-a](https://doi.org/10.1016/0277-9536(94)e0116-a)
6. Malone RE. Whither the almshouse? overutilization and the role of the emergency department. *J Health Polit Policy Law* 1998;23: 795-832. <https://doi.org/10.1215/03616878-23-5-795>
7. Spillane LL, Lumb EW, Cobaugh DJ, et al. Frequent users of the emergency department: can we intervene? *Acad Emerg Med* 1997;4:574-80. <https://doi.org/10.1111/j.1553-2712.1997.tb03581.x>
8. Dent AW, Phillips GA, Chenhall AJ, et al. The heaviest repeat users of an inner city emergency department are not general practice patients. *Emerg Med (Fremantle)* 2003;15:322-9. <https://doi.org/10.1046/j.1442-2026.2003.00470.x>
9. Huang JA, Tsai WC, Chen YC, et al. Factors associated with frequent use of emergency services in a medical center. *J Formos Med Assoc* 2003;102:222-8.
10. Mandelberg JH, Kuhn RE, Kohn MA. Epidemiologic analysis of an urban, public emergency department's frequent users. *Acad Emerg Med* 2000;7:637-46. <https://doi.org/10.1111/j.1553-2712.2000.tb02037.x>
11. Sandoval E, Smith S, Walter J, et al. A comparison of frequent and infrequent visitors to an urban emergency department. *J Emerg Med* 2010;38:115-21. <https://doi.org/10.1016/j.jemermed.2007.09.042>
12. Sun BC, Burstin HR, Brennan TA. Predictors and outcomes of frequent emergency department users. *Acad Emerg Med* 2003;10:320-8. <https://doi.org/10.1111/j.1553-2712.2003.tb01344.x>
13. Byrne M, Murphy AW, Plunkett PK, et al. Frequent attenders to an emergency department: a study of primary health care use, medical profile, and psychosocial characteristics. *Ann Emerg Med*. 2003;41:309-18. <https://doi.org/10.1067/mem.2003.68>
14. Jung Hoon Woo, Zachary Grinspan, Jason Shapiro, Sang Youl Rhee. Frequent Users of Hospital Emergency Departments in Korea Characterized by Claims Data from the National Health Insurance: A Cross Sectional Study. *PLoS One* 2016; 11(1): e0147450. <https://doi.org/10.1371/journal.pone.0147450>
15. Doupe MB, Palatnick W, Day S, Chateau D, Soodeen RA, Burchill C, Derksen S. Frequent users of emergency departments: developing standard definitions and defining prominent risk factors. *Ann Emerg Med* 2012 Jul;60(1):24-32. <https://doi.org/10.1016/j.annemergmed.2011.11.036>
16. SW Moon, SY Yun, HG Seong, et al. 2018 Emergency Medical System Annual Report. 1st ed. Seoul, Korea: National Emergency Medical Center; 2017.
17. Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: a statewide analysis. *Ann Emerg Med* 2006;48:9-16. <https://doi.org/10.1016/j.annemergmed.2006.03.001>
18. Kne T, Young R, Spillane L. Frequent ED users: patterns of use over time. *Am J Emerg Med* 1998;16:648-52. [https://doi.org/10.1016/s0735-6757\(98\)90166-8](https://doi.org/10.1016/s0735-6757(98)90166-8)
19. Birmingham LE, Cheruvu VK, Frey JA, Stiffler KA, VanGeest J. Distinct subgroups of emergency department frequent users: A latent class analysis. *Am J Emerg Med*.2019 Apr 13. pii: S0735-6757(19)30249-9. <https://doi.org/10.1016/j.ajem.2019.04.029>
20. Baillargeon J, Thomas CR, Williams B, et al. Medical emergency department utilization patterns among uninsured patients with psychiatric disorders. *Psychiatr Serv* 2008;59:808-11. <https://doi.org/10.1176/ps.2008.59.7.808>

21. Curran GM, Sullivan G, Williams K, et al. The association of psychiatric comorbidity and use of the emergency department among persons with substance use disorders: an observational cohort study. *BMC Emerg Med* 2008;8:17. <https://doi.org/10.1186/1471-227X-8-17>
22. Ford JG, Meyer IH, Sternfels P, et al. Patterns and predictors of asthma-related emergency department use in Harlem. *Chest* 2001;120:1129-35. <https://doi.org/10.1378/chest.120.4.1129>
23. Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. *Ann Emerg Med* 1998;32:563-8. [https://doi.org/10.1016/s0196-0644\(98\)70033-2](https://doi.org/10.1016/s0196-0644(98)70033-2)
24. Freitag FG, Kozma CM, Slaton T, et al. Characterization and prediction of emergency department use in chronic daily headache patients. *Headache* 2005;45:891-8. <https://doi.org/10.1111/j.1526-4610.2005.05157.x>
25. Griswold SK, Nordstrom CR, Clark S, et al. Asthma exacerbations in North American adults: who are the “frequent fliers” in the emergency department? *Chest* 2005;127:1579-86. <https://doi.org/10.1378/chest.127.5.1579>
26. Abelson R. Uninsured put a strain on hospitals. *The New York Times*. December 8, 2008:B1.5.
27. Jamieson D. The treatment of Kenny Farnsworth. *Washington Post*. November 11, 2009: Magazine W12.6.