The Changes in Epidemiology of Visiting Emergency Department at COVID-19

SungJoon Park

Korea University College of Medicine Department of Emergency Medicine

Young-Hoon Yoon

Korea University College of Medicine Department of Emergency Medicine

Ji Young Lee

Korea University College of Medicine Department of Emergency Medicine

Eusun Lee

Korea University College of Medicine Department of Emergency Medicine

Hong Seok Park

Korea University College of Medicine Department of Urology

Jung-Youn Kim (✉ yellowwizard@hanmail.net)

Korea University College of Medicine Department of Emergency Medicine

Research Article

Keywords: Emergency service Hospital, Pandemics, COVID-19

Posted Date: March 9th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-225651/v1>

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

Abstract

Background

On December 31, 2019, a type of pneumonia with unknown origin was reported in Wuhan, China. It was named as coronavirus disease 2019 by the World Health Organization. Several studies showed that the outbreaks of infectious diseases affect the emergency department visits. Therefore, this study aimed to identify the epidemiological characteristics of patients visiting the emergency department during the coronavirus disease outbreak.

Method

This retrospective observational study was conducted in the three tertiary emergency departments. To evaluate the general characteristics of patients visiting the emergency department, data on sex, age, date and time of visit, initial blood pressure, heart rate, respiration rate, body temperature, level of consciousness, and disposition upon discharge were collected.

Results

A total of 180,192 patients were enrolled in this study. There were 52,245 patients who visited the emergency department during the coronavirus disease outbreak (December 2019–April 2020). This number was significantly reduced compared with the 64,405 and 63,542 patients who visited during the pre-coronavirus disease period. During the period of coronavirus disease outbreak, the proportion of alert patients began to decline from February to April. Also, the proportions of patients with Korean Triage and Acuity scores 4–5 and discharged patients decreased during the same period. The number of patients who were diagnosed with “influenza because of identified seasonal influenza virus” decreased to 1,507 (2.9%), compared with the 2,131 (3.4%) and 2,157 (3.3%) patients diagnosed with this condition during the pre-coronavirus disease period.

Conclusion

The study showed changes in the patterns of emergency department visits during the coronavirus disease outbreak. During this period, the total number of patients and non-emergency patients visiting the emergency department decreased.

Introduction

On December 31, 2019, a type of pneumonia with unknown origin was reported in Wuhan, the central city and the capital of Hubei Province, China. It was reported to be caused by a novel coronavirus known as severe acute respiratory syndrome coronavirus 2 and was named as coronavirus disease 2019 (COVID-19) by the World Health Organization on February 12, 2020 (1-3).

Several strains of coronaviruses can infect humans and animals, and approximately 15%–30% of the cases of common colds are caused by a human coronavirus. Similar to severe acute respiratory syndrome coronavirus outbreak and Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak, some strains of coronaviruses that cause zoonotic infections may spread from animals to humans (4, 5). A coronavirus causes respiratory illnesses such as pneumonia and acute respiratory distress syndrome, resulting in death because of respiratory failure and sepsis (3, 6).

Generally, the epidemic is related to the basic reproduction number (R_0) and the average people infected by a person with a disease. This R_0 value only represents the average infection rate and does not reflect the individual characteristics. Therefore, even if the initial R_0 value is not high, the presence of super-spreaders can cause the epidemic (7-10). These super-spreading events occur when infected individuals who developed symptoms come in contact with other people without knowing that they are infected or when proper isolation measures have not been taken (7, 9, 11). In Korea, the initial R_0 value of COVID-19 was only 0.6 before the super-spreading event in February, and R_0 increased to 3.5 after the super-spreading event (10). In COVID-19, asymptomatic people could infect others, which raised social awareness (12, 13).

In Korea, COVID-19 was first identified on January 20, 2020, from a Chinese female tourist residing in Wuhan. After the super-spreading event around mid-February, the number of confirmed cases began to rise sharply and reached more than a thousand (10). As of June 1, 6,080,000 patients and 124,000 deaths were reported worldwide, and 11,503 patients with confirmed COVID-19 and 271 deaths were reported in Korea (14, 15).

Several studies showed that the outbreaks of infectious diseases affect the emergency department (ED) visits. During the *Escherichia coli* 0157:H7 outbreak in the United States in 1993 and the H1N1 influenza pandemic in 2009, the number of ED visits increased. During the SARS outbreak in 2003 and MERS outbreak in 2014, the number of ED visits decreased (16-19). To date, no study has evaluated the pattern of ED visits during the period of COVID-19 outbreak. Therefore, this study aimed to identify the epidemiological characteristics of patients visiting the ED during period of COVID-19 outbreak.

Methods

Design and setting

This retrospective observational study was conducted in three tertiary EDs in Korea University Hospitals. Two of these EDs are regional EDs in Seoul, and 49,994 and 64,456 patients, respectively, visited these EDs in 2019. One of these EDs is a local ED in Ansan, Gyeonggi-do and is visited by 47,933 patients each year. To examine the effect of COVID-19 on the pattern of ED visits, we collected the data of patients who visited the ED for 6 months from December 1, 2019, to April 30, 2020. This period was referred to as the COVID-19 period. The pattern of ED visits during this period was compared with that during the period from December 1, 2018, to April 30, 2019, and from December 1, 2017, to April 30, 2018, also referred to as the pre-COVID-19 period.

Ethical statement

The study protocol is performed in accordance with the relevant guidelines. The requirement for informed consent was waived by Institutional Review Board of Korea University. Because this is a retrospective observational study and the data was extracted without identifying the study participants' personal information, informed consent was not sought for the present study. This study was reviewed and approved by the Institutional Review Board of Korea University. (IRB no.: 2020GR0208).

Measurements

To evaluate the general characteristics of patients visiting ED, data on sex, age, date and time of visit, initial blood pressure, heart rate, respiration rate, body temperature, level of consciousness, and disposition upon discharge were collected. The Korean Triage and Acuity Scale (KTAS) was used as a triage tool to assess the severity. KTAS was used as a trial tool in all regional and local EDs in Korea and was divided into five levels. Individuals with KTAS scores from 1 to 3 were generally classified as emergency patients, and those with KTAS scores 4–5 were classified as non-emergency patients (20). To identify the changes in the pattern of disease of patients who visited the ED during the study period, the diagnosis was made using the International Classification of Case, 10th revision (ICD-10) codes. The extracted ICD-10 code comprised three characters, and only the primary diagnosis was recorded per one patient.

Statistical analyses

The SPSS Statistics (SPSS 20.0, IBM, Armonk, NY, USA) was used to perform all statistical analyses. The continuous variables were expressed as means $\pm$ standard deviations. and the categorical variables were expressed as frequencies (percentages). To analyze the difference between the means of the three groups, a normality test was performed using the Kolmogorov-Smirnov test, and the homogeneity of variance was checked using the Levene's test. The test results indicated a normal variance although not homogeneity, and the difference in the number of samples among the three groups was relatively large. Therefore, the analysis was performed using Welch's robust analysis of variance, and post hoc analysis was performed following the Dunnett T3 method. To identify the correlation among categorical variables, the χ^2 test was performed. A *P* value of < 0.05 was considered significant.

Results

Differences in the number of patients visiting the ED

A total of 191,217 patients visited the ED during the study period. However, patients whose visits were non-medical in nature, such as issuance of medical certificates and cancellation of reception, and those who lacked data in their medical records were included. Overall, 180,192 patients were enrolled in the study. 52,245 patients visited the ED during the COVID-19 period (December 2019–April 2020). This number was significantly reduced compared with the 64,405 and 63,542 patients who visited the ED during the pre-COVID-19 period (December 2017–April 2018 and December 2018–April 2019, respectively) (**Fig. 1**). The patterns of ED visits significantly decreased in February, March, and April (**Fig. 2**).

Changes in the characteristics of patients visiting the ED

Table 1 shows the general characteristics of each year during the study period. The mean age of patients who visited the ED during the COVID-19 period (43.5 ± 26.1) was significantly higher than those who visited the ED during the pre-COVID-19 period (40.2 ± 26.4 vs 41.1 ± 26.3) ($P < 0.001$). No significant difference was observed in the annual number of patients who visited the ED during the study period between sexes ($P = 0.0756$). However, significant differences were observed in the visiting reason with a medical or non-medical disease, the level of consciousness, initial KTAS, and disposition ($P < 0.001$). Approximately 77.3% of the patients had medical illness during the COVID-19 period. This proportion increased compared with those (74.0% and 75.1%) reported during the pre-COVID-19 period. The proportion of alert patients during the COVID-19 period was around 94.2%, which was lower than those who visited the ED (95.5% and 95.3%) during the pre-COVID-19 period. Approximately 37.3% of the patients had KTAS scores 4–5 during the COVID-19 period, which was lower than those (42.1% and 41.6%) reported during pre-COVID-19 period. In contrast, the proportion of admission during the COVID-19 period increased to 23.3%, compared with those (19.5% and 20.9%) reported during the pre-COVID-19 period (**Table 1**).

During the COVID-19 period, the proportion of alert patients started to decline from February to April (**Fig. 3**). In addition, the proportion of patients with KTAS scores 4–5 and discharged patients decreased during the same period (**Fig. 4–5**). However, the mean ages of patients who visited the ED increased during the same period (**Fig. 6**). Comparing the pattern of patients visiting the ED by time zone, the number of patients coming to the ED decreased during COVID-19 period. Especially in the morning (6:00 to 12:00), afternoon (12:00 to 18:00), and evening (18:00 to 00:00). At night time (0:00 to 6:00), the decrease was also shown but not much as other times. (**Fig. 7**).

Changes in the patterns of disease in patients visiting the ED

The three most common diagnoses prompting an ED visit during the COVID-19 period and pre-COVID-19 period were “abdominal and pelvis pain,” “fever of other and unknown origin,” and “open wound in the head” and remained unchanged during the study period. During the COVID-19 period, the number of patients who were diagnosed with “influenza because of an identified seasonal influenza virus” decreased (1,507 (2.9%)), compared with those (2131 (3.4%) and 2157 (3.3%)) reported in the pre-COVID-19 period. Some patients were diagnosed with “influenza because of an identified seasonal influenza virus” among the top 10 diagnoses after February during the pre-COVID-19 period. However, there were no included diagnostic cases after February in COVID-19 period. “Other gastroenteritis and colitis of infectious and unspecified origin,” which was included in the top 10 diagnoses prompting an ED visit during the pre-COVID-19 period, was not included in the top 10 diagnoses during the COVID-19 period. Furthermore, “other sepsis” was initially included in the top 10 diagnoses after February during the COVID-19 period, although not in the top 10 diagnoses during the pre-COVID-19 period (**Table 2**).

Discussion

This is the first study to show the changes in the characteristics of patients visiting the ED during the COVID-19 period. During the COVID-19 period, the total number of patients visiting the ED decreased, and the proportion of patients who visited the ED because of a disease increased. The number of patients with a KTAS score 4–5 that was classified as non-emergency patients, and the proportion of alert patients decreased. The rate of admission increased during the COVID-19 period. These

trends had stood out since February when the number of patients were strikingly increased. From March 22 to May 5 in 2020, the government implemented “social distancing,” but there was no obvious difference compared with that in February.

Worldwide, non-emergency patients who do not need to visit the ED were markedly increased. Some studies reported that 30%–50% of the patients who visited the ED are classified as non-emergency patients (21-25). The same situation was reported in this study. About 42% of patients were classified as non-emergency patients (KTAS scores 4–5) during the pre-COVID-19 period. However, the number of non-emergency patients decreased during the COVID-19 period.

During the SARS outbreak in 2009, the infection spread in the hospital. Similarly, when MERS outbreak occurred in Korea in 2015, one patient with confirmed MERS infected 81 patients in the ED (7, 9, 19). The super-spreading event also occurred during the COVID-19 period. Before patient #31 was confirmed of having the infection in February 18, only 30 had confirmed COVID-19. However, the number of COVID-19 patients in North Gyeongsang Province (NGP) and Daegu dramatically increased after patient #31 visited Daenam Hospital in NGP and Shincheonji Church in Daegu before the infection was confirmed. On February 26, 1,146 patients were reported, exceeding 1,000 patients for the first time (5, 10). Because of the high infectivity of COVID-19 and possible infection from non-specific people, EDs and hospitals are no longer considered as a safe place. Instead, they are considered as a hot zone (19, 26). Therefore, non-emergency patients were thought to have fewer visits to the ED. The reduction in ED visits among non-emergency patients suggests an increase in admission rates and decrease in the number of alert patients visiting the ED.

In Korea, the incidence of influenza showed bimodal patterns during winter and spring. In our study, the number of influenza cases decreased since February during the COVID-19 period. Similarly, Noh et al. reported that influenza rarely occurred during the spring of 2020 (27). During the COVID-19 period, the number of individuals wearing mask increased, and hand hygiene practices improved (27, 28). These behaviors were thought to have helped prevent influenza. In our study, the number of sepsis patients increased since February during the COVID-19 period. This finding is possibly because of the overall decrease in the proportion of non-emergency patients. Because many people stay at home and are not performing any outdoor activities because of fear of acquiring COVID-19, the number of patients visiting the ED because of trauma has decreased (28).

Some studies showed a difference in the number of patients and severity of the condition of patients visiting the ED according to the daily cycle (21, 25). In our study, we also showed that the overall number of patients visiting the ED decreased after the super-spreading event occurred during the COVID-19 period compared to the pre-COVID-19 period. Moreover, at night time, the decrease was lesser than other times. This relatively less reduction in the number of COVID-19 cases at night may be because of the fact that there is no other place where the patient can be treated during this time of the day.

This study has the following limitations. First, only three university hospitals in Seoul and Gyeonggi Province were involved. Hence, our results do not reflect the statistics of all ED patients in Korea. Second, only one primary diagnosis was recorded; it does not involve all accompanying diagnoses. In some cases, the sub-diagnosis is important. However, in the ED, the patient is classified mainly according to their primary diagnosis. This study only analyzed the overall trend; hence, it would not have significantly affected our results.

In conclusion, this study showed changes in the patterns of ED visits during the COVID-19 outbreak. During this period, the total number of patients and non-emergency patients visiting the ED decreased. However, the COVID-19 outbreak still persists. Further research is needed to determine whether these results will remain the same or will change because of the characteristics of local EDs.

Declarations

Ethics approval and consent to participate

The study protocol is performed in accordance with the relevant guidelines. The requirement for informed consent was waived by Institutional Review Board of Korea University. Because this is a retrospective observational study and the data was

extracted without identifying the study participants' personal information, informed consent was not sought for the present study. This study was reviewed and approved by the Institutional Review Board of Korea University. (IRB no.: 2020GR0208).

Consent for publication

Not Applicable

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to our IRB approval that the patient's data can only be used for this study and reuse is not allowed but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research was supported by R&D Platform Project through the Korea University Medical Center and Korea University Guro Hospital, funded by the Korea University Guro Hospital (Grant number : O1905201)

Authors' contributions

Conceptualization: Park HS. Data curation: Lee ES. Formal analysis: Park SJ. Funding acquisition: Kim JY. Investigation: Lee JY. Methodology: Yoon YH. Software: Lee JY. Validation: Park HS, Yoon YH. Visualization: LEE ES. Writing - original draft: Park SJ. Writing - review & editing: Kim JY.

Acknowledgements

Not applicable

References

1. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med*. 2020;382(13):1199-207.
2. World Health O. Novel Coronavirus (2019-nCoV): situation report, 22. Geneva: World Health Organization; 2020 2020-02-11.
3. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *The Lancet*. 2020;395(10229):1054-62.
4. Fung TS, Liu DX. Human Coronavirus: Host-Pathogen Interaction. *Annu Rev Microbiol*. 2019;73:529-57.
5. Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, et al. Current Status of Epidemiology, Diagnosis, Therapeutics, and Vaccines for Novel Coronavirus Disease 2019 (COVID-19). *J Microbiol Biotechnol*. 2020;30(3):313-24.
6. Peiris JSM, Lai ST, Poon LLM, Guan Y, Yam LYC, Lim W, et al. Coronavirus as a possible cause of severe acute respiratory syndrome. *The Lancet*. 2003;361(9366):1319-25.
7. Yu IT, Xie ZH, Tsoi KK, Chiu YL, Lok SW, Tang XP, et al. Why did outbreaks of severe acute respiratory syndrome occur in some hospital wards but not in others? *Clin Infect Dis*. 2007;44(8):1017-25.
8. Hsieh YH. 2015 Middle East Respiratory Syndrome Coronavirus (MERS-CoV) nosocomial outbreak in South Korea: insights from modeling. *PeerJ*. 2015;3:e1505.
9. Kim SW, Park JW, Jung HD, Yang JS, Park YS, Lee C, et al. Risk factors for transmission of Middle East respiratory syndrome coronavirus infection during the 2015 outbreak in South Korea. *Clin Infect Dis*. 2017;64(5):551-7.

10. Choi S, Ki M. Estimating the reproductive number and the outbreak size of COVID-19 in Korea. *Epidemiol Health*. 2020;42:e2020011.
11. Kang CK, Song KH, Choe PG, Park WB, Bang JH, Kim ES, et al. Clinical and Epidemiologic Characteristics of Spreaders of Middle East Respiratory Syndrome Coronavirus during the 2015 Outbreak in Korea. *J Korean Med Sci*. 2017;32(5):744-9.
12. Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, et al. Presumed Asymptomatic Carrier Transmission of COVID-19. *JAMA*. 2020.
13. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, et al. Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *N Engl J Med*. 2020;382(10):970-1.
14. KCDC COVID-19 situation reports in South Korea. Available from <https://www.cdc.go.kr/board/board.es?mid=a20501000000&bid=0015>. Accessed 24 JUL. 2020.
15. WHO Coronaviurs Disease (COVID-19) Dashboard. Available from https://covid19.who.int/?gclid=CjwKCAjwq832BRA5EiwACvCWsXBHyDVozyaYdyrcqHetclEnMlCkmUZTlr4hl31cqDtaaP_rDp4QKhoClwYQAvD_BwE. Accessed 24 JUL. 2020.
16. Del Beccaro MA, Brownstein DR, Cummings P, Goldoft MJ, Quan L. Outbreak of Escherichia coli O157:H7 hemorrhagic colitis and hemolytic uremic syndrome: effect on use of a pediatric emergency department. *Ann Emerg Med*. 1995;26(5):598-603.
17. Heiber M, Lou WY. Effect of the SARS outbreak on visits to a community hospital emergency department. *CJEM*. 2006;8(5):323-8.
18. McDonnell WM, Nelson DS, Schunk JE. Should we fear "flu fear" itself? Effects of H1N1 influenza fear on ED use. *Am J Emerg Med*. 2012;30(2):275-82.
19. Paek SH, Kim DK, Lee JH, Kwak YH. The Impact of Middle East Respiratory Syndrome Outbreak on Trends in Emergency Department Utilization Patterns. *J Korean Med Sci*. 2017;32(10):1576-80.
20. Kwon H, Kim YJ, Jo YH, Lee JH, Lee JH, Kim J, et al. The Korean Triage and Acuity Scale: associations with admission, disposition, mortality and length of stay in the emergency department. *Int J Qual Health Care*. 2019;31(6):449-55.
21. Carret ML, Fassa AG, Kawachi I. Demand for emergency health service: factors associated with inappropriate use. *BMC Health Serv Res*. 2007;7:131.
22. McKenna P, Heslin SM, Viccellio P, Mallon WK, Hernandez C, Morley EJ. Emergency department and hospital crowding: causes, consequences, and cures. *Clin Exp Emerg Med*. 2019;6(3):189-95.
23. Bardelli P, Kaplan V. Non-urgent encounters in a Swiss medical emergency unit. *Swiss Med Wkly*. 2013;143:w13760.
24. McCormack LA, Jones SG, Coulter SL. Demographic factors influencing nonurgent emergency department utilization among a Medicaid population. *Health Care Manag Sci*. 2017;20(3):395-402.
25. Bahadori M, Mousavi SM, Teymourzadeh E, Ravangard R. Emergency department visits for non-urgent conditions in Iran: a cross-sectional study. *BMJ Open*. 2019;9(10):e030927.
26. Harper CA, Satchell LP, Fido D, Latzman RD. Functional Fear Predicts Public Health Compliance in the COVID-19 Pandemic. *Int J Ment Health Addict*. 2020:1-14.
27. Noh JY, Seong H, Yoon JG, Song JY, Cheong HJ, Kim WJ. Social Distancing against COVID-19: Implication for the Control of Influenza. *J Korean Med Sci*. 2020;35(19):e182.
28. Huang Y, Wu Q, Wang P, Xu Y, Wang L, Zhao Y, et al. Measures Undertaken in China to Avoid COVID-19 Infection: Internet-Based, Cross-Sectional Survey Study. *J Med Internet Res*. 2020;22(5):e18718.

Tables

Table 1. The demographic and epidemiological characteristics of pre-COVID-19 period (2017.12 – 2018.04, 2018.12 – 2019.04) and COVID-19 period (2019.12 - 2020.04)

Characteristic	2017.12 - 2018.04	2018.12 - 2019.04	2019.12 - 2020.04	p-value
Number of Patients, n	64,405	63,542	52,245	
Age (year), Mean $\pm$ SD	40.2 $\pm$ 26.4	41.1 $\pm$ 26.3	43.5 $\pm$ 26.1	<0.001
Gender				0.756
Male, n (%)	32790 (50.9%)	32481 (51.1%)	26633 (51.0%)	
Reason for visiting				< 0.001
Medical disease, n (%)	47680 (74.0%)	47692 (75.1%)	40360 (77.3%)	
None-medical disease, n (%)	16725 (26.0%)	15850 (24.9%)	11885 (22.7%)	
Consciousness				<0.001
Alert, n (%)	61489 (95.5%)	60586 (95.3%)	49217 (94.2%)	
Verbal, n (%)	1534 (2.4%)	1596 (2.5%)	1609 (3.1%)	
Pain, n (%)	977 (1.5%)	987 (1.6%)	1022 (2.0%)	
Unresponse, n (%)	405 (0.6%)	373 (0.6%)	397 (0.8%)	
Initial KTAS				< 0.001
KTAS 1, n (%)	749 (1.2%)	697 (1.1%)	732 (1.4%)	
KTAS 2, n (%)	4074 (6.3%)	3761 (5.9%)	3644 (7.0%)	
KTAS 3, n (%)	32440 (50.4%)	32697 (51.5%)	28379 (54.3%)	
KTAS 4, n (%)	19279 (29.9%)	19414 (30.6%)	14644 (28.0%)	
KTAS 5, n (%)	7863 (12.2%)	6973 (11.0%)	4846 (9.3%)	
SBP (mmHg), Mean $\pm$ SD	130.8 $\pm$ 24.5	132.5 $\pm$ 25.0	134.9 $\pm$ 25.6	<0.001
DBP (mmHg), Mean $\pm$ SD	79.6 $\pm$ 14.9	79.3 $\pm$ 15.4	80.8 $\pm$ 15.7	<0.001
RR (rate), Mean $\pm$ SD	21.7 $\pm$ 4.9	21.4 $\pm$ 4.8	20.7 $\pm$ 5.0	<0.001
HR (rate), Mean $\pm$ SD	96.8 $\pm$ 25.2	96.4 $\pm$ 24.7	96.4 $\pm$ 24.9	0.006
BT ($^{\circ}$ C), Mean $\pm$ SD	36.8 $\pm$ 1.7	36.8 $\pm$ 1.6	36.8 $\pm$ 1.8	0.001
Disposition				<0.001
Admission, n (%)	12528 (19.5%)	13277 (20.9%)	12156 (23.3%)	
Transfer out, n (%)	1645 (2.6%)	1573 (2.5%)	1235 (2.4%)	
Expire, n (%)	302 (0.5%)	294 (0.5%)	304 (0.6%)	

Discharge, n (%)	49394 (76.7%)	48009 (75.6%)	38214 (73.1%)
Escape, n (%)	536 (0.8%)	389 (0.6%)	336 (0.6%)

P values were obtained using the χ^2 test for categorical variables, and the Welch's robust ANOVA for continuous variables.

KTAS, Korean Triage and Acuity Scale; SBP, systolic blood pressure; DBP, diastolic blood pressure; RR, respiration rate; HR, heart rate; BT, body temperature

Table 2. Monthly the top ten most common diagnoses for five months beginning every December from 2017 to 2019.

	2017.12	2018.01	2018.02	2018.03	2018.04
1	Fever of other and unknown origin (946, 6.6%)	Influenza due to identified seasonal influenza virus (973, 7.3%)	Abdominal and pelvic pain (939, 7.7%)	Abdominal and pelvic pain (874, 7.1%)	Fever of other and unknown origin (936, 7.5%)
2	Abdominal and pelvic pain (904, 6.3%)	Abdominal and pelvic pain (968, 7.3%)	Open wound of head (758, 6.2%)	Open wound of head (780, 6.4%)	Abdominal and pelvic pain (841, 6.8%)
3	Open wound of head (879, 6.2%)	Fever of other and unknown origin (918, 6.9%)	Fever of other and unknown origin (743, 6.1%)	Fever of other and unknown origin (682, 5.6%)	Open wound of head (726, 5.8%)
4	Influenza due to identified seasonal influenza virus (713, 5.0%)	Open wound of head (723, 5.4%)	Other gastroenteritis and colitis of infectious and unspecified origin (478, 3.9%)	Other gastroenteritis and colitis of infectious and unspecified origin (444, 3.6%)	Superficial injury of head (423, 3.4%)
5	Other gastroenteritis and colitis of infectious and unspecified origin (701, 4.9%)	Other gastroenteritis and colitis of infectious and unspecified origin (505, 3.8%)	Dizziness and giddiness (385, 3.2%)	Dizziness and giddiness (429, 3.5%)	Dizziness and giddiness (406, 3.3%)
6	Dizziness and giddiness (439, 3.1%)	Dizziness and giddiness (428, 3.2%)	Influenza due to identified seasonal influenza virus (339, 2.8%)	Pain in throat and chest (394, 3.2%)	Pain in throat and chest (352, 2.8%)
7	Pain in throat and chest (405, 2.8%)	Pain in throat and chest (357, 2.7%)	Pain in throat and chest (333, 2.7%)	Superficial injury of head (372, 3.0%)	Other gastroenteritis and colitis of infectious and unspecified origin (348, 2.8%)
8	Nausea and vomiting (333, 2.3%)	Superficial injury of head (306, 2.3%)	Superficial injury of head (329, 2.7%)	Open wound of wrist and hand (270, 2.2%)	Headache (256, 2.1%)
9	Superficial injury of head (324, 2.3%)	Nausea and vomiting (284, 2.1%)	Open wound of wrist and hand (223, 1.8%)	Headache (246, 2.0%)	Open wound of wrist and hand (219, 1.8%)
10	Headache (278, 2.0%)	Headache (259, 1.9%)	Nausea and vomiting (218, 1.8%)	Nausea and vomiting (202, 1.6%)	Convulsions, not elsewhere classified (207, 1.7%)
	2018.12	2019.01	2019.02	2019.03	2019.04
1	Fever of other and unknown origin (1106, 7.7%)	Abdominal and pelvic pain (956, 7.8%)	Abdominal and pelvic pain (1007, 8.7%)	Abdominal and pelvic pain (1072, 8.5%)	Fever of other and unknown origin (1006, 7.8%)
2	Influenza due to identified seasonal influenza virus (1054, 7.4%)	Fever of other and unknown origin (796, 6.5%)	Open wound of head (683, 5.9%)	Fever of other and unknown origin (839, 6.7%)	Abdominal and pelvic pain (975, 7.6%)
3	Abdominal and pelvic pain (969, 6.8%)	Open wound of head (751, 6.1%)	Fever of other and unknown origin (665, 5.7%)	Open wound of head (744, 5.9%)	Open wound of head (832, 6.5%)
4	Open wound of head (817, 5.7%)	Other gastroenteritis and colitis of infectious and unspecified origin (453, 3.7%)	Dizziness and giddiness (419, 3.6%)	Dizziness and giddiness (448, 3.6%)	Dizziness and giddiness (488, 3.8%)

5	Other gastroenteritis and colitis of infectious and unspecified origin (544, 3.8%)	Pain in throat and chest (406, 3.3%)	Other gastroenteritis and colitis of infectious and unspecified origin (359, 3.1%)	Pain in throat and chest (356, 2.8%)	Influenza due to identified seasonal influenza virus (418, 3.2%)
6	Dizziness and giddiness (442, 3.1%)	Dizziness and giddiness (397, 3.2%)	Pain in throat and chest (352, 3.0%)	Superficial injury of head (346, 2.8%)	Pain in throat and chest (393, 3.1%)
7	Pain in throat and chest (351, 2.5%)	Superficial injury of head (307, 2.5%)	Headache (261, 2.3%)	Other gastroenteritis and colitis of infectious and unspecified origin (297, 2.4%)	Other gastroenteritis and colitis of infectious and unspecified origin (365, 2.8%)
8	Superficial injury of head (304, 2.1%)	Influenza due to identified seasonal influenza virus (305, 2.5%)	Superficial injury of head (255, 2.2%)	Open wound of wrist and hand (284, 2.3%)	Superficial injury of head (338, 2.6%)
9	Headache (273, 1.9%)	Headache (258, 2.1%)	Pain, not elsewhere classified (236, 2.0%)	Headache (259, 2.1%)	Headache (297, 2.3%)
10	Open wound of wrist and hand (268, 1.9%)	Abnormalities of breathing (230, 1.9%)	Open wound of wrist and hand (225, 1.9%)	Abnormalities of breathing (255, 2.0%)	Open wound of wrist and hand (261, 2.0%)
	2019.12	2020.01	2020.02	2020.03	2020.04
1	Fever of other and unknown origin (1186, 8.9%)	Abdominal and pelvic pain (1340, 9.6%)	Abdominal and pelvic pain (748, 8.7%)	Abdominal and pelvic pain (715, 9.0%)	Abdominal and pelvic pain (719, 8.5%)
2	Abdominal and pelvic pain (1178, 8.8%)	Fever of other and unknown origin (1238, 8.9%)	Fever of other and unknown origin (732, 8.5%)	Fever of other and unknown origin (687, 8.6%)	Fever of other and unknown origin (669, 7.9%)
3	Open wound of head (839, 6.3%)	Influenza due to identified seasonal influenza virus (821, 5.9%)	Open wound of head (502, 5.8%)	Open wound of head (496, 6.2%)	Open wound of head (545, 6.5%)
4	Influenza due to identified seasonal influenza virus (633, 4.8%)	Open wound of head (683, 4.9%)	Dizziness and giddiness (294, 3.4%)	Pain in throat and chest (300, 3.8%)	Dizziness and giddiness (283, 3.4%)
5	Dizziness and giddiness (405, 3.0%)	Pain, not elsewhere classified (498, 3.6%)	Pain, not elsewhere classified (285, 3.3%)	Dizziness and giddiness (284, 3.6%)	Pain in throat and chest (273, 3.2%)
6	Pain in throat and chest (399, 3.0%)	Dizziness and giddiness (437, 3.1%)	Pain in throat and chest (269, 3.1%)	Abnormalities of breathing (262, 3.3%)	Other sepsis (199, 2.4%)
7	Nausea and vomiting (323, 2.4%)	Pain in throat and chest (431, 3.1%)	Abnormalities of breathing (217, 2.5%)	Pain, not elsewhere classified (188, 2.4%)	Pain, not elsewhere classified (199, 2.4%)
8	Superficial injury of head (309, 2.3%)	Nausea and vomiting (355, 2.6%)	Other sepsis (215, 2.5%)	Other sepsis (187, 2.3%)	Headache (196, 2.3%)
9	Pain, not elsewhere classified (294, 2.2%)	Adverse effects, not elsewhere classified (274, 2.0%)	Headache (182, 2.1%)	Headache (155, 1.9%)	Open wound of wrist and hand (196, 2.3%)
10	Abnormalities of breathing	Abnormalities of breathing	Superficial injury of head	Open wound of wrist and hand	Abnormalities of breathing

(275, 2.1%)

(265, 1.9%)

(175, 2.0%)

(149, 1.9%)

(190, 2.2%)

Values are presented as diagnosis (number, %)

Figures

Figure 1

Study population ED, emergency department.

Figure 2

Monthly patients visiting the ED for five months beginning every December from 2017 to 2019. ED, emergency department.

Figure 3

The number of patients visiting the ED each month according to the level of consciousness for five months beginning every December from 2017 to 2019. ED, emergency department.

Figure 4

The number of patients visiting the ED each month according to the KTAS level for five months beginning every December from 2017 to 2019. ED, emergency department; KTAS, Korean Triage and Acuity Scale.

Figure 5

The number of patients visiting the ED each month according to the disposition when discharged from the ED for five months beginning every December from 2017 to 2019. ED, emergency department.

Figure 6

The mean age of patients visiting the ED each month for five months beginning every December from 2017 to 2019. ED, emergency department. Data are presented as mean (SD). *P < 0.05.

Figure 7

The number of patients visiting the ED by time zone each month during three years. (A) December, (B) January, (C) February, (D) March, (E) April. ED, emergency department.