한국응급구조학회지 제26권 제1호, 151～166 (2022. 04)
Korean J Emerg Med Ser Vol. 26, No. 1, 151～166 (2022. 04)
The Korean Journal of Emergency Medical Services

ISSN 1738-1606 (Print)
ISSN 2384-2091 (Online)
https://doi.org/10.14408/KJEMS.2022.26.1.151

응급실에 내원한 환자의 한국형 중증도 분류 결과

장경민[1*]

[1]부천대학교 간호학과

Comparative length of emergency department stay of patients with different Korean Triage and Acute Scale severities: A descriptive analysis

Kyeongmin Jang[1*]

[1]Department of Nursing, Bucheon University

=Abstract=

Purpose: The severity classification in association with the time of visit to and the appropriateness of using a public ambulance for visiting the emergency department (ED) have not been thoroughly evaluated, and we aimed to evaluate these aspects.

Methods: In this descriptive research, we retrospectively reviewed and analyzed the medical records of patients who visited the ED of the B General Hospital, Seoul from January to December 2019.

Results: Of the 54,297 patients who were included in the analysis, 34,629 (63.8%) and 14,065 (25.9%) visited the ED directly and through public ambulances, respectively; 10,328 (73.4%) patients who used public ambulances were discharged home. In the daytime and nighttime, 24,891 (45.8%) and 29,406 (54.2%), respectively, visited the ED. The mean length of ED stay (LoS) of emergency and non-emergency patients was 326 and 159 minutes, respectively, and of patients classified as Korean Triage and Acuity Scale levels 1 and 2 was 427 and 430 minutes, respectively, which was longer than the total of 236 minutes.

Conclusion: Patients who visited the ED using public ambulances constituted nearly 25% of all ED visits, and more than 70% of these patients were discharged home. Patients with high severity had a longer mean LoS, and daytime ED visits were characterized by higher numbers and severity of patients than nighttime ED visits.

Keywords: Triage, Severity, Emergency department

Received November 16, 2021 Revised March 29, 2022 Accepted April 26, 2022

*Correspondence to Kyeongmin Jang

Department of Nursing, Bucheon University, 56, Sosa-ro, Bucheon-si, Gyeonggi-do, Republic of Korea

Tel: +82-32-610-8313 E-mail: jkm@bc.ac.kr

Ⅰ. Introduction

In the emergency department (ED), it is important to classify the severity of injury or disease via a primary evaluation of the patient's condition so that safe and timely treatment can be provided according to their clinical condition [1]. Classification of emergency patients is essential to identify patients who do not need priority intervention and to optimize limited emergency medical resources for priority application to patients who need immediate treatment [2]. Accordingly, most EDs throughout the world classify patients based on the severity of their condition. The most widely used emergency triage systems in the world today include the Emergency Severity Index (ESI), Manchester Triage System (MTS), Australian Triage System (ATS), and Canadian Triage and Acuity Scale (CTAS). The ESI is a triage system that was developed and implemented by Weurtz et al. in 2001 to address the problems of the 3rd and 4th level triage systems [3], with a particular focus on screening non-emergency patients, so as to reach and verify high agreement among evaluators [4]. MTS is a triage system developed in the UK in 1994, and its reliability has been proven through several studies [5, 6]. ATS is a 5-level triage system developed by the Australian College for Emergency Medicine (ACEM) in 1993; the minimum waiting time for each level is presented and reliability between evaluators has been proven [7]. In addition, CTAS is a comprehensive triage system developed by the Canadian Association of Emergency Physicians (CAEP) in 1999 based on ATS in Australia and modified and developed to suit Canada [8].

KTAS is a five-stage emergency patient classification system developed as a research project by the Ministry of Health and Welfare in 2012 by revising and supplementing it according to the situation in Korea based on CTAS [9]. Since January 2016, all EDs have classified emergency patients using KTAS, according to the revised Emergency Medical Service Act [9]. Since the KTAS triage system began to classify emergency patients, many studies have been conducted to verify reliability and validity [10, 11], and evaluate inter-rater agreement [12, 13] and the accuracy of classification [14, 15]. However, there is a lack of research on the characteristics of patients using public ambulances, their triage acuity by time of day, the lengths of stay, and treatment requirements based on acuity [16, 17]. About 25% of patients who visited the ED using a public ambulance were classified as non-emergency [18], and, according to some reports, 16% were mild patients who did not need to be transported to the hospital [19]. In addition, there was a difference in the number of patients according to the ED visit time [20, 21], and there was a difference in the severity classification result according to the visit time [22].

Therefore, this study attempted to determine the percentage of patients who visited an ED using public ambulances, and b) their severity and length of ED stay (LoS). In addition, we

would like to suggest an appropriate number of emergency medical personnel by grasping the LoS according to the severity and the number of visiting patients according to the time period.

Ⅱ. Methods

1. Study design

This study is a descriptive research study that retrospectively reviewed and analyzed Electronic Medical Records (EMR) for patients who visited the ED of a general hospital in Seoul, Korea.

2. KTAS (Korean Triage and Acuity Scale)

The emergency patient classification process using KTAS is divided into four stages [23]. In the first stage, the age of the patient is over 15 years old and under 15 years old. Next, the chief complaint is selected by identifying the symptoms (including past history) that complain of, and the main symptoms are composed of 17 major categories (stage 2) including 155 sub-categories (3 stages), and the respiratory condition representing the main symptoms. Hemodynamic status such as blood pressure and pulse, level of consciousness, body temperature, pain, hemorrhagic predisposition, accident mechanism, etc, and selecting one of the sub-classification (step 4) items will determine the level.

The severity is divided into levels 1 to 5. Level 1 is a life-threatening situation that requires active treatment and corresponds to patients who need immediate medical attention. Level 2 refers to a situation where there is a potential threat to life and requires quick treatment according to a doctor or medical instruction, and it is a principle that a doctor treats within 15 minutes. Level 3 refers to a condition that has the potential to progress to a serious problem requiring first aid and requires a doctor to treat it within 30 minutes. Level 4 refers to a condition that can be treated or re-evaluated within an hour or two when considering the patient's age, pain, and the likelihood of deterioration. It is a principle that a doctor treats within 60 minutes. And Level 5 refers to a condition that is acute but not urgent (e.g. a light wound, medication, etc.) or is considered to be part of a chronic problem that has deteriorated or remains unchanged, and in principle is to be treated by a physician within 120 minutes [23].

3. Setting and sample

This study was conducted on patients who visited the ED of the B general hospital in Seoul for one year from January to December 2019, and excluded this study when the data needed for statistical analysis were insufficient or inaccurate. Finally, a total of 54,297 patients were included in the study.

4. Data collection

The collection of study data was approved by the Institutional Review Board of B general hospital to which the researcher belongs, and

the Medical Information Center was requested to provide the data with personal information in accordance with the form of the evidentiary records. We collected the EMR of patients who had visited the ED during the period corresponding to the study and excluded them if details in the EMR that were needed for statistical analysis were missing or insufficient. The data collected included age, sex, ED time of visits, mode of arrival, visiting type, medical results, LoS, and initial severity classification results. In the classification of disease and trauma, if there is a clear history of trauma, it is classified as trauma, otherwise it is classified as a disease.

5. Ethical considerations

This study was approved by the B Medical Center Institutional Review Board. The collected data were used for research purposes only and will be managed and destroyed in accordance with management standards and related laws.

6. Statistical analysis

The collected data were analyzed using SPSS for Windows (version 26; Chicago, Illinois) software. Descriptive analyses were used to report frequencies and percentages for categorical variables and the mean ± standard deviation for continuous variables. A Chi-square test and Fisher's exact test were conducted to confirm the KTAS classification results and disposition while in the ED according to the modes of ED visit and duty hours. An independent t test was used to compare the mean LoS according to KTAS classification and was considered statistically significant at $p<.05$.

Ⅲ. Results

1. General characteristics of the study participants

The total number of patients included in this study was 54,297, and 26,996 (49.7%) were women 〈Table 1〉. The average age was 46.6 years and, based on the KTAS classification, 13,987 (25.7%) were under 15 years of age, and 16,626 (30.6%) were over 65 years. In addition, the mean LoS for all patients was 236.74 minutes. When the ED visit time was divided into daytime (09:00 - 18:00) and nighttime (18:01~next day 08:59), the number of patients visiting was 24,891 (45.8%) and 29,406 (54.2%), respectively. In addition, with regard to mode of ED arrival, 34,629 (63.8%) patients visited directly, 14,065 (25.9%) patients used public ambulances, 1,558 (2.9%) patients were referred from OPD, 3,712 (6.8%) patients referred by other medical institutions, and 333 patients were in other modes. Using the initial KTAS classification, level 1 consisted of 919 patients (1.7%); 5,236 (9.6%) were classified as level 2; 19,098 (35.2%) as level 3; 24,756 (45.6%) at level 4; and 4,298 (7.9%) at level 5. In the emergency and non-emergency classification according to KTAS, 25,423 (46.5%) patients were classified as emergency

Table 1. General characteristics of study subjects

Characteristics	Categories	n (%) or mean (SD*)
Gender	Male	26,996 (49.7)
	Female	27,301 (50.3)
Age	All	54,297 (100.0)
	0~5	5,725 (10.5)
	0~14	8,262 (15.2)
	0~17	8,942 (16.5)
	18~64	28,729 (52.9)
	65~	16,626 (30.6)
Length of ED† stay (min)		236.7 (318.0)
Visiting time 1	Day (09:00~18:00)	24,891 (45.8)
	Night (18:01~next day 08:59)	29,406 (54.2)
Visiting time 2	Day (07:00~14:59)	20,508 (37.8)
	Evening (15:00~10:29)	20,802 (38.3)
	Night (10:30~next day 06:59)	12,987 (23.9)
Mode of arrival	Direct visit	34,629 (63.8)
	Public ambulances	14,065 (25.9)
	Via OPD‡	1,558 (2.9)
	Referred-in	3,712 (6.8)
	Etc.	333 (0.6)
Visiting type	Disease	42,336 (78.0)
	Accident	11,957 (22.0)
Medical results	Discharged home	43,029 (79.2)
	Referred-out	915 (1.7)
	Hospitalized	10,017 (18.4)
	Dead (include DOA?)	263 (0.5)
	Disappear (Escape)	73 (0.1)
Initial KTAS§	KTAS level 1	919 (1.7)
	KTAS level 2	5,236 (9.6)
	KTAS level 3	19,098 (35.2)
	KTAS level 4	24,756 (45.6)
	KTAS level 5	4,298 (7.9)
Emergency vs. non-emergency	Initial KTAS level 1, 2, and 3	25,243 (46.5)
	Initial KTAS level 4 and 5	29,054 (53.5)

*SD=standard deviation; †ED=emergency department; ‡OPD=out-patient department; §KTAS=Korean triage and acuity scale; ?DOA=deathonarrival

corresponding to KTAS levels 1, 2, and 3; and 29,054 (53.5%) patients were classified as non-emergency corresponding to KTAS levels 4 and 5.

2. Initial KTAS classification results and disposition at the ED according to the modes of ED arrival

〈Table 2〉 shows the KTAS classification results and disposition at the ED according to the modes of arrival at the ED. The results of the initial KTAS classification according to the modes of ED arrival show that, in the case of direct visits, KTAS levels 3 and 4 accounted for most of the patients: 9,991 (18.4%) and 19,846 (36.6%), respectively. In the case of public ambulances, KTAS levels 1, 2, and 3 accounted for 781 (1.4%), 3,386 (6.2%), and 6,277 (11.6%), respectively. A total of 1,558 (2.9%) patients were referred to the ED from outpatients and, of these, 828 (1.5%) were classified as KTAS level 3. Of all 3,712 (6.8%) patients who visited other medical institutions, KTAS level 3 was the highest, with 1,835 (3.4%). In addition, when looking at ED disposition according to the modes of ED arrival, in the case of a direct visit by private car or on foot, discharge and

Table 2. Results of KTAS* classification and medical examination according to the mode of arrival

Mode of arrival	Initial KTAS, n (%) (p<.001)					
	Level 1	Level 2	Level 3	Level 4	Level 5	Total
Direct visit	10 (0.0)	1,078 (2.0)	9,991 (18.4)	19,846 (36.6)	3,704 (6.8)	34,629 (63.8)
Public ambulances	781 (1.4)	3,386 (6.2)	6,277 (11.6)	3,258 (6.0)	363 (0.7)	14,065 (25.9)
OPD†	14 (0.0)	170 (0.3)	828 (1.5)	430 (0.8)	116 (0.2)	1,558 (2.9)
Referred-in	87 (0.2)	568 (1.0)	1,835 (3.4)	1,114 (2.1)	108 (0.2)	3,712 (6.8)
Etc.	27 (0.0)	34 (0.1)	159 (0.3)	106 (0.2)	7 (0.0)	333 (0.6)
Total	919 (1.7)	5,236 (9.6)	19,090 (35.2)	24,754 (45.6)	4,298 (7.9)	54,297 (100.0)
Mode of arrival	Results, n (%)					
	Discharged home	Referred-out	Hospitalized	Dead	Disappear (Escape)	Total
Direct visit	29,881 (55.0)	387 (0.7)	4,287 (7.9)	20 (0.0)	54 (0.1)	34,629 (63.8)
Public ambulances	10,328 (19.0)	331 (0.6)	3,176 (5.8)	214 (0.4)	16 (0.0)	14,065 (25.9)
OPD	811 (1.5)	13 (0.0)	731 (1.3)	1 (0.0)	2 (0.0)	1,558 (2.9)
Referred-in	1,785 (3.3)	174 (0.3)	1,744 (3.2)	8 (0.0)	1 (0.0)	3,712 (6.8)
Etc.	224 (0.4)	10 (0.0)	79 (0.1)	20 (0.0)	0 (0.0)	333 (0.6)
Total	43,029 (79.2)	915 (1.7)	10,017 (18.4)	263 (0.5)	73 (0.1)	54,297 (100.0)

*KTAS=Korean triage and acuity scale; †OPD=out-patient department

hospitalization accounted for 29,881 (55.0%) and 4,287 (7.9%), respectively. In the case of visits using public ambulances, 10,328 (19.0%) and 3,176 (5.8%) patients were discharged home and hospitalized, respectively. The results show that even when referred to ED from outpatients, 1,785 (3.3%) and 1,744 (3.2%) of the patients were discharged and hospitalized, respectively.

3. Severity classification results and length of ED stay according to the time of visit

〈Table 3〉 shows the LoS and KTAS classification results according to the time of visit. The number of patients who visited from 09:00 to 18:00 was 24,891 (45.8%) and the LoS was 275.14 minutes. On the other hand, 29,406 (54.2%) patients who visited from 18:00 to 09:00 the next day, had a LoS of 204.23 minutes, which was shorter than during the daytime. Looking at the results of the initial KTAS classification of patients who visited between 09:00 and 18:00, levels 1, 2, 3, 4, and 5 were 465 (0.9%), 2,702 (5.0%), 9,271 (17.1%), 10,699 (19.7%), and 1,754 (3.2%), respectively. The breakdown of the KTAS classification levels of patients who visited between 18:00 and 09:00 the following day was 454 (0.8%) for level 1; 2,534 (4.7%) for level 2; 9,819 (18.1%) for level 3; 14,055 (25.9%) for level 4; and 2,544 (4.7%) for level 5.

In addition, looking at the results of the initial KTAS and LoS according to nursing

Table 3. Length of ED* stay and KTAS† classification result according to the time of visit

Visiting time	LoS‡, mean (SD§) (p<.001)	Initial KTAS, n (%) (p<.001)					
		Level 1	Level 2	Level 3	Level 4	Level 5	Total
Day (09:00~18:00)	275.1 (367.3)	465 (0.9)	2,702 (5.0)	9,271 (17.1)	10,699 (19.7)	1,754 (3.2)	24,891 (45.8)
Night (18:00~09:00)	204.2 (265.0)	454 (0.8)	2,534 (4.7)	9,819 (18.1)	14,055 (25.9)	2,544 (4.7)	29,406 (54.2)
Total	236.7 (318.0)	919 (1.7)	5,236 (9.7)	19,090 (35.2)	24,754 (45.6)	4,298 (7.9)	54,297 (100)
Day (07:00~14:59)	276.8 (352.3)	396 (0.7)	2,280 (4.2)	7,690 (14.2)	8,717 (16.1)	1,425 (2.6)	20,508 (37.8)
Evening (15:00~22:29)	222.8 (316.4)	334 (0.6)	1,914 (3.5)	7,059 (13.0)	9,770 (18.0)	1,725 (3.2)	20,802 (38.3)
Night (22:30~next day 06:59)	195.8 (248 .7)	189 (0.3)	1,042 (1.9)	4,341 (8.0)	6,267 (11.5)	1,148 (2.1)	12,987 (23.9)
Total	236.7 (318.0)	919 (1.7)	5,236 (9.6)	19,090 (35.2)	24,754 (45.6)	4,298 (7.9)	54,297 (100)

*ED= emergency department; †KTAS=Korean triage and acuity scale; ‡LoS=length of emergency department stay; §SD=standard deviation

staff shift time, 20,508 (37.8%) patients visited from 07:00 to 15:00 with a LoS of 276.75 minutes. The number of patients who visited from 15:00 to 22:30 was 20,802 (38.3%), with a LoS of 222.83minutes. From 22:30 to 07:00 the following day, 12,987 (23.9%) visited with a LoS of 195.82 minutes. The results of the initial KTAS classification of patients who visited from 07:00 to 15:00 showed that levels 1, 2, 3, 4, and 5 were 396 (0.7%); 2,280 (4.2%); 7,690 (14.2%); 8,717 (16.1%); and 1,425 (2.6%), respectively. The results of the initial KTAS classification of patients who visited between 15:00 and 22:30 showed that levels 1, 2, 3, 4, and 5 were 334 (0.6%); 1,914 (3.5%); 7,059 (13.0%); 9,770 (18.0%); and 1,7 25 (3.2%), respectively. Finally, the results of initial KTAS classification of patients who visited the ED from 22:30 to 07:00 the following day showed that levels 1, 2, 3, 4, and 5 were 189 (0.3%); 1,042 (1.9%); 4,341 (8.0%); 6,267 (8.50%); and 1,148 (2.1%), respectively (Table 3).

4. Comparison of length of ED stay in emergency and non-emergency patients

The number of patients classified as emergency KTAS levels 1, 2, and 3 was 25,243 (46.5%), and the mean LoS was 326.02 minutes. Conversely, non-emergency KTAS levels 4 and 5 showed 29,054 (53.5%) with a mean LoS of 159.16 minutes, statistically significantly shorter than emergency ($t=60.640$, $p<.001$)〈Table 4〉.

5. KTAS classification results and length of ED stay

According to the initial KTAS classification results, KTAS levels 1, 2, 3, 4, and 5 were 919 (1.7%); 5,236 (9.6%); 19,090 (35.2%); 24,754 (45.6%); and 4,398 (7.9%), respectively; and LoS were 427, 403, 293, 165, and 124 m, respectively 〈Fig. 1〉.

Ⅳ. Discussion

In this study, we analyzed around 55,000 patients who visited an ED over a period of one year three years after the start of severity classification using KTAS. Based on the results obtained through this study, we will discuss how to improve the emergency medical system and how to properly operate emergency medical personnel in order to create a safer and more efficient ED.

Table 4. Comparison of Length of ED* stay between emergency and non-emergency patients according to KTAS† classification results

Emergency vs. non-emergency	N	mean (SD‡), min	t	*p*
KTAS 1, 2, 3 (emergency)	25,243	326.0 (394.8)	60.64	<.001
KTAS 4, 5 (non-emergency)	29,054	159.2 (201.5)		

*ED=emergency department; †KTAS=Korean triage and acuity scale; ‡SD=standard deviation

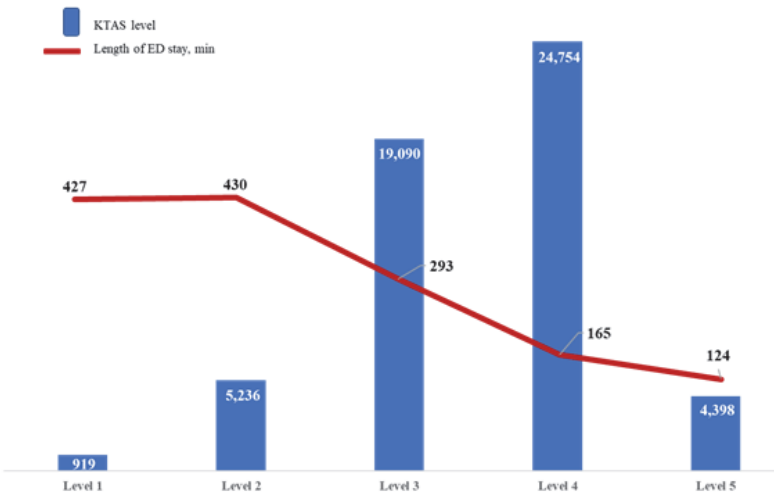

Fig. 1. Average length of ED stay according to KTAS level.
Although the number of patients corresponding to KTAS level 1 and 2 was small, the length of stay in the emergency department was the longest. The number of patients corresponding to KTAS level 4, which is a non-emergency symptom, was found to be the largest, and the residence time in the emergency department was relatively short.

1. Use of public ambulances

In this study, patients using public ambulance when visiting the ED accounted for 25.9% of all patients. The results were similar to the results of other domestic studies, which showed approximately 26% [19] and around 19.8% [24]. The results also concur with some foreign studies, for example, a study found a quarter of all patients visiting the ED in Melbourne, Australia used public ambulances [24], and a United States study conducted in one state showed similar results of around 26.5% [25]. Looking at the aforementioned studies, worldwide the average rate of patients used a public ambulance to visit the ED was 20% and it is believed to vary depending on the geographical location of the hospital and the characteristics of the community.

In addition, the severity of patients using a public ambulance was relatively higher than those who visited the hospital directly by walk-in or private vehicles. In examining the severity of patients using public ambulance, the results of this study indicate that patients classified as KTAS 1, 2, and 3 corresponding to emergencies accounted for around 70% of all those using public ambulance. These results are similar to those of several studies [19, 24], which showed that approximately 75% of patients were classified as emergency patients. However, in this study, approximately 73% of the patients using the public ambulance showed that they were discharged home. Approximately 40% of patients using public ambulances in both Munich, Germany and Detroit, Michigan, United States were discharged home [26, 27]. These results raise the question of whether public ambulance use was appropriate among many patients in Korea as more than 25% of patients using the public ambulance were classified as non-emergency (KTAS levels 4 and 5). These results are

similar to those of a domestic study where 23.8% of patients were classified as non-emergency [24]. Looking further afield, the Fire Department of New Taipei City in 2012 reported that 42% of patients who visited the ED using public ambulance were levels 4 and 5 (non-emergency) [28]. Another report showed that 16% of patients dispatched by paramedics did not receive hospital-level care [29]. Even though there is a shortage of public ambulances in the UK, the demand for ambulance use has increased significantly [30], with nearly half of the patients requesting a public ambulance over a year not requiring ED [31]. Globally, it was reported that approximately 30% of patients who were not transferred to the ED because they were not emergency [32]. Between 5% and 46% of patients who were not taken to the hospital by paramedics visited the ED themselves and most were discharged without hospitalization [24] as they did not have health problems requiring emergency services [33]. It would appear that the demand for public ambulance use is increasing worldwide, but indiscriminate use of public ambulances by some non-emergency patients requires improvement both domestically and internationally. In Korea, some non-emergency chronic patients repeatedly used public ambulances with a significantly high rate of ED use [34]. There have been many social issues related to the use of public ambulances to the extent that the charge for public ambulance use is under discussion [35]. In particular, it is not possible to limit the use of public ambulances for vulnerable people at low socioeconomic levels, but the damage of emergency patients who need to visit the ED using ambulances can be a problem in an emergency. Therefore, in order to prevent such problems, it is deemed necessary to supplement the emergency medical system at the national level and raise public awareness through public service advertisements so that genuine emergency patients can use public ambulances.

2. Number of patients and severity according to the time of visit

In this study, we compared the number of patients visiting the ED and the KTAS level of severity according to the time of visit, divided into working hours (09:00-17:59) and after hours (18:00-08:59), as well as nurse shift hours of daytime (07:00-14:59), evening (15:00-22:29), and nighttime (22:30-06:59), to determine the number and severity of patients at the time of visit. The results show that the number of patients visiting during working hours and after hours was almost the same, but more patients classified at KTAS levels 4 and 5 (non-emergency) visited after hours. In addition, the LoS based on the time of visit was found to be shorter during working hours than outside the normal time. Based on nurse shift hours, daytime had the largest number of patients, followed by evening and nighttime. The severity of the patients and the LoS were also the highest in the daytime, followed by evening and nighttime. These results differ from the number of patients who visited in the evening

in study [19] but are similar to those with the lowest number of patients visiting at nighttime. [36]'s study reported that more than 60% of patients who visited the ED did so during daytime while [20] also showed that fewer patients visited the ED at nighttime. [21]'s study showed that more than 90% of patients visited the ED between 07:00 and 22:00, in particular, the largest number of patients visited the ED between 10:00 and 12:00 and between 14:00 and 16:00. On the other hand, a study that analyzed over 170,000 patients registered with the Japan Trauma Data Bank over 12 years showed that more patients visited at nighttime between 17:00 and 08:59 [36]. These results differ from those of all patients who visited the ED in the study by [37] because only those who visited the ED due to trauma were analyzed. As such, the number of patients who visited the ED at nighttime was found to be small, and these results are likely to differ because of regional and social characteristics. In this context, the appropriate number of emergency medical personnel should be assigned to the ED, taking into account the characteristics of the community.

Furthermore, our study found that the proportion of patients classified as non-emergency (KTAS level 4 and 5) was higher at nighttime than daytime. The study by [38] also showed a high proportion of non-emergency patients visiting at night. These results are considered to be due to the domestic medical environment in which the ED is inevitably used even though there is no emergency because general medical treatment is not available at night. On the other hand, in the study of [36], the proportion of patients corresponding to levels 4 and 5 showed lower nighttime than daytime or evening. This opposite result is believed to be due to the low cost of ED in Korea compared to other countries and the ease of use of our ED as it is located in downtown.

3. Length of ED stay according to KTAS classification results

One of the best ways to address ED overcrowding is to shorten LoS [28, 39]. LoS can be reduced through a triage system that efficiently utilizes emergency medical resources [40] and, in this context, LoS management is important. In our study, the mean LoS of the ED was approximately 237 minutes. The mean LoS of patients classified as KTAS levels 1, 2, and 3 and those classified as KTAs level 4 and 5 was 326 and 159 minutes, respectively. In particular, the mean LoS was the longest at 427 min and 430 min, respectively, at high severity KTAS levels 1 and 2. These results are similar to the results of [41], in which the mean LoS of KTAS levels 1 and 2 among patients returning to the ED was 542 minutes and 275 minutes, respectively. In addition, some studies have reported that patients with emergencies corresponding to KTAS levels 1, 2, and 3 have a longer LoS than non-emergency patients [42, 43], and the study of [44] the mean LoS was around 204 minutes, and levels 1, 2, and 3 were longer than the mean LoS of all patients.

These results suggest that there are many emergency medical resources required for severe health issues, and several tests are required which increase LoS. Measures to shorten the LoS of patients with high severity should be prepared.

This study has several limitations. First, the data included in the analysis of this study consisted of patients who visited the ED in a single general hospital, and it is thus difficult to generalize the results. Second, public ambulances in Korea are operated by the state and are free to use. Also, the cost of using the emergency room is cheaper than in the US or other European countries. Therefore, our results may differ from those of other US or European countries in the emergency medical system. Finally, the results of KTAS severity classification may be different because the nurse's clinical experience, knowledge, and results of numeric rating scale that evaluate the pain intensity of patients are different.

Ⅴ. Conclusions

We found that about 25% of patients visited to the ED using public ambulances, more than 25% of them were classified as non-emergency. We also found that more than 70% of patients who visited the ED using public ambulances returned home without being admitted to the ED. These results can increase the mean LoS of the ED, which can result in overcrowding. In order to provide emergency patients with public ambulances, it is necessary to supplement the system by raising public awareness of the problems caused by non-emergency use of public ambulances. In addition, we found that the higher the severity of the patients, the longer the mean LoS, and the more patients visited at nighttime, the higher the severity. Depending on the number of patients and severity, appropriate medical personnel are required. In future research, it will be necessary to study how to reduce the use of public ambulance for non-emergency patients and to suggest a way to reduce LoS for patients with high severity.

ORCID ID

Jang Kyeongmin: 데이터수집, 통계분석, 원고작성, 최종검토

0000-0003-3599-4183

References

1. Hardern RD. Critical appraisal of papers describing triage systems. Acad Emerg Med 1999;6(11):1166-71. https://doi.org/10.1111/j.1553-2712.1999.tb00121.x
2. Kuriyama A, Urushidani S, Nakayama T. Five-level emergency triage systems: variation in assessment of validity. Egerg Med J 2017;34(11):703-10. https://doi.org/10.1136/emermed-2016-206295
3. Gilboy N, Travers D, Wuerz R. Re-evaluating triage in the new millennium: a comprehensive

look at the need for standardization and quality. J Emerg Nurs 1999;25(6):468-73. https://doi.org/10.1016/S0099-1767(99)70007-3
4. Wuerz RC, Milne LW, Eitel DR, Travers D, Gilboy N. Reliability and validity of a new five-level triage instrument. Acad Emerg Med 2000;7(3):236-42. https://doi.org/10.1111/j.1553-2712.2000.tb01066.x
5. Grouse A, Bishop R, Bannon A. The Manchester Triage System provides good reliability in an Australian emergency department. Emerg Med J 2009;26(7):484-6. https://doi.org/10.1136/emj.2008.065508
6. Parenti N, Reggiani MLB, Iannone P, Percudani D, Dowding D. A systematic review on the validity and reliability of an emergency department triage scale, the Manchester Triage System. Int J Nurs Stud 2014;51(7):1062-9. https://doi.org/10.1016/j.ijnurstu.2014.01.013
7. Jelinek GA, Little M. Inter-rater reliability of the National Triage Scale over 11,500 simulated occasions of triage. Emerg Med 1996;8(4):226-30. https://doi.org/10.1111/j.1442-2026.1996.tb00277.x
8. Murray M, Bullard M, Grafstein E. Revisions to the Canadian emergency department triage and acuity scale implementation guidelines. CJEM 2004;6(6):421-7. https://doi.org/10.1017/S1481803500009428
9. Park J, Lim T. Korean triage and acuity scale (KTAS). J Korean Soc Emerg Med 2017;28(6):547-51.
10. Kim JY, Hong DY, Kim SY, Kim JW, Park SO, Lee KR et al. Reliability of Korean Triage and Acuity Scale-based triage system as a severity index in emergency patients. J Korean Soc Emerg Med 2017;28(6):552-6.
11. Shin JW, Lee SH, Lee DS, Kim HB, Jo YM, Bae BG et al. Validity of the newly developed Five Level Pediatric Triage System implemented in a children's hospital emergency department. J Korean Soc Emerg Med 2017;28(6):557-63.
12. Lee KJ, Park MH, Suh J, Jung SY, Lee SJ, Cha M-i. Triage results of children who visited the emergency department via emergency medical service providers: an observational study in a regional emergency medical center. Pediatr Emerg Med J 2017;4(1):18-24. https://doi.org/10.22470/pemj.2017.00017
13. Lim T, Park J, Je S. Pediatric Korean triage and acuity scale. Pediatr Emerg Med J 2015;2(2):53-8.
14. Kim HI, Oh SB, Choi HJ. Inter-rater agreement of Korean Triage and Acuity Scale between emergency physicians and nurses. J Korean Soc Emerg Med 2019;30(4):309-17.
15. Moon S, Shim JL. Triage Accuracy of Pediatric Patients using the Korean Triage and Acuity Scale in Emergency Departments. JKAIS 2018;19(11):626-34. https://doi.org/10.5762/KAIS.2018.19.11.626
16. Søvsø MB, Christensen MB, Bech BH, Christensen HC, Christensen EF, Huibers L. Contacting out-of-hours primary care or emergency medical services for time-critical conditions-impact on patient outcomes. BMC Health Services Research 2019;19(1):813. https://doi.org/10.1186/s12913-019-4674-0
17. Sarıyer G, Ataman MG, Kızıloğlu İ. Factors affecting length of stay in the emergency department: A research from an operational viewpoint. Int J Healthc Manag 2018:1-10. https://doi.org/10.1080/20479700.2018.1489992

18. Andrew E, Nehme Z, Cameron P, Smith K. Drivers of increasing emergency ambulance demand. Prehosp Emerg Care 2020;24(3):385. https://doi.org/10.1080/10903127.2019.1635670
19. Wang IJ, Cho SJ, Yeom SR, Bae BK, Cho YM, Lee KH et al. Relationship between emergency department disposition, level of emergency base on Korean Triage and Acuity Scale, visit mode. J Korean Soc Emerg Med 2018;29(2):144-51.
20. Hinson JS, Martinez DA, Schmitz PS, Toerper M, Radu D, Scheulen J et al. Accuracy of emergency department triage using the Emergency Severity Index and independent predictors of under-triage and over-triage in Brazil: a retrospective cohort analysis. Int J Emerg Med 2018;11(1):3. https://doi.org/10.1186/s12245-017-0161-8
21. Moreno-Carrillo A, Arenas LMÁ, Fonseca JA, Caicedo CA, Tovar SV, Muñoz-Velandia OM. Application of Queuing Theory to Optimize the Triage Process in a Tertiary Emergency Care ("ER") Department. J Emerg Trauma Shock 2019;12(4):268-73. https://doi.org//10.4103/JETS.JETS_42_19
22. Azeredo TRM, Guedes HM, de Almeida RAR, Chianca TCM, Martins JCA. Efficacy of the Manchester Triage System: a systematic review. Int Emerg Nurs 2015;23(2):47-52. https://doi.org/10.1016/j.ienj.2014.06.001
23. The Korean Society of Emergency Medicine. Reliability and validity verification study of the Korean Triage and Acuity Scale [Internet]. Sejong: Ministry of Health and Welfare; 2014 [cited 2020 March 4]. Available from: http://www.prism.go.kr/homepage/entire/retrieveEntireDetail.do?pageIndex=1&research_id=1351000-201400241&left-MenuLevel=160&cond_research_name=한국형+중증%.
24. Kim MH, An HG. Classification of emergency room usage patterns according to the type of insurance in patients visiting an emergency medical center in Seoul, Korea. Korean J Emerg Med Ser 2020;24(1):25-36. https://doi.org/10.14408/KJEMS.2020.24.1.025
25. Pearson C, Kim DS, Mika VH, Imran Ayaz S, Millis SR, Dunne R et al. Emergency department visits in patients with low acuity conditions: Factors associated with resource utilization. Am J Emerg Med 2018;36(8):1327-31. https://doi.org/10.1016/j.ajem.2017.12.033
26. Hegenberg K, Trentzsch H, Prückner S. Differences between cases admitted to hospital and discharged from the emergency department after emergency medical services transport. BMJ open 2019;9(9):e030636. https://doi.org/10.1136/bmjopen-2019-030636
27. Hettinger AZ, Cushman JT, Shah MN, Noyes K. Emergency medical dispatch codes association with emergency department outcomes. Prehosp Emerg Care 2013;17(1):29-37. https://doi.org/10.3109/10903127.2012.710716
28. Wong HT, Lin TK, Lin JJ. Identifying rural-urban differences in the predictors of emergency ambulance service demand and misuse. J Formos Med Assoc 2019;118(1, Part 2):324-31. https://doi.org/10.1016/j.jfma.2018.05.013
29. Norberg G, Wireklint Sundström B, Christensson L, Nyström M, Herlitz J. Swedish emergency medical services' identification of potential candidates for primary healthcare: Retrospective patient record study. Scand J Prim Health Care 2015;33(4):311-7. https://doi.org/10.3109/02813432.2015.1114347
30. Wankhade P. The crisis in NHS Ambulance

Services in the UK: Let's deal with the 'elephants in the room'!! Ambulance Today.2018;15(1):13-7.
31. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R et al. Understanding variation in ambulance service non-conveyance rates: a mixed methods study. Health Serv Deliv Res 2018;6(19). https://doi.org/10.3310/hsdr06190
32. Snooks H, Dale J, Hartley-Sharpe C, Halter M. On-scene alternatives for emergency ambulance crews attending patients who do not need to travel to the accident and emergency department: a review of the literature. Egerg Med J 2004;21(2):212-5. https://doi.org/10.1136/emj.2003.005199
33. Coster J, O'Cathain A, Jacques R, Crum A, Siriwardena AN, Turner J. Outcomes for patients who contact the emergency ambulance service and are not transported to the emergency department: A data linkage study. Prehosp Emerg Care 2019;23(4):566-77. https://doi.org/10.1080/10903127.2018.1549628
34. Lee J, Ahn B. Factors associated with multiple emergency department visits: focused on general hospital level regional emergency medical center. Korea Public Health Research 2018;44(44):3129-46.
35. Yun HW, Lee J, Choi JW. A delphi study on charging for 119 emergency medical services. J Korean Soc Emerg Med 2017;28(2):190-200.
36. Duvald I, Moellekaer A, Boysen MA, Vest-Hansen B. Linking the severity of illness and the weekend effect: a cohort study examining emergency department visits. Scand J Trauma Resusc Emerg Med 2018;26(1):72. https://doi.org/10.1186/s13049-018-0542-x
37. Hirose T, Kitamura T, Katayama Y, Sado J, Kiguchi T, Matsuyama T et al. Impact of nighttime and weekends on outcomes of emergency trauma patients: A nationwide observational study in Japan. Medicine (Baltimore) 2020;99(1):e18687-e. https://doi.org/10.1097/MD.0000000000018687
38. Seo JH, Lee H, Park EJ, Kim H, Lee H, Kim SH. The factors affecting the level of urgency in the frequent users of the emergency department. J Korean Soc Emerg Med 2019;30(6):473-83.
39. Yoon BS, Choa MH, Kong TY, Joo YS, Ko DR, Hwang YJ et al. The effect of time target on overcrowding and clinical quality in the ED: a systematic review and meta-analysis. J Korean Soc Emerg Med 2018;29(2):170-8.
40. Williams P, Csipke E, Rose D, Koeser L, McCrone P, Tulloch A et al. Efficacy of a triage system to reduce length of hospital stay. Br J Psychiatry 2014;204(6):480-5. https://doi.org/10.1192/bjp.bp.113.141051
41. 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 2018;31(6):449-55. https://doi.org/10.1093/intqhc/mzy184
42. Kim JH, Kim JW, Kim SY, Hong DY, Park SO, Baek KJ et al. Validation of the Korean Triage and Acuity Scale compare to triage by emergency severity index for emergency adult patient: preliminary study in a tertiary hospital emergency medical center. J Korean Soc Emerg Med 2016;27(5):436-41.
43. Lee I, Kim O, Kim C, Oh J, Lim T, Lee J et

al. Validity analysis of Korean triage and acuity scale. J Korean Soc Emerg Med 2018;29(1):13-20.

44. Hocker MB, Gerardo CJ, Theiling BJ, Villani J, Donohoe R, Sandesara H et al. NHAMCS validation of emergency severity index as an indicator of emergency department resource utilization. West J Emerg Med 2018;19(5):855. https://doi.org/10.5811/westjem.2018.7.37556