

Usage Patterns and Severity Classification of Elderly Patients in a Public Hospital Emergency Department

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Abstract : This study aims to enhance the accuracy of severity classification by examining the usage patterns and characteristics of emergency department visits. It focuses on adult and elderly patients who visited a public hospital in Seoul. This descriptive study retrospectively reviewed the electronic medical records of patients who visited the emergency department of a public hospital between November and December 2023. The total number of participants was 1,033, with 46.4% (n=479) being elderly and 53.6% (n=554) being adults. The chief complaints of the participants were as follows: for the elderly, nervous system symptoms at 8.2% (n=85) and digestive symptoms at 7.5% (n=77) were the most common, while for adults, gastrointestinal symptoms at 11.0% (n=114) and trauma at 8.6% (n=89) were more prevalent. In the case of the elderly, patients classified as urgent accounted for the highest percentage at 23.9% (n=247), while for adults, non-emergency were more prevalent at 32.2% (n=333). The initial severity classification error rate for elderly patients in the urgent was 3.8%, indicating that the suitability of KTAS for elderly patients with high severity was low. To minimize severity classification errors and enhance KTAS accuracy, it's essential to address its current limitation of only classifying adults and children separately by developing a KTAS classification system that reflects the diverse characteristics of elderly patients.

Keywords : Aged, Emergency Department, Triage, Public Hospital, Korean Triage and Acuity Scale (KTAS)

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1. Introduction

A public hospital is an institution established by the government, taking the lead in responding to national disasters such as various calamities or significant infectious diseases like COVID-19. In Korea, as of 2019, there were 221 public healthcare institutions, accounting for 5.5% of all medical institutions. This is significantly lower than the OECD average of 65.5%, making it the lowest among these countries. Additionally, the disparity in the supply of public healthcare resources across regions is very large, resulting in inadequate provision of high-quality medical services [1].

The primary purpose of public hospitals is to provide affordable and high-quality medical services to vulnerable groups and socially disadvantaged individuals, such as the elderly. Recently the increase in the elderly population and the rise in chronic geriatric diseases have resulted in 61.6% of inpatients in public hospitals being elderly, compared to 27.5% in tertiary general hospitals. This indicates a higher proportion of elderly inpatients in public hospitals [2]. Considering the nature of elderly patients who require long-term treatment, it is expected that the rate of emergency room (ED) visits and medical expenses for elderly patients will increase as they undergo repeated admissions and discharges.

The ED is the first place where emergency patients receive medical care, and their lives can depend on the treatment they receive there. To efficiently treat many patients with limited medical resources, it is crucial to quickly and accurately determine patient priority [3]. To maximize these functions of the ED, the Korean Triage and Acuity Scale (KTAS) was developed in 2016 and is used in ED nationwide [4].

The application of KTAS plays a pivotal role in categorizing the severity and urgency of

patients visiting the ED [5]. However, the ED continues to face overcrowding due to the increasing number of patients with minor conditions and chronic diseases, making timely treatment of emergency patients difficult and efficient operation challenging [6,7]. Elderly patients often have multiple underlying conditions and atypical symptoms, such as fever being masked due to a lower baseline body temperature, which can complicate accurate diagnosis and severity classification [8]. Consequently, the KTAS classification for elderly patients may result in under-triage or over-triage, leading to inappropriate treatment prioritization. This misclassification can cause critical emergency patients and those suspected of severe conditions to miss their golden hour for treatment, negatively impacting their prognosis [9,10]. Furthermore, the prognostic accuracy of the KTAS shows lower discriminative power in elderly patients compared to adult patients, with concerns raised regarding inappropriate classification for elderly patients in terms of hospitalization, ICU admission, and in-hospital mortality [11-13].

A review of previous studies on the characteristics of elderly patients in the ED reveals several key areas of focus. These include the visit rates and related characteristics of elderly patients [14,15,16], factors related to the re-visits of elderly patients to emergency rooms [17], emergency medical transport systems [18], and elderly emergency patients with chronic diseases [19]. However, comprehensive studies considering the severity classification of elderly patients visiting public medical institutions are rare. Therefore, this study aims to analyze the general characteristics and ED utilization patterns of adult patients who visited a public hospital in Seoul. By understanding the characteristics of severity classification in adult and elderly groups, the study seeks to improve the quality of severity classification in the ED in public hospitals.

2. Research methods

2.1. Research participants and design

The participants consisted of 1,033 patients who visited the ED of a public hospital located in Seoul from May 1 to May 30, 2023. The enrolled participants were divided into two groups: participants who were over 65 were classified as the "elderly group," and those who were between the ages of 18 and 64 as the "adult group." Participants were excluded based on the following criteria: 1) patients under 19 years old; 2) those with insufficient data due to being transferred to another hospital; 3) those who were dead on arrival.

This study is a retrospective research analyzing the utilization patterns of emergency room patients based on KTAS classification. It also focuses on patients visiting the ED and examines the characteristics of severity classification between adult and elderly patients.

2.2. Data collection

The data was collected from November 1 to December 15, 2023. The data collection method involved the EMR data manager at the public hospital transferring patient information that met the selection criteria into an excel file.

KTAS classification in this study was conducted by certified triage nurses with qualifications as follows: 1) those who have worked in an ED for more than a year; 2) those who have completed KTAS training; and 3) those who have worked as a triaged nurse in an ED for at least five years.

2.3. Ethical considerations

Prior to data collection, approval was obtained from the head of the ED and the EMR data manager at the medical institution where the study data were collected, in accordance with the institution's regulations. During the data extraction process, identifiable

personal information such as medical record numbers, names, and dates of visits was excluded. The collected data were used for research purposes only and will be managed and destroyed in accordance with management standards and related laws.

2.4. Research tool

2.4.1. KTAS classification

KTAS classifies the urgency of patients into five levels based on the symptoms they present, applying first and second consideration criteria. The first consideration criteria consist of consciousness, hemodynamic status based on vital signs, degree of respiratory distress, fever, pain, presence of bleeding disorders, and mechanism of injury, applicable to most symptoms. The second consideration criteria consist of specific characteristics applicable to certain symptoms.

The KTAS level is classified into five levels based on first and second consideration criteria [4]. Level 1 indicates a situation where the patient's life is in immediate danger and requires aggressive treatment. Level 2 involves a potential threat to life, necessitating prompt treatment under physician supervision within 15 minutes. Level 3 pertains to conditions that could develop into serious problems, requiring emergency treatment within 30 minutes. Level 4 considers factors such as age, pain, and potential for deterioration, indicating treatment or reevaluation within 1–2 hours, with the physician treating the patient within 60 minutes. Level 5 refers to serious but non-urgent conditions, treated within 120 minutes. According to the Korean Triage and Acuity Scale Committee [5], KTAS levels I, II, and III are classified as urgent, while levels IV and V are categorized as non-emergency.

To evaluate the reliability of KTAS, two nurses who received KTAS training independently classified the same patients, and their inter-rater agreement was assessed using Weighted Kappa. In the previous study [20],

the Weighted Kappa was reported as 0.9, while in this study, it was 0.8, indicating substantial reliability of KTAS.

2.5. Statistical analysis

We examined the data using SPSS 25.0 (IBM, Chicago, IL, USA). General characteristics were analyzed using frequency and percentage, while the patterns of ED visits according to age and the patterns of visits based on KTAS urgency were analyzed using χ^2 tests and t-tests. The level of statistical significance was set at $p < .05$.

3. Results

3.1. General characteristics

Table 1 shows the general characteristics of this study, which included a total of 1,003 participants. Among them, 554 (53.7%) were adults, and 479 (46.3%) were elderly patients. Regarding gender, there were 460 (46.4%) males and 543 (53.6%) females. The distribution of ED visits showed that 477

(47.6%) occurred during the daytime and 556 (53.4%) at night. The most common mode of arrival at the ED was direct visit, accounting for 901 (89.8%) patients, while the main means of transportation to the ED were walking and private cars, used by 725 (72.3%) patients, followed by ambulances, used by 278 (27.7%) patients. Among the patients who visited the ED, 836 (83.4%) did so due to illness, while 197 (19.6%) visited due to injury (non-illness reasons).

3.2. Classification of emergency department visit patterns by age

The analysis of ED visit patterns based on the age of participants (Table 2) revealed that return visits were more common among the elderly, with 410 (39.7%) elderly patients, while initial visits were more prevalent among the adult, with 209 (20.2%) adult patients ($p < 0.001$). ED visit times showed that among the elderly, daytime visits were more frequent, with 278 (26.9%) elderly patients compared to 201 (19.5%) elderly patients for nighttime visits. In contrast, among the adult, nighttime

Table 1. General characteristics of the participants

($N=1,033$)

Characteristic	n (%)	M±SD
Age (years)	< aged 65	554 (53.6)
	≥ aged 65	479 (46.4)
Gender	Male	490 (47.4)
	Female	543 (52.6)
The time of emergency department visits	Daytime	477 (46.2)
	Nighttime	556 (53.8)
Mode of arrival	Direct visit	901 (87.2)
	via OPD	37 (3.6)
	via other hospital	86 (8.3)
	Etc.	9 (0.9)
Means of transportation to the ED	119 ambulances	278 (26.9)
	Private ambulances	20 (1.9)
	Walking and private cars	735 (71.2)
The presence of illness	Disease	836 (80.9)
	Injury	197 (19.1)

ED = Emergency Department; OPD = Out Patient Department; SD = Standard Deviation.

Table 2. Classification of ED visit patterns by age (N=1,033)

Characteristics		Elderly group	Adult group	Sum(%)	χ^2 (p)
		(\geq aged 65) n(%)	(aged 18–64) n(%)		
ED visits	Initial visits	69(6.7)	209(20.2)	278(26.9)	71.03
	Return visits	410(39.7)	345(33.4)	755(73.1)	(<.001)
The time of ED visits	Daytime	278(26.9)	199(19.3)	477(46.2)	50.56
	Nighttime	201(19.5)	355(34.4)	556(53.8)	(<.001)
Means of transportation to the ED	119 ambulances	159(15.4)	119(11.5)	278(26.9)	
	Private ambulances	16(1.5)	4(0.4)	20(1.9)	29.61
	Walking and private cars	304(29.4)	431(41.7)	735(71.2)	(<.001)
Mode of arrival	Direct visit	397(38.4)	504(48.8)	901(87.23)	
	via OPD	26(2.5)	11(1.1)	37(3.6)	21.86
	via other ospital	54(5.2)	32(3.1)	86(8.3)	(<.001)
	Etc.	2(0.2)	7(0.7)	9(0.9)	
The presence of illness	Disease	415(40.3)	421(40.8)	836(80.9)	18.87
	Injury	64(6.2)	133(12.9)	197(19.1)	(<.001)

ED = Emergency Department; OPD = Out Patient Department.

visits were more common, with 355 (34.4%) adult patients compared to 199 (19.3%) adult patients for daytime visits ($p<0.001$).

Regarding means of transportation to the ED, walking and private car usage was higher among the adult, with 431 (41.7%) adult patients, compared to 304 (29.4%) elderly patients. Conversely, the usage of 119 ambulances was higher among the elderly, with 159 (15.4%) elderly patients compared to 119 (11.5%) adult patients ($p<0.001$).

In terms of mode of arrival to the ED, direct visits were more common among the adult, with 504 (48.8%) adult patients, compared to 397 (38.4%) elderly patients ($p<0.001$). Regarding the presence of illness, among adult patients who visited the ED due to injury (non-illness reasons), there were 133 (12.9%), which was approximately twice as high as the number of elderly patients, with 64 (6.2%) ($p<0.001$).

3.3. Classification of severity levels among emergency department attendees by age

Table 3 shows the classification of KTAS based on age. The initial KTAS upon ED visits indicated that among the elderly, 247 (23.9%) patients were classified as urgent (KTAS I, II, III), which was higher than the 221 (21.4%) adult patients classified as such in the adult. Additionally, the number of non-emergency (KTAS IV, V) was higher in the adult, with 333 (32.2%) adult patients, compared to 232 (22.5%) elderly patients ($p<0.001$). The final KTAS showed that among the elderly, 265 (25.7%) patients were classified as urgent (KTAS I, II, III), which was higher than the 214 (20.7%) elderly patients classified as non-emergency (KTAS IV, V). Conversely, in the adult, 322 (31.2%) patients were classified as non-emergency (KTAS IV, V), which was higher than the 232

Table 3. Classification of severity levels among ED attendees by age (N=1,033)

Characteristics		Elderly group (≥ aged 65) n(%) or mean	Adult group (aged 18–64) n(%) or mean	Sum(%) or t	p
Initial KTAS	Urgent (KTAS I, II, III)	247(23.9)	221(21.4)	468(45.3)	<.001
	Non-emergency (KTAS IV, V)	232(22.5)	333(32.2)	565(54.7)	
Final KTAS	Urgent (KTAS I, II, III)	265(25.7)	232(22.5)	497(48.2)	<.001
	Non-emergency (KTAS IV, V)	214(20.7)	322(31.2)	536(51.9)	
The allocation of ED beds	General bed	337(32.6)	441(42.7)	778(75.3)	.001
	Critical care beds	142(13.7)	113(10.9)	255(24.6)	
Chief complaints	Digestive symptoms	77(7.5)	114(11.0)	191(18.5)	<.001
	Nervous symptoms	85(8.2)	57(5.5)	142(13.7)	
	Urinary symptoms	25(2.4)	19(1.8)	44(4.2)	
	Mental Health	6(0.6)	45(4.4)	51(5)	
	Trauma	62(6.0)	89(8.6)	151(14.6)	
	musculoskeletal symptoms	31(3.0)	29(2.8)	60(5.8)	
	Respiratory symptoms	70(6.8)	26(2.5)	96(9.3)	
	Dermatology symptoms	4(0.4)	31(3.0)	35(3.4)	
	cardiovascular symptoms	37(3.6)	37(3.6)	74(7.2)	
	Obstetric Gynecology symptoms etc.	1(0.1) 81(7.8)	5(0.5) 102(9.9)	6(0.6) 183(17.7)	
Emergency treatment outcomes	Discharge to home	283(27.4)	454(43.9)	737(71.3)	<.001
	Hospitalization	168(16.3)	81(7.8)	249(24.1)	
	Transfer	27(2.6)	18(1.7)	45(4.3)	
	Death	1(0.1)	1(0.1)	2(0.2)	
ED Waiting time (min)		13.7	12.9	-0.824	.410
Initial KTAS time (min)		5.4	4.7	-4.939	<.001
The length of stay in the ED (min)		442.9	291.7	-6.360	<.001

KTAS = Korean Triage and Acuity Scale; ED = Emergency Department.

(22.5%) adult patients classified as urgent (KTAS I, II, III) ($p<.001$).

Regarding ED bed allocation, critical care beds were assigned more frequently to the elderly, with 142 (13.7%) elderly patients, whereas general beds were assigned more to the adult, with 441 (42.7%) adult patients

($p<.001$). In terms of chief complaints, excluding others, among the elderly, the following order was observed: nervous symptoms (8.2%), digestive symptoms (7.5%), respiratory symptoms (6.8%), and trauma (6.0%). Among the adult, the order was digestive symptoms (11.0%), trauma (8.6%),

Table 4. Classification urgent (KTAS I, II, III) and non-emergency (KTAS IV, V) among elderly participants (N=479)

Characteristics		Urgent (KTAS I, II, III) n(%) or mean	Non-emergency (KTAS IV, V) n(%) or mean	Sum(%) or F	P
The presence of illness	Disease	242(50.5)	173(36.1)	415(86.6)	.001
	Injury	23(4.8)	41(8.6)	64(13.4)	
initial KTAS classification	Urgent (KTAS I, II, III)	247(51.6)	0(0.0)	247(51.6)	<.001
	non-emergency (KTAS IV, V)	18(3.8)	214(44.7)	232(48.4)	
The alteration of KTAS Level	KTAS under-triage	19(4.0)	1(0.2)	20(4.2)	<.001
	KTAS over-triage	0	0	0	
	No change	246(51.4)	213(44.5)	459(95.8)	
KTAS accuracy	Accurate	242(50.5)	207(43.2)	449(93.7)	.015
	Inaccurate	23(4.8)	7(1.5)	30(6.3)	

KTAS =Korean Triage and Acuity Scale; ED = Emergency Department.

nervous symptoms (5.5%), and mental health (4.4%) ($p<.001$).

Regarding emergency treatment outcomes, discharge to home was higher among the adult, with 454 (43.9%) patients, compared to 283 (27.4%) elderly patients. In contrast, hospitalizations were higher among the elderly, with 168 (16.3%) patients, compared to 81 (7.8%) adult patients ($p<.001$). The initial KTAS time in the ED was significantly longer for the elderly, averaging 5.4 minutes, compared to 4.7 minutes for the adult ($p<.001$). The length of stay in the ED was significantly longer for the elderly, averaging 442.9 minutes, compared to 291.7 minutes for the adult ($p<.001$).

3.4. Classification urgent (KTAS I, II, III) and non-emergency (KTAS IV, V) among elderly participants

Results of the severity level classification analysis for urgent (KTAS I, II, III) and non-emergency (KTAS IV, V) among elderly patients (Table 4) revealed significant

differences in the presence of illness, with a higher proportion of patients categorized as having an illness among urgent, with 242 (50.5%) individuals, compared to non-emergency, with 173 (36.1%) individuals ($p=0.001$). Regarding the initial KTAS assessment, among urgent, there were 18 (3.8%) cases classified as non-emergency, while among non-emergency, there were no cases (0%) classified as urgent ($p<.001$).

Regarding the alteration of KTAS results, 19 (4.0%) urgent were classified as KTAS over-triage, while among non-emergency, only 1 (0.2%) individual showed a KTAS over-triage ($p<.001$). In terms of KTAS accuracy, 23 (4.8%) urgent and 7 (1.5%) non-emergency were classified as inaccurate ($p=0.015$).

4. Discussion

This study aims to analyze the ED utilization patterns of patients visiting a public hospital and to identify the characteristics of

severity classification in elderly patients, in order to use the findings as basic data for improving the quality of severity classification in the ED of public hospitals.

The general characteristics of participants in the study showed that 46.4% were elderly patients, with an average age of 76.8 ± 7.02 years. The ED visit patterns by age reveals that both elderly and adult patients predominantly made return visits, with elderly patients having more return visits than adult patients. Internationally, elderly patients aged 65 and over revisit the ED at a rate of 10.4% in the Netherlands [21] and 29.2% in the United States [22]. In contrast, the revisit rate for elderly patients in this study was notably higher at 39.7%, surpassing rates reported in other countries [21–22]. These study findings, while based on a single public hospital in Seoul, may reflect a nationwide trend in ED due to the aging population and the increase in chronic geriatric diseases. However, the generalizability of these findings is limited by the retrospective design. Future research should involve prospective studies, comprehensively collecting and analyzing data from public hospital ED across various regions.

In this study, while the proportion of ED visits due to illness was similar for both elderly and adult patients, at around 40%, visits due to injury were approximately twice as high in adult patients at 12.9% compared to elderly patients at 6.2%. This differs somewhat from a preliminary study on elderly patients at a regional emergency medical center in Busan [16], where the proportions were reported as 88.7% for illness and 11.3% for injury. This discrepancy may be attributed to the characteristics of the regional emergency medical center in Busan, which experiences a higher volume of visits from medical protection beneficiaries, homeless individuals, and travelers [16]. The time of the ED visit shows that elderly patients frequently used the ED during the daytime, while adult patients had a higher usage rate during the nighttime.

The most common means of arrival at the ED were walking and private cars, which is consistent with previous research [17].

When examining the severity classification results in the ED based on age (using 65 years as the criterion), it was found that the proportion of elderly patients was higher among urgent (KTAS I, II, III) in both the initial KTAS and final KTAS, whereas the proportion of adult patients was higher among non-emergency (KTAS IV, V). Additionally, the allocation of critical care beds was higher for elderly patients at 13.7% compared to 10.9% for general beds, whereas for adult patients, the allocation of general beds was higher at 42.7%. This aligns with previous research [13], indicating that the urgency of elderly patients in the ED is higher than that of adult patients. The emergency treatment outcomes showed that the hospitalization rate for elderly patients was 16.3%, which is twice as high as the 7.8% hospitalization rate for adult patients, consistent with previous findings [13]. It can be inferred that elderly patients visiting the ED can be predicted to have higher urgency and severity from the time of their visit. Additionally, due to the likelihood of hospitalization, they may have a less favorable prognosis compared to adult patients. Therefore, it is necessary to not only expand and adjust the allocation of emergency department beds considering the high severity and hospitalization rate of elderly patients, but also to develop policies that provide tailored medical services needed for elderly patients.

Upon visiting the ED, the chief complaints for elderly patients were neurological symptoms (8.2%) and digestive symptoms (7.5%), while for adult patients, the chief complaints were digestive (11.0%) and trauma-related (8.6%). This aligns with previous research [16], which found that elderly patients are more likely to visit the ED for chronic diseases rather than trauma or surgical diseases. Specifically, the high prevalence of neurological symptoms in elderly

patients has contributed to the increased ED utilization and the length of stay in the ED in recent years [23]. Chronic conditions like neurological disorders can impair cognitive abilities, create communication barriers, and decline physical function, necessitating multiple tests and prolonging ED stay. To reduce ED length of stay, tailored diagnostic and treatment protocols should be developed and implemented. These protocols will enable rapid and accurate assessment and appropriate treatment of neurological symptoms.

The KTAS classification results showed that among elderly patients, those in the high urgency (KTAS I, II, III) had a rate of 50.5% with underlying disease, which is higher than the 36.1% observed in the non-urgent (KTAS IV, V). This suggests that, compared to adults, elderly individuals have a higher prevalence of underlying illnesses. Furthermore, complex chronic conditions often require intricate management and treatment, which may lead to a higher likelihood of being classified into the high urgency upon ED admission. In the initial KTAS classification of the high-urgency group, 3.8% were classified as non-emergency, indicating that under-triage resulted in miss-triage for elderly patients. Such classification errors can delay the treatment of highly urgent patients, potentially increasing morbidity and mortality rates within the ED [9, 10, 24]. Especially in elderly patients with degenerative conditions such as neurological disorders, there may be difficulty in accurately expressing their own physical symptoms, leading to more classification errors among elderly patients. Therefore, triage nurses need to be aware of these issues and actively address them. Understanding the specific needs of the elderly and receiving specialized training in geriatric emergency nursing are essential steps to effectively manage such challenges.

The alteration of KTAS level showed that in the urgent, 4.0% had an increase in KTAS level from the initial KTAS classification to the final KTAS classification, while in the non-

emergency, it was 0.2%. Additionally, regarding KTAS accuracy, 4.8% of the urgent group were inappropriately classified, compared to 1.5% in the non-emergency group, suggesting that classification errors are higher in elderly patients within the urgent group. Even with standardized training and certification, triage nurses may score differently due to personal traits and hospital policies [13]. Their experience and competence in severity classification also play significant roles [25–27]. These factors can influence the accuracy and consistency of triage assessments. Additionally, in the current KTAS classification, there is no consideration for the elderly, and the elderly are classified through the same classification system as adults [13]. Therefore, it is necessary to develop a KTAS classification system that reflects the characteristics of elderly patients to improve the current KTAS algorithm, which does not adequately consider these diverse characteristics, and apply it in the ED of public hospitals nationwide.

As limitations of this study, firstly, there may be selection bias due to the retrospective study design. Secondly, considering that KTAS severity classification is performed by triage nurses with varying levels of experience, differences in severity classification scores may exist among triage nurses. Despite these limitations, providing insights into the utilization patterns of emergency departments in public healthcare institutions and the characteristics of severity classification between adult and elderly patients is significant in establishing the role of emergency departments amidst the aging population trend.

5. Conclusions

This study analyzed the utilization patterns of the ED by patients presenting at a public hospital in Seoul and sought to enhance the quality of severity classification in the ED by identifying characteristics of severity classi-

cation for adult and elderly patients. The results of this study showed that elderly patients have a higher proportion of urgent KTAS level I, II, and III cases, making them twice as likely to be immediately admitted to the hospital from the ED compared to adults. Among elderly patients aged 65 and over, 3.8% of those initially classified into the urgent group (KTAS I, II, III) were misclassified as non-emergency, indicating over-triage. Additionally, regarding KTAS accuracy, 4.8% of patients in the urgent group were inappropriately classified, compared to 1.5% in the non-emergency group, suggesting a higher classification error rate in the urgent group for elderly patients. Therefore, to improve the accuracy of KTAS, it is recommended to develop a severity classification system specifically tailored to the intrinsic characteristics of elderly patients.

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