



## Original Article

## Unnecessary Emergency Medical Services Transports of Geriatric Patients in a Tertiary Hospital in South Korea

Jung Sung Hwang<sup>a</sup>, Sun Hyu Kim<sup>a\*</sup>, Christine Van Dillen<sup>b</sup><sup>a</sup> Department of Emergency Medicine, University of Ulsan College of Medicine, Ulsan University Hospital, Ulsan, Republic of Korea, <sup>b</sup> Department of Emergency Medicine, Orlando Health, Orlando, FL, USA

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## SUMMARY

**Background:** This study investigated unnecessary emergency medical services (EMS) transports by comparing geriatric patients treated and not treated at the emergency department (ED) after EMS transports, and factors associated with lack of treatment at the ED of geriatric patients after EMS transports.

**Methods:** A retrospective review of EMS run sheets was conducted for geriatric patients ( $\geq$ age 65) admitted by EMS. Study subjects were divided in two groups according to if they were treated at the ED (ED treatment group) or not treated (non-ED treatment group). General demographics, clinical demographics and prehospital treatment were compared between groups.

**Results:** Of the total of 1251 EMS run sheets, non-ED treatment group comprised 49 (3.9%) of patients. Elapsed time from scene to ED was longer with the non-ED treatment group. Oxygen saturation was lower in the ED treatment group than the non-ED treatment group and wound care was more frequently conducted in the non-ED treatment group. Causes of not receiving treatment at the ED were against medical advice (37%) and based on doctors' suggestion (67%).

**Conclusion:** The non-ED treatment group consisted of more patients with alcohol intake, higher oxygen saturation, alert mentality and wound care than the ED treatment group. Prehospital wound care was the risk factor for not receiving ED treatment after EMS transports in geriatric patients.

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## 1. Introduction

Emergency department (ED) care is critical in providing emergency treatment for patients with acute or chronic illnesses.<sup>1</sup> Some patients that arrive at the ED are transported by public ambulance or emergency medical services (EMS). However, medically unnecessary EMS transports can lead to waste of hospital and EMS resources. Misuse of EMS transports include unmet need (EMS transports not used even though medically necessary) and inappropriate use (use of EMS transports when medically unnecessary). Inappropriate EMS use may be used to evaluate equity of medical use and efficiency of medical resources<sup>2</sup>. Unnecessary EMS transports of geriatric patients requiring more diagnostic examinations

and lengthier stays at the ED than younger patients<sup>3</sup> burden the EMS system and medical institution<sup>4</sup>.

Unnecessary EMS transports have been investigated based on hospital diagnosis or results of ED treatment<sup>1,5–8</sup>. Until now no study has investigated unnecessary EMS transports of patients not treated at ED although transported by EMS. This study examined unnecessary EMS transports by comparing geriatric patients treated and not treated at the ED after EMS transports, and factors associated with lack of treatment at the ED of geriatric patients after EMS transports.

## 2. Materials and methods

## 2.1. Study design &amp; setting

This retrospective study involved geriatric patients ( $\geq$ age 65) admitted by EMS at one training hospital ED on the southeast coast area of South Korea during for one-year August 2014–July 2015. This study was reviewed by the relevant institutional review board.

\* Corresponding author. Department of Emergency Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, 877 Bangeojinsunhwando-ro, Dong-gu Ulsan 44033, Republic of Korea.

E-mail address: [stachy1@paran.com](mailto:stachy1@paran.com) (S.H. Kim).

EMS run sheets submitted to the study hospital ED after EMS transports were analyzed and data was excluded if a run sheet was not readable. Study subjects were divided in two groups according to if treated at the ED (ED treatment group) or not treated (non-ED treatment group). The non-ED treatment group was defined as patients that had no further medical treatment and diagnostic tests at the ED, and that did not pay for the ED regardless of history-taking and physical examinations conducted after arrival at the ED.

## 2.2. Data collection

General demographics, clinical demographics and prehospital treatment were compared between groups. General demographics included age, sex, day of EMS use, time of EMS use, season of EMS use, elapsed time from EMS call to scene, elapsed time from scene to ED arrival, occupation and place of call for EMS use. Three age groups were used: 65–74, 75–84 and  $\geq 85$ . Day of EMS use was determined as weekday (Monday–Friday) and holidays (Saturday, Sunday and national holidays). Seasons comprised spring (March–May), summer (June–August), fall (September–November) and winter (December–February). Occupation was designated as employed or unemployed, including stay-at-home wives. Clinical characteristics of patients in prehospital setting included symptoms, medical history, alcohol intake, blood pressure, pulse rate, oxygen saturation, glucose test, level of consciousness and pupil light reflex that were investigated. Symptoms were recorded based on the EMS run sheet and characteristics of symptoms were categorized as disease related or non-disease related, such as trauma or intoxication. Frequent causes of non-disease related symptoms were examined and level of consciousness was classified as alert and non-alert, that included verbal response, pain response and unresponsiveness. Airway management, oxygen administration, electrocardiogram (ECG) monitoring, intravenous line, immobilization, wound care, warming or cooling, automated defibrillator (AED) monitoring and direct medical control contact for prehospital treatment were evaluated. Numbers and certificates of responding firefighters were investigated because the fire department is responsible for prehospital EMS transports in South Korea. Airway management was defined as manual manipulation or use of equipment and immobilization were determined if immobilization for spine or extremities was conducted. Direct medical control was defined as telephone communication of EMS personnel with the medical director or medical doctor.

Causes of not receiving ED treatment in the non-ED treatment group were classified as patient-oriented (against medical advice) and physician-oriented (based on doctors' suggestions) causes. Details of patient-oriented causes were classified into denial of treatment after EMS use, uncooperative towards ED healthcare providers, desire for transfer to another hospital and desire for treatment at outpatient department (OPD). Details of physician-oriented causes were classified as no symptoms at ED arrival, drunken state without medical problem or trauma, patients can be treated in OPD and other hospital treatment and repeat visit to study hospital with the same symptoms.

## 2.3. Statistical analyses

Student t-test, chi-square test and Fisher's exact test were used to compare general demographics, clinical demographics and prehospital treatment between ED treatment and non-ED treatment groups. Multivariate regression with forward stepwise method after adjusting for age and sex was conducted using significant factors ( $p < 0.1$ ) from univariate comparison to identify factors associated with non-ED treatment in patients with EMS transports.

IBM SPSS 20.0 (IBM Inc., Somers, NY, USA) was used for analyses and statistical significance was defined as  $p < 0.05$ .

## 3. Results

### 3.1. General demographics

The 1251 EMS run sheets overwhelmingly involved the ED treatment group ( $n = 1202$ , 96.1%) versus the non-ED treatment group ( $n = 49$ , 3.9%) (Fig. 1). There was no difference in mean age between groups, with patients age 65–74 being the most common in both groups. There was no difference in gender, or day and season of EMS use between groups. The most common time of EMS use was between 0600 and 1200 (33%) in the ED treatment group and between 1800 and 2400 (35%) in the non-ED treatment group. There was no difference in elapsed time from EMS call to scene between groups, however the time from scene to ED was lengthier in the non-ED treatment group (22 min vs 25 min,  $p = 0.043$ ). Most frequent location of EMS calls was at home in both groups (Table 1).

### 3.2. Clinical demographics

Common symptoms were general weakness (9.6%), abdominal pain (8.8%) and nausea/vomiting (6.3%) in the ED treatment group, and general weakness (14.3%) and nausea/vomiting (6.1%) in the non-ED treatment group. Medical history was not different between groups. Disease related symptoms were present in 73% and 69% of patients in the ED treatment group and non-ED treatment group, respectively. There was no difference in blood pressure, pulse rate and glucose between groups, however oxygen saturation was lower in the ED treatment group (95% vs 98%,  $p < 0.001$ ). All patients in the non-ED treatment group had alert mental status and 11% were not alert in the ED treatment group. Pupil light reflex was intact in patients in the non-ED treatment group, but 4% of the ED treatment group had abnormal pupil light reflex (Table 2).

### 3.3. Prehospital care

There was no difference in airway manipulation between groups. Oxygen was administered most frequently via nasal prong in both groups. Bag valve masks for oxygen supply was used for 9% of patients in the ED treatment group and none in the non-ED treatment group. More oxygen was administered in the ED treatment group than the non-ED treatment group (7 L/minutes vs 4 L/minutes). There was no difference in ECG monitor, intravenous line,

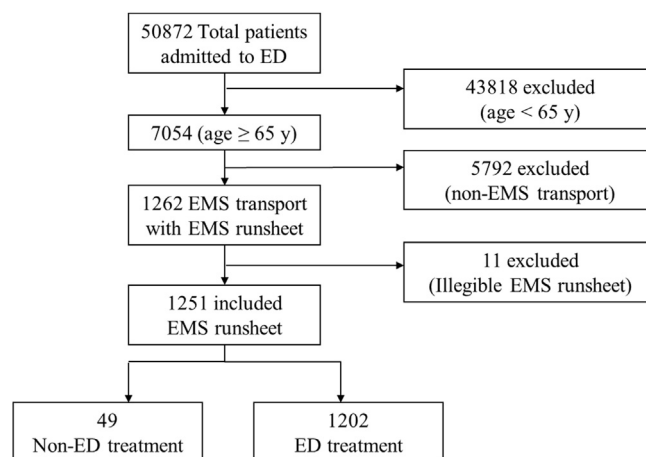


Fig. 1. Study subjects.

**Table 1**  
General demographics of patients with or without ED treatment after EMS use.

	ED treatment (n = 1202)	Non-ED treatment (n = 49)	p-value
Age, years ± SD	74.8 ± 7.2	73.3 ± 6.6	0.169
Classification by age, n (%)			0.304
65–74	670 (55.7)	31 (63.3)	
75–84	406 (33.8)	16 (32.7)	
≥85	126 (10.5)	2 (4.1)	
Male sex, n (%)	622 (51.8)	29 (59.2)	0.310
Day of EMS use, n (%)			0.751
Weekdays	808 (67.2)	34 (69.4)	
Weekends and holidays	394 (32.8)	15 (30.6)	
Time of EMS use, n (%)	n = 1165	n = 49	0.158
0–600 o'clock	153 (13.1)	8 (16.3)	
600–1200 o'clock	384 (33.0)	10 (20.4)	
1200–1800 o'clock	355 (30.5)	14 (28.6)	
1800–2400 o'clock	273 (23.4)	17 (34.7)	
Season of EMS use, n (%)			0.504
Spring	353 (29.4)	18 (36.7)	
Summer	301 (25.0)	8 (16.3)	
Fall	269 (22.4)	11 (22.4)	
Winter	279 (23.2)	12 (24.5)	
Elapsed time, min ±SD			
From EMS call to scene	7.0 ± 5.1	6.4 ± 2.8	0.392
From scene to arrival at ED	21.6 ± 13.1	25.4 ± 12.1	0.043
Occupation of patient, n (%)	n = 1096	n = 49	0.602
Employed	329 (30.0)	13 (26.5)	
Unemployed	767 (70.0)	36 (73.5)	
Place of asking for EMS use, n (%)	n = 1167	n = 49	0.234
Home	866 (74.2)	32 (65.3)	
Residential area	53 (4.5)	5 (10.2)	
Work place	6 (0.5)	0 (0)	
Street, freeway	102 (8.7)	5 (10.2)	
Medical facility	15 (1.3)	2 (4.1)	
Outdoor area	21 (1.8)	0 (0)	
Public facility	19 (1.6)	2 (4.1)	
Others	85 (7.3)	3 (6.1)	

EMS = emergency medical service; ED = emergency department.

immobilization, AED monitor, call for direct medical control and number of firefighters between groups. Wound care was more frequently conducted in the non-ED treatment group, and warming or cooling was conducted more often in the ED treatment group (Table 3). Prehospital wound care was the factor associated with not receiving treatment at the ED after EMS transports in geriatric patients (Table 4).

#### 3.4. Causes of not receiving treatment at ED

The causes of not receiving treatment at the ED were against medical advice (37% of patients) and based on doctors' suggestions (63%) in the non-ED treatment group. Common causes of against medical advice were patient's non-cooperation and desire to transfer to another hospital, followed by refusal of treatment after EMS use. Most common cause based on doctors' suggestions was doctors' decision that patients could be treated in OPD or another hospital, rather than at the ED, with patients or guardians accepting this decision (Table 5).

## 4. Discussion

In recent years, many countries realize that EMS transports are critical for prognosis of patients<sup>9–11</sup>. Appropriate EMS transports are critical to maintaining a high-quality EMS system<sup>6</sup>. Many studies have focused on unnecessary EMS transports. However the definition of unnecessary EMS transports has differed between studies. This study is meaningful as it extends the definition of unnecessary EMS transports by including patients that did not

**Table 2**  
Clinical characteristics of patients with or without ED treatment after EMS use.

	ED treatment (n = 1202)	Non-ED treatment (n = 49)	p-value
Symptom of patients, n (%)	n = 1200	n = 49	
Headache	57 (4.8)	1 (2.0)	
Chest pain	25 (2.1)	0 (0)	
Abdominal pain	106 (8.8)	2 (4.1)	
Back pain	42 (3.5)	0 (0)	
Other pain	281 (23.4)	13 (26.5)	
Laceration	30 (2.5)	2 (4.1)	
Mental deterioration	68 (5.7)	0 (0)	
Respiration difficulty	68 (5.7)	0 (0)	
Cardiac arrest	42 (3.5)	0 (0)	
Syncope	12 (1.0)	0 (0)	
Diarrhea/constipation	13 (1.1)	0 (0)	
Nausea/vomiting	76 (6.3)	3 (6.1)	
Hematemesis	10 (0.8)	1 (2.0)	
Other hemorrhaging	28 (2.3)	0 (0)	
Fever	35 (2.9)	1 (2.0)	
Dizziness	28 (2.3)	2 (4.1)	
Vertigo	13 (1.1)	2 (4.1)	
General weakness	115 (9.6)	7 (14.3)	
Paralysis	19 (1.6)	0 (0)	
Others	132 (11.0)	11 (22.4)	
Medical history, n (%)	n = 1200	n = 49	0.394
Yes	710 (59.2)	26 (53.1)	
No	490 (40.8)	23 (46.9)	
Characteristics of symptoms, n (%)	n = 1195	n = 49	0.599
Disease	870 (72.8)	34 (69.4)	
Non-disease	325 (27.2)	15 (30.6)	
Causes of non-disease	n = 326	n = 15	0.740
Traffic accident			
Driver	10 (3.1)	0 (0)	
Passenger	13 (4.0)	0 (0)	
Pedestrian	25 (7.7)	0 (0)	
Motorcycle	15 (4.6)	1 (6.7)	
Ground fall	143 (43.9)	7 (46.7)	
Others	120 (36.8)	7 (46.7)	
Alcohol intake, case n/total n (%)	43/1199 (3.6)	8/49 (16.3)	0.001
Systolic blood pressure, mmHg	126.3 ± 29.6 (n = 1149)	127.7 ± 16.3 (n = 47)	0.594
Diastolic blood pressure, mmHg	79.4 ± 18.7 (n = 1149)	79.9 ± 13.5 (n = 47)	0.860
Pulse, rate/min	80.4 ± 21.6 (n = 1170)	80.0 ± 8.6 (n = 46)	0.756
SpO <sub>2</sub> , %	95.2 ± 12.6 (n = 1151)	98.0 ± 1.5 (n = 47)	0.000
Glucose test, mg/dL	148.6 ± 95.1 (n = 201)	149.8 ± 98.0 (n = 9)	0.971
Level of consciousness, n (%)	n = 1194	n = 49	0.015
Alert	1064 (89.1)	49 (100)	
Non-alert	130 (10.9)	0 (0)	
Pupil light reflexes, n (%)	n = 1151	n = 49	0.258
Normal	1103 (95.8)	90 (100)	
Abnormal	48 (4.2)	0 (0)	

receive treatment at the ED, even though they used EMS transports.

A previous study reported that more intoxicated patients were admitted to the ED during the night, and that many were violent and refused to be treated<sup>12</sup>. The rate of alcohol intake was higher in the non-ED treatment group than the ED treatment group. The proportion of alcohol intake was higher in the non-ED treatment group than the ED treatment group. Patients in distress because of alcohol intake reportedly visit the ED more frequently compared to patients without alcohol intake<sup>13</sup>. Well trained prehospital medical providers can adequately triage drunken patients using specific prehospital EMS protocol<sup>13</sup>, therefore protocol for necessity of EMS transports in patients with alcohol intake may be necessary to maintain a high quality EMS system.

**Table 3**  
Prehospital treatment of patients with or without ED treatment after EMS use.

	ED treatment (n = 1202)	Non-ED treatment (n = 49)	p-value
Airway manipulation, n (%)	398 (33.1)	11 (22.4)	0.119
Oxygen supply, n (%)	n = 350	n = 7	0.349
Nasal prong	185 (52.9)	5 (71.4)	
Facial mask	56 (16.0)	2 (28.6)	
Non-rebreathing mask	77 (22.0)	0 (0)	
Bag valve mask	32 (9.1)	0 (0)	
Oxygen amount administered, L/min	6.9 ± 3.6 (n = 338)	3.6 ± 1.1 (n = 7)	0.000
Electrocardiogram monitor, case n/total n (%)	228/1200 (19.0)	6/49 (12.2)	0.235
Intravenous line, n (%)	72 (6.0)	2 (4.1)	1.000
Immobilization, case n/total n (%)	108/1201 (9.0)	3/49 (6.1)	0.796
Wound care, n (%)	109 (9.1)	11 (22.4)	0.005
Keep warm or cool, n (%)	252 (21.0)	4 (8.2)	0.029
AED monitor, n (%)	127 (10.6)	3 (6.1)	0.318
Direct medical control, n (%)	165 (13.7)	5 (10.2)	0.481
Number of firefighters, n (%)	n = 1200	n = 49	0.245
Two	1032 (86.0)	45 (91.8)	
Three	168 (14.0)	4 (8.2)	
Certificate of firefighters, n (%)	n = 2568	n = 102	
EMT intermediate	811 (31.6)	32 (31.4)	
EMT basic	732 (28.5)	31 (30.4)	
Nurse	704 (27.4)	26 (25.5)	
Education with first aid	252 (9.8)	11 (10.8)	
Others	69 (2.7)	2 (2.0)	

AED = automated external defibrillator; EMT = emergency medical technician.

**Table 4**  
Factors associated with non-ED treatment in patients with EMS transport.

	Odds ratio <sup>a</sup>	95% Confidence interval <sup>a</sup>	p-value <sup>a,b</sup>
Wound care	13.289	2.266–77.925	0.004

<sup>a</sup> Same results of unadjusted and adjusted analysis.

<sup>b</sup> Model included all the significant factors from univariate comparison including elapsed time from scene to arrival to ED, alcohol intake, SpO<sub>2</sub>, amount of oxygen administration, wound care, keep warm or cool with adjustment for age, sex or without adjustment.

**Table 5**  
Causes of non-ED treatment in patients with EMS transports.

	Total n = 49 (%)
Against medical advice, n (%)	18 (36.7)
Denial for treatment after EMS use	7 (14.3)
Uncooperative	5 (10.2)
Want transfer to another hospital	5 (10.2)
For OPD treatment	1 (2.0)
Based on doctor's suggestion, n (%)	31 (63.3)
No symptoms at ED arrival	1 (2.0)
Simply drunken state	1 (2.0)
Can be treated in OPD or other hospital	28 (57.1)
Repeated visits with same symptoms	1 (2.0)

ED = emergency department; EMS = emergency medical service; OPD = out-patient department.

The distance from each fire department to the scene may be same since the time from the EMS call to scene was not different, however it took longer to the ED from the scene in the non-ED treatment group than the ED treatment group. A prehospital delay from the scene to ED arrival increased mortality in several

studies<sup>14,15</sup>, however another study validated no relation between prehospital delay and mortality<sup>16</sup>. Presently, the lengthier time from the scene to ED arrival in the non-ED treatment group may have resulted from prehospital wound care or non-cooperation of the patient. Prehospital delay has been associated with prehospital treatment<sup>14</sup>. Prehospital wound care influenced not receiving ED treatment and prehospital time from scene to ED arrival was lengthier in the non-ED treatment group. The reasons for not receiving ED treatment after EMS transports in patients with prehospital wound care may be uncooperative attitude of the patient or the mild nature of the injury, obviating need for further treatment. However, we were unable to specify the specific reason since we did not investigate the environment of the injury scene through interviews with EMS personnel.

Fall-related injury was the most common cause of non-disease in both groups. Prehospital EMS protocol for geriatric patients with fall injury may be helpful to select the destination hospital for adequate treatment<sup>3</sup>, however it is not easy to decide to use EMS transports or not in a prehospital environment. A protocol to determine necessity of EMS transports, as well as the appropriate hospital for geriatric patients is necessary for adequate EMS transports.

We classified causes of not receiving ED treatment as against medical advice (patient-oriented) or based on doctors' suggestions (physician-oriented). The most common cause of patient refusal of medical advice was denial for treatment after EMS use, such as in recovery from hypoglycemia after glucose administration or minor trauma treated by wound care during EMS transports. A patient's desire to transfer to another hospital may be motivated by a desire to be treated in a hospital with less expensive medical care than the training hospital or a facility that was closer to the patient's house or where staff was familiar with the patient. Uncooperative cases were associated with higher proportion of alcohol intake and night time EMS transports in the non-ED treatment group, consistent with a previous study<sup>12</sup>. A patient cannot be discharged if a physician judges that the patient has obvious or potential medical issues, although the patient may refuse treatment at the ED in South Korea. Presently cases with patient's refusal of medical advice as the reason for not receiving ED treatment involved the lack of need of immediate treatment at the ED.

Results are limited in generalizability since this study was retrospective and involved a training hospital in one metropolitan city. EMS run sheets submitted to the ED after EMS transports may have missing information or errors compared to EMS run sheets finalized after return to the fire department. Causes of not receiving ED treatment in the non-ED treatment group were analyzed only by EMS run sheets without hospital medical records, so there may have been classification errors. We reduced this error by having experienced emergency physicians familiar with EMS run sheets conduct analyses. A medical doctor's initial judgment for patients not needing treatment at the ED even if transported by EMS may be mistaken if patients revisited the ED within 24 h. There were no cases of return to the study hospital ED within 24 h in this study, but we could not investigate cases that sought care at other ED units. It is necessary to verify if initial medical judgment for patients not requiring ED treatment is accurate or not, to improve the quality of studies on unnecessary EMS transports defined by authors. Another limitation is that reasons for denial of ED treatment after EMS use (Table 5) may include fear of high cost of ED treatment as well as return of symptoms due to prehospital management. Detailed causes for denial for ED treatment after EMS use were not investigated. Prospective multicenter studies that include hospital medical records and well as recorded EMS run sheets will be necessary to overcome the limitations.

## 5. Conclusion

Among geriatric patients that arrived at the ED by EMS transports, 4% did not receive ED treatment, that was unnecessary use of EMS transports. The non-ED group consisted of more patients in distress because of alcohol intake, higher oxygen saturation, more patients with an alert mentality, and more patients that received wound care than the ED treatment group. Prehospital wound care was the risk for not receiving ED treatment after EMS transports in geriatric patients. Unnecessary use of EMS transports is socially and economically wasteful and may pose a disadvantage to patients needing EMS transports. The effort to reduce unnecessary use of EMS transports is necessary to a maintain high quality EMS system.

## Conflict of interest

The authors declare no conflicts of interest with this study.

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