



Original Contribution

Effects of an emergency transfer coordination center on secondary overtriage in an emergency department☆



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ARTICLE INFO

Article history:

Received 19 March 2018

Received in revised form 8 May 2018

Accepted 28 May 2018

Keywords:

Secondary overtriage

Emergency transfer

Transfer coordination

ABSTRACT

Background: Patients who cannot be stabilized at a lower-level emergency department (ED) should be transferred to an upper-level ED by emergency medical services. However, some patients are subsequently discharged after transfer without any intervention or admission, and this secondary overtriage (SO) wastes the limited resources of upper-level EDs. This study aimed to investigate whether an emergency transfer coordination center (ETCC) could reduce the risk of SO among patients who were transferred to a tertiary ED by emergency medical services.

Methods: This retrospective observational study evaluated data from a prospective registry at an urban tertiary ED in Korea (January 2017 to May 2017). The exposure of interest was defined as ETCC approval prior to transfer and the primary outcome was SO. Univariate analyses were used to identify statistically significant variables, which were used for a multivariate logistic regression analysis to estimate the effects of ETCC approval on SO.

Results: During the study period, 1270 patients were considered eligible for this study. A total of 291 transfers were approved by the center's ETCC, and the remaining patients were transferred without approval. Compared to cases without ETCC approval, cases with transfer after ETCC approval had a significantly lower risk of SO (odds ratio: 0.624, 95% confidence interval: 0.413–0.944).

Conclusion: Transfers that were evaluated by an ETCC had a lower risk of SO, which may improve the appropriateness of transfer. Thus, tertiary EDs that have high proportions of transferred patients should have a transfer coordination system that is similar to an ETCC.

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1. Introduction

Patients who cannot be stabilized at a lower-level emergency department (ED) should be transferred to an upper-level ED by emergency medical services (EMS) [1]. Furthermore, when the initial hospital lacks the resources to provide for hospitalization after patients stabilization, patients should also be transferred to an appropriate facility by EMS [2,3]. This process has led to an increased proportion of patients who, after transfer to the ED in a tertiary hospital, are discharged relatively rapidly without any intervention or admission [4]. This secondary overtriage (SO) wastes the limited resources of

upper-level EDs, delays definitive care, and creates economic and psychological burdens on the patient and their caregivers [5,6]. Therefore, medical staff at the receiving hospital needs a process to evaluate the need for transfer and determine whether the transfer is appropriate through efficient communication with physicians at the referring hospital [7]. However, the lack of integrated communication systems for emergency transfer can delay the transfer and increase the burden on ED physicians [8], who may order transfer to a tertiary hospital without prior approval. Moreover, while Korea has a law similar to the Emergency Medical Treatment and Labor Act, it is not legally enforced, unlike in the US [9]. This might further drive physicians to order unapproved transfers that have an increased risk of SO.

Although many studies have evaluated SO, we are not aware of any studies that have evaluated interventions for reducing SO. Moreover, most studies have only included trauma cases and have focused on the incidence and causes of SO [4,10–13]. Our tertiary ED has an emergency transfer coordination center (ETCC), which coordinates interfacility communication regarding emergency transfers. The ETCC has been physically in place at our tertiary ED since 2012. It was

Abbreviations: ETCC, emergency transfer coordination center; SO, secondary overtriage; ED, emergency department; EMS, emergency medical service; ICU, intensive care unit; CT, computed tomography; KTAS, Korean triage and acuity scale; LOS, length of stay.

☆ Clinical trial number and registry URL: Not applicable. Prior presentations: Not applicable.

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developed to better organize interfacility transfers through the ED, which helps prevent inappropriate emergency transfers and improves the utilization of the ED's limited medical resources. Therefore, the present study examined whether ETCC approval was associated with a lower risk of SO among patients who were transferred to our ED by EMS.

2. Methods

This retrospective observational study evaluated prospectively collected data from a patient registry at an urban tertiary teaching hospital in Korea. The study's protocol adhered to the STROBE statement, and was approved by the appropriate institutional review board (approval number 4-2016-0724). The requirement for informed consent was waived, and the study protocol complies with the tenets of the Declaration of Helsinki.

2.1. Study setting and population

In Korea, EDs are designated as level 1, 2, or 3 by a government health authority, and the designation is based on the ED's human resources, emergency equipment, and availabilities of medical service and specialists. By law, level 1 and level 2 EDs must have 24-h/day staffing by board-certified emergency physicians [14]. The ETCC at our center is in a level 1 ED with approximately 80,000 annual visits. This ED is located in northwestern Seoul (the capital city of Korea) and is responsible for receiving patients who could not be stabilized in its catchment area. Among the approximately 80,000 annual visits to this ED, approximately 4000 patients (5%) are transferred from other hospitals by EMS because the referring center was unable to manage these patients' medical conditions. Approximately 25% of all patients who visit the ED are subsequently admitted to our hospital.

The present study evaluated all consecutive patients who were transferred by EMS to our ED between January 2017 and May 2017. However, patients who were <18 years were excluded from the present study because the ETCC is not involved in the referral of pediatric patients. In addition, patients with missing data or electronic medical records were excluded from the analysis.

2.2. Study protocol

The ETCC is staffed by six coordinators and nine board-certified emergency physicians, with each shift consisting of one coordinator and one emergency physician. The coordinators are nurses with ≥ 5 years of ED experience, who use a computerized system to perform real-time monitoring of intensive care unit (ICU) and ward statuses, availability of operating rooms, and equipment needed for emergency treatment. When a patient is referred to this ED, the coordinator is supposed to collect the patient's information according to standardized protocols. The coordinator then shares information with the emergency medical staff regarding the patient, available equipment, and space in the hospital to obtain approval for the transfer. If the opinion of subspecialty staff is needed to approve the transfer, the coordinator includes their feedback in the decision-making process. The ETCC protocol mandates that transfers should be approved whenever there is sufficient capacity in the ED, and emergency transfers from the catchment area are approved regardless of admitting unit availability if primary stabilization is considered the highest priority. Transfers may be refused for the following reasons: 1) ED crowding does not allow immediate and appropriate emergency management for the transferred patient, 2) the ICU is not available for transfers that require ICU admission, 3) there is a lack of the necessary specialist(s) or emergency equipment, and 4) transfer via the ED is considered inappropriate (i.e., a non-urgent transfer that does not require primary stabilization in the ED, with full capacity at the admissions unit).

2.3. Data source and collection

The study data were retrospectively collected from an EMS transfer registry, which contains prospectively collected data regarding patient age, sex, ED visit time and date, insurance status, reason for transfer, computed tomography (CT) scan status, and patient location and stage at the referring facility (throughput or output) [15]. The reason for transfer was classified as either a lack of capacity for emergency management or other reasons. The registry also contained data regarding whether the transfer was approved by the ETCC, any consulted subspecialty, the patient's disposition after transfer, the Korean triage and acuity scale score (KTAS; level 1 indicates the most severe cases), and a crowding index, which is automatically determined by the computerized system based on the number of ED patients at the time of the transfer.

2.4. Outcome definition and measurement

The primary outcome was SO, which was defined as discharge within 24 h and without definitive treatment that addressed the cause of the transfer (e.g., an emergency procedure or definitive subspecialty treatment). The proportion of SO cases was compared between transfers with and without ETCC approval. Transfer without ETCC approval included both patients who were contacted by ETCC but were refused, and those who were transferred without ETCC contact. Using data from patients who were hospitalized after the transfer, we performed a secondary analysis of their ED length of stay (LOS) according to ETCC approval status.

2.5. Statistical analysis

Categorical variables were reported as number and percentage, while continuous variables were reported as mean \pm standard deviation. The Student's *t*-test was used to analyze differences in continuous variables between the two groups, and the chi-square test was used to analyze categorical variables. Differences were considered statistically significant at *P*-values of <0.05 . Univariate analyses were used to compare the baseline characteristics of the groups with and without ETCC approval, and variables with a univariate *P*-value of <0.1 were included in the multivariate logistic regression analysis. The ED LOS values from the groups with and without ETCC approval were also compared using multivariate linear regression analysis. All statistical analyses were performed using SAS software (version 9.4; SAS Inc.).

3. Results

The EMS transfer registry revealed that 1385 patients were transferred to this ED during the study period, although 109 patients (7.9%) were excluded because they were <18 years old and 6 patients were excluded because of incomplete electronic medical records. Thus, 1270 patients were included in the study, with 291 patients transferred after ETCC approval and the remaining 979 patients transferred without ETCC approval. The rates of SO were 13.4% among approved transfers (39/291) and 22.2% (217/979) among non-approved transfers (Fig. 1). The patient's baseline characteristics according to ETCC approval status are shown in Table 1.

In the univariate analyses, the risk of SO was significantly associated with crowding index, CT scan and patient location at the referring facility, reason for transfer, KTAS level, and subspecialty consultation (Table 2). Those factors were subsequently included in the multivariate logistic regression analysis (Table 3), which revealed that the ETCC approval group had a lower risk of SO than the non-approved group (odds ratio: 0.624, 95% confidence interval: 0.413–0.944). The other risk factors for SO were CT scan at the referring facility, reason for transfer, KTAS level, and neurology or minor surgery consultations. The

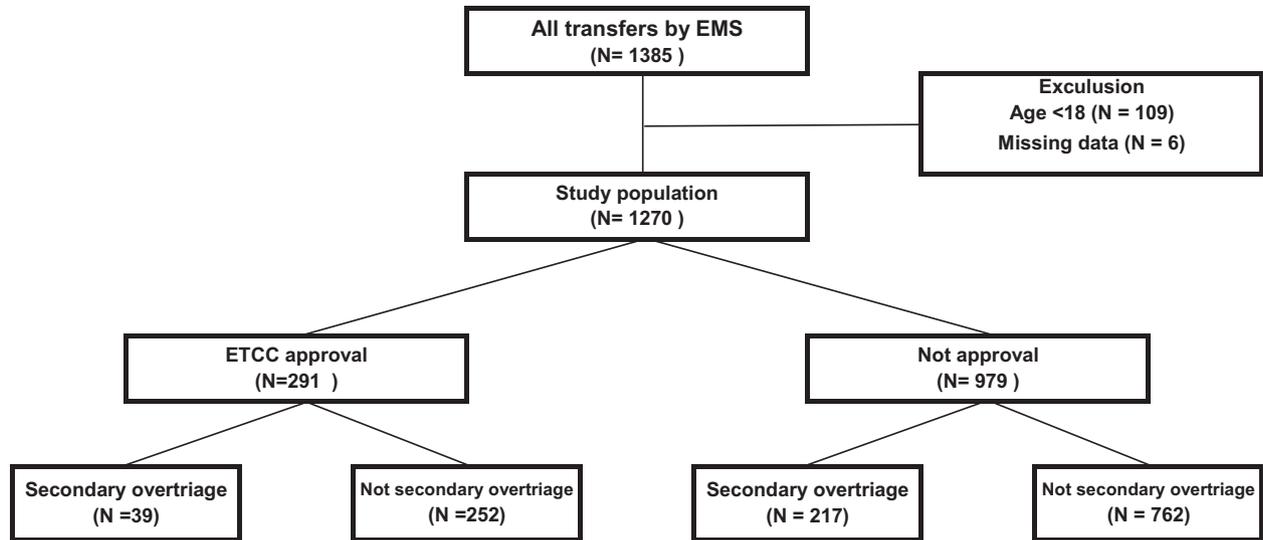


Fig. 1. Flowchart of the study population between January 2017 and May 2017. EMS = emergency medical service; ETCC = emergency transfer coordination center.

results of the Hosmer-Lemeshow test indicate that the multivariate model was well calibrated ($P = 0.638$).

Among the included patients, 1004 patients were admitted to our hospital. Multivariate linear regression analysis was performed to determine

whether ETCC approval was associated with ED LOS (Table 4). The results indicate that the ETCC approval group has an ED LOS that was approximately 45 min shorter than the non-approved group, although this result was not statistically significant (adjusted R^2 : 0.197).

Table 1
Patient characteristics and outcomes according to emergency transfer coordination center approval status.

| | | No approval (n = 977) | ETCC approval (n = 291) | P-value |
|---|----------------------------|--------------------------|----------------------------|---------|
| Age (years) | | 64.67 ± 18.31 | 62.63 ± 17.74 | 0.094 |
| Sex | Female | 473 (48.41%) | 142 (48.80%) | 0.909 |
| | Male | 504 (51.59%) | 149 (51.20%) | |
| Crowding index | | 48.79 ± 11.00 | 45.10 ± 10.53 | <0.001 |
| CT scan at referring facility | Not performed | 660 (67.55%) | 176 (60.48%) | 0.025 |
| | Performed | 317 (32.45%) | 115 (39.52%) | |
| Location at referring facility | ED | 474 (48.52%) | 228 (78.35%) | <0.001 |
| | Ward | 467 (47.8%) | 56 (19.24%) | |
| | ICU | 36 (3.68%) | 7 (2.41%) | |
| Trauma status | Non-trauma | 825 (84.44%) | 264 (90.72%) | 0.007 |
| | Trauma | 152 (15.56%) | 27 (9.28%) | |
| Reason for transfer | Lack of capacity | 721 (73.80%) | 177 (60.82%) | <0.001 |
| | Other reasons ^a | 256 (26.20%) | 114 (39.18%) | |
| | Throughput | 720 (73.69%) | 221 (75.95%) | |
| ED stage at referring facility | Output | 257 (26.31%) | 70 (24.05%) | 0.441 |
| | Level 1 | 37 (3.79%) | 15 (5.15%) | |
| KTAS | Level 2 | 211 (21.60%) | 103 (35.4%) | <0.001 |
| | Level 3 | 428 (43.81%) | 124 (42.61%) | |
| | Level 4 | 260 (26.61%) | 46 (15.81%) | |
| | Level 5 | 41 (4.20%) | 3 (1.03%) | |
| | None | 1 (0.10%) | 1 (0.34%) | |
| Insurance | Korea Medicaid type 1 | 40 (4.09%) | 11 (3.78%) | 0.149 |
| | Korea Medicaid type 2 | 4 (0.41%) | 2 (0.69%) | |
| | National health insurance | 885 (90.58%) | 271 (93.13%) | |
| | Private insurance | 47 (4.81%) | 6 (2.06%) | |
| | None | 1 (0.10%) | 1 (0.34%) | |
| Consulted subspecialty | Cardiology | 113 (11.57%) | 87 (29.9%) | <0.001 |
| | Internal medicine | 417 (42.68%) | 118 (40.55%) | |
| | General surgery | 63 (6.45%) | 20 (6.87%) | |
| | Orthopedics | 105 (10.75%) | 1 (0.34%) | |
| | Neurology | 67 (6.86%) | 15 (5.15%) | |
| | Neurosurgery | 103 (10.54%) | 19 (6.53%) | |
| | Other subspecialty | 109 (11.16%) | 31 (10.65%) | |
| | On-hours | 503 (51.48%) | 114 (39.18%) | |
| Arrival to referred facility ^b | Off-hours | 474 (48.52%) | 177 (60.82%) | 0.002 |

Data are reported as mean ± standard deviation or number (%).

^a Other reasons for transfer included lack of bed availability in the referring center and the request of the patients or their caregivers.

^b On-hours: 9 am to 6 pm; Off-hours: 6 pm to 9 am of the next day, weekends, and holidays. ETCC: emergency transfer coordination center; CT: computed tomography; ED: emergency department; ICU: intensive care unit; KTAS: Korean triage and acuity scale.

Table 2
Univariate analysis of secondary overtriage.

| | | OR (95% CI) | P-value |
|---|----------------------------|----------------------|---------|
| ETCC status | Not approved | Ref | – |
| | Approved | 0.542 (0.375–0.784) | 0.001 |
| Age | | 1.003 (0.996–1.011) | 0.392 |
| Sex | Female | Ref | – |
| | Male | 0.812 (0.617–1.069) | 0.137 |
| Crowding index | | 0.987 (0.975–0.999) | 0.041 |
| CT scan at referring facility | Not performed | Ref | – |
| | Performed | 0.571 (0.418–0.779) | 0.004 |
| Location at referring facility | ED | Ref | – |
| | Ward | 0.990 (0.749–1.310) | 0.946 |
| | ICU | 0.186 (0.044–0.778) | 0.021 |
| Trauma vs. non-trauma | Non-trauma | Ref | – |
| | Trauma | 1.104 (0.752–1.621) | 0.615 |
| Reason for transfer | Other reasons ^a | Ref | – |
| | Absence of capacity | 1.758 (1.264–2.446) | 0.008 |
| ED stage at referring facility | Output | Ref | – |
| | Throughput | 0.953 (0.698–1.301) | 0.763 |
| KTAS | Level 1 | 0.041 (0.002–0.687) | 0.026 |
| | Level 2 | 0.745 (0.511–1.087) | 0.127 |
| | Level 3 | ref | – |
| | Level 4 | 1.762 (1.272–2.440) | 0.007 |
| | Level 5 | 2.737 (1.440–5.204) | 0.002 |
| Insurance | Korea Medicaid type 1 | Ref | – |
| | Korea Medicaid type 2 | 0.705 (0.091–5.445) | 0.738 |
| | National health insurance | 0.614 (0.327–1.153) | 0.129 |
| | Private insurance | 1.462 (0.637–3.352) | 0.370 |
| Consulted subspecialty | None | 0.519 (0.012–22.395) | 0.733 |
| | Cardiology | Ref | – |
| | Internal medicine | 0.793 (0.512–1.227) | 0.298 |
| | General surgery | 0.573 (0.262–1.254) | 0.163 |
| | Orthopedics | 1.420 (0.797–2.529) | 0.234 |
| | Neurology | 1.951 (1.071–3.552) | 0.029 |
| | Neurosurgery | 1.095 (0.612–1.960) | 0.759 |
| | Other subspecialty | 3.857 (2.354–6.320) | <0.001 |
| Arrival to referred facility ^b | Off-hours | ref | – |
| | On-hours | 0.947 (0.720–1.246) | 0.698 |

^a Other reasons for transfer included lack of bed availability in the referring center and the request of the patients or caregivers.

^b On-hours: 9 am to 6 pm; Off-hours: 6 pm to 9 am of the next day, weekends, and holidays. ETCC: emergency transfer coordination center; CT: computed tomography; ED: emergency department; ICU: intensive care unit; KTAS: Korean triage and acuity scale.

Table 3
Multivariate analysis of secondary overtriage.

| | | OR (95% CI) | P-value |
|--------------------------------|----------------------------|---------------------|---------|
| ETCC status | Not approved | Ref | – |
| | Approved | 0.624 (0.413–0.944) | 0.026 |
| Crowding index | | 0.987 (0.974–1.001) | 0.062 |
| CT scan at referring facility | Not performed | Ref | – |
| | Performed | 0.526 (0.367–0.753) | 0.005 |
| Location at referring facility | ED | Ref | – |
| | Ward | 0.956 (0.695–1.317) | 0.785 |
| | ICU | 0.324 (0.086–1.219) | 0.096 |
| Reason for transfer | Other reasons ^a | Ref | – |
| | Absence of capacity | 1.607 (1.123–2.299) | 0.010 |
| KTAS | Level 1 | 0.033 (0.002–0.550) | 0.018 |
| | Level 2 | 0.776 (0.521–1.156) | 0.212 |
| | Level 3 | ref | – |
| | Level 4 | 1.739 (1.209–2.501) | 0.003 |
| | Level 5 | 2.516 (1.240–5.105) | 0.011 |
| Consulted subspecialty | ref | – | – |
| | Cardiology | 0.665 (0.418–1.057) | 0.084 |
| | Internal medicine | 0.537 (0.240–1.198) | 0.129 |
| | General surgery | 0.868 (0.453–1.662) | 0.669 |
| | Orthopedics | 2.220 (1.162–4.242) | 0.016 |
| | Neurosurgery | 1.272 (0.671–2.412) | 0.461 |
| Other subspecialty | 3.322 (1.946–5.670) | <0.001 | |

^a Other reasons for transfer include lack of bed availability in the referring center and the request of the patients or caregivers. ETCC: emergency transfer coordination center; CT: computed tomography; KTAS: Korean triage and acuity scale.

4. Discussion

To the best of our knowledge, only a few studies have examined SO among all transferred patients, and the existing studies have not examined interventions that can lower the incidence of SO [4,10–13]. Furthermore, there is no consensus regarding the definition of SO, and previous studies have mainly defined SO as a case of discharge without any surgical intervention that occurred within 24–48 h after ED presentation [11,16]. However, addressing this issue requires a definition of SO that quantitatively determines whether the transfer was ultimately unnecessary. Morphet et al. have suggested that referring lower-level facilities should focus on avoiding unnecessary transfers, rather than simply being afraid of discharge from the referred center or return to the referring center [17]. Therefore, we defined SO as cases that involved discharge within 24 h and without definitive treatment that addressed the cause of the transfer (e.g., an emergency procedure or definitive subspecialty treatment).

Malpass et al. have suggested that a simple referral protocol can be used to standardize communication and improve outcomes among critically ill patients who undergo interhospital transfer, which allows the physicians at both centers to discuss the patient's status and appropriate management [7]. In addition, a transfer system similar to our ETCC was able to increase the appropriateness of emergency transfers to an academic medical center [18]. These processes seem to allow the ETCC to examine the cost/benefit of the transfer based on the patient's status in the referring facility and the availability of medical resources at the accepting ED. However, physicians at lower-level facilities without a transfer communication system may feel burdened by the considerable time and effort that is needed to transfer patients to other facilities [8], and the absence of a transfer system is associated with delayed transfers and prolonged ED LOS [19,20]. Moreover, delayed transfer can increase the time to critical treatment in the referred hospital, and increased the risk of mortality [7]. Thus, physicians at lower-level centers may order an unapproved transfer, based on real or anticipated deterioration in the patient's condition, if they do not receive sufficiently rapid approval of the transfer. However, recent studies have provided evidence that this approach is counterproductive, as patient stabilization before the transfer and adequate interfacility communication are factors that improve patient outcomes [21–23]. Interestingly, our ETCC dataset revealed that an average of 10 min was required to respond to a transfer request, which may indicate that the ETCC facilitated rapid and accurate assessment of the transfer's suitability, which prevented unnecessary transfers and reduced SO.

Among patients who are transferred to upper-level EDs, there is a high proportion of non-urgent cases that are admitted via ED, rather than urgent transfer [6,24]. Thus, if the receiving hospital has reached its capacity, poorly coordinated non-urgent transfers are likely to result in SO. Therefore, our ETCC protocol allows the coordinator, in cases of non-urgent transfer, to instruct the patient to visit our outpatient department or instruct the referring center's staff to initiate a ward-to-ward transfer. These factors may also explain why the ETCC was able to reduce SO.

In tertiary EDs, prolonged ED LOS is mainly related to a long boarding time, which is associated with poor patient outcomes [25–27]. In our center, the ETCC protocol determines whether the patient requires hospitalization after the transfer, and evaluates whether there is room in the appropriate admission unit (including the ICU). However, many of the cases that are transferred to tertiary EDs are thought to require an emergency evaluation and there is no clear final diagnosis [6]. Thus, our ETCC only approves these transfers from low-level facilities if the ED has the capability to admit the patient, even if the admission unit is full. Therefore, these patients may have a long boarding time, which could explain why our ETCC protocol did not reduce the ED LOS among hospitalized patients after transfer.

The present study revealed that several factors affected SO, independent of ETCC approval. For example, we confirmed that severity of the

Table 4
Multivariate analysis of emergency department length of stay.

| | | β (SE) | P-value |
|---|----------------------------|--------------------|---------|
| ETCC status | Not approved | Ref | – |
| | Approved | –44.890 (36.554) | 0.210 |
| Age | | 1.584 (0.895) | 0.077 |
| Crowding index | | 6.934 (1.364) | <0.001 |
| CT scan at referring facility | Not performed | Ref | – |
| | Performed | 0.557 (33.860) | 0.987 |
| Location at referring facility | ED | Ref | – |
| | Ward | 66.753 (32.771) | 0.042 |
| Trauma vs. non-trauma | ICU | –201.919 (78.332) | 0.010 |
| | Ref | Ref | – |
| Reason for transfer | Non-trauma | Ref | – |
| | Trauma | –47.759 (57.834) | 0.042 |
| KTAS | Other reasons ^a | Ref | – |
| | Absence of capacity | 22.340 (32.533) | 0.492 |
| Insurance | Level 1 | –170.238 (70.403) | 0.016 |
| | Level 2 | –99.736 (36.615) | 0.007 |
| | Level 3 | Ref | – |
| | Level 4 | 38.039 (40.005) | 0.342 |
| | Level 5 | –92.028 (91.363) | 0.314 |
| Consulted subspecialty | Korea Medicaid type 1 | Ref | – |
| | Korea Medicaid type 2 | –52.051 (220.097) | 0.813 |
| | National health insurance | –104.131 (76.706) | 0.175 |
| | Private insurance | –134.676 (111.611) | 0.260 |
| | None | –374.169 (332.121) | 0.228 |
| Arrival to referred facility ^b | Cardiology | Ref | – |
| | Internal medicine | 314.288 (43.039) | <0.001 |
| | General surgery | –56.667 (67.277) | 0.400 |
| | Orthopedics | 9.446 (81.905) | 0.908 |
| | Neurology | 17.866 (73.167) | 0.807 |
| | Neurosurgery | –30.383 (65.426) | 0.643 |
| | Other subspecialty | 19.133 (68.463) | 0.780 |
| Off-hours | Off-hours | Ref | – |
| | On-hours | 6.930 (29.817) | 0.816 |

^a Other reasons for transfer include lack of bed availability in the referring center and the request of the patients or caregivers.

^b On-hours: 9 am to 6 pm; Off-hours: 6 pm to 9 am of the next day, weekends, and holidays. SE: standard error, ETCC: emergency transfer coordination center; ED: emergency department; ICU: intensive care unit; KTAS: Korean triage and acuity scale.

patient's condition was independently associated with SO, which is consistent with the findings of previous studies [11,12]. The present study also revealed that performing CT at the referring center reduced the risk of SO, which has also been described in previous reports [13,28]. The lack of radiology services in rural EDs causes numerous transfers to tertiary EDs each year, with most of these cases involving the absence of CT or inability to interpret CT finding [28,29]. Thus, if normal CT results are detected at the tertiary ED, the patient would be discharged quickly and without any intervention, which would contribute to the occurrence of SO. We also found that SO was associated with transfers that required consultation with a minor surgery or neurology specialist. In this context, patients with minor injury have an increased likelihood of being inappropriately transferred to tertiary EDs [4,30]. In addition, advanced neurological assessments (e.g., brain magnetic resonance imaging or a portable electroencephalogram) can be performed in the present ED without admission, which could explain the elevated risk of SO among patients who required a neurological consultation. The present study also revealed that transfers caused by insufficient stabilizing capacity at the referring hospitals were associated with SO. In the present study, other reasons for transfer included the lack of bed availability at the referring center and the request of the patients or caregivers. Transfers caused by insufficient stabilizing capacity at the referring center mainly involved lower-level facilities with limited resources for emergency assessment [1]. In this context, one study examined elderly care facilities with a lack of capacity for the required evaluations, and revealed that 54.9% of patients who were transferred to upper-level facilities were subsequently returned to the referring hospital [17].

The present study has several strengths, including the fact that it considered all patients who were transferred via EMS, rather than

only trauma causes. Second, our tertiary ED provides emergency services 24 h/day and treats patients from throughout Korea. Thus, this center is ideal for studying the overall status of transferred patients. Moreover, most guidelines regarding interfacility transfer recommend clear communication between the referring and receiving centers, which should be guided by a protocol for stabilizing patients [22,23]. The present study has significant implications for quantitatively evaluating the practical effects of these recommended protocols.

In Korea, a generally authorized central agency is responsible for coordinating emergency transfers [31], although it is difficult for this agency to intervene, because emergency transfer approvals must consider the real-time variability between centers. Furthermore, critical care transfers require significant effort and teamwork to complete successfully [32], which makes it difficult for centralized coordinating to efficiently manage complex emergency transfers. Therefore, our ETCC model may be a practical method to control all emergency transfers in the catchment area.

4.1. Limitations

This present study has several limitations. First, the retrospective design is prone to the effects of unidentified confounders. Moreover, the vast majority of the transfers in the present setting were sent without ETCC approval. In addition, some transfers may have been performed with non-ETCC approval through private communication channels. However, those cases are generally approved by the subspecialty physician who is responsible for the admission unit, which would decrease the risks of SO and prolonged ED LOS. Therefore, these alternate approvals would be unlikely to change the directions of the associations that we observed. Furthermore, our research was conducted in Korea, so it is difficult to generalize our results globally. Finally, the present study did not include transferred pediatric patients, who have a higher risk of SO than adult patients [33,34], and further studies are needed to determine whether ETCCs can be effective for managing pediatric patient transfers.

5. Conclusions

This study evaluated patients who were transferred to a tertiary ED in a major Korean city, and revealed that the ETCC reduced the rate of SO. Therefore, it may be useful for tertiary EDs that are central in a catchment area to have a system that is capable of coordinating interfacility transfers.

Declarations of interest

None

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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