Predictors of Mortality among Inter-Hospital Transferred Patients in a Middle-Income Country: a Retrospective Cohort Study

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ABSTRACT

Objective: To identify predictors for hospital mortality among inter-hospital transferred patients in low-resource settings of rural hospitals in Thailand.

Methods: We conducted a retrospective cohort study of patients transferred from emergency room(ER) of a community hospital to its designated tertiary care hospital in a western province of Thailand. During March 2018 and February 2019, medical records of 412 patients were reviewed and extracted for potential predictor variables and outcomes. We defined deaths within 72 hrs after a transfer as primary outcome and overall hospital mortality as secondary outcome. Multivariate logistic regression analysis was performed to identify predictors of the outcomes adjusted for potential confounders.

Results: Out of 412 patients, a total of 37 patients (9.0%) died during the stay in receiving hospital and 18 (4.4%) of them died within 72 hrs after transfer. Top ten primary diagnostic categories included road traffic injuries (19.7%), acute appendicitis (9.7%), and acute myocardial infarction (5.1%). Univariate analysis revealed early mortality (<72 hrs) was associated with NEWS2, Emergency Severity Index (ESI), cardiac arrest prior to transfer, use of vasoactive agents, endotracheal intubation and admitting service. Using multiple logistic regression model adjusted for the predictors identified by univariate analysis, we found early mortality was independently associated with NEWS2 ≥ 9 (compared to NEWS2 0-6) with OR= 17.51(95%CI 3.16-97.00) and vasoactive medication use (OR= 5.46, 95%CI 1.39-21.46). Similarly, overall mortality was also independently associated with NEWS2 ≥ 9(OR= 4.76, 95%CI 1.31–17.36) and vasoactive medication use (OR= 7.51,95%CI 2.76 -20.45).

Conclusion: This study identified predictors of early (<72 hrs) hospital mortality and overall hospital mortality among ER patients transferred from a rural community hospital to its designated tertiary care hospital in Thailand, a middle-income country with universal healthcare coverage. The findings might be helpful to inform decision-making dealing with the inter-hospital transfer of ER patients in resource-poor rural settings with similar case-mix.

Keywords: Patient transfer; critical illness; prognosis; mortality (Siriraj Med J 2021; 73: 312-321)

INTRODUCTION

Inter-hospital transfer(IHT) is considered a complex and challenging practice, requiring multiple resources and coordination from varied healthcare providers.[1] The transitional process is vulnerable for discontinuity error, combining with restricted resources outside hospital

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settings during transport, IHT patients are at risk of adverse events and unsatisfied outcomes.[2]

Additional to the systemic threats, growing evidence demonstrated higher acute severity, a longer length of stay, higher hospital mortality and higher resources use in IHT patients when compared to non-IHT cases.[3-7] These undesirable outcomes of IHT patients could be due to heterogeneity among IHT patients depending on the diagnosis, presenting a nuanced assessment of this complex care transition.[8] Variability in transfer practices means ambiguity and subjectivity in decision making between transferring physicians and receiving physicians.[9,10] Standardization of the care processes is considered a means to minimize the variability, which is amenable to improving the quality of care among IHT patients.[11]

According to earlier studies, prognostic factors for early death (<72 hrs) included male gender, summer season, admitting service, diagnostic related group level, Charlson Comorbidity Score, insurance type, and major diagnostic category. For overall hospital mortality, prognostic factors included length of stay, medical complication, distance traveled, insurance type, and major diagnostic category.[5,6,8] Application of such knowledge in overcrowded emergency room (ER) settings is a challenge.

As a result several triage systems have been proposed and were found to be significantly related with admission rate and medical resource consumption.[,4,5] According to previous reports, triage systems such as Acute Physiology and Chronic Health Evaluation (APACHE) or Sequential Organ Failure Assessment (SOFA) were frequently applied to estimate disease severity in IHT patients.[4,5,12,13] However, some parameters (e.g., arterial oxygenation and blood pH) in these scoring systems may not be available at ER of rural community hospital settings where resources are limited.

In Thailand, many hospitals, especially in rural areas, have no standardized decision-support and communication tool during patient transfer. Even in a similar patient, management decisions may differ as there is variation in clinical practices among physicians. This study intends to identify predictors of IHT patients using basic parameters, which are generally available at ER of rural community hospitals in Thailand. The expected findings might be useful to facilitate patient care during IHT.

MATERIALS AND METHODS

This study was approved by the Office for Research Ethics Committee of Hua Hin Hospital, Prachuap Khiri Khan, Thailand (RECHHH145/2019).

Setting

Our study involved ER patients transferred from a community hospital to its designated tertiary care hospital in a western province of Thailand, a middle-income country with universal healthcare coverage. The community hospital is a 60-bed public hospital (No intensive care bed) staffed with 1 pediatrician, 7 general practitioner physicians, 5 pharmacists, and 54 nurses. Four ambulances equipped with an oxygen tank, suction, blood pressure monitor, and a defibrillator. are available for IHT and Emergency Medical Services. At ER of the community hospital, there are 1 physician, 3 ER nurses, and 2 assistant nurses for each 8-hour shift. The estimated nurse-to-patient ratio in the ER is 1 to 9. The estimated annual number of IHT patients from ER and inpatient care are 750. The receiving hospital is a 278-bed (12 intensive care beds) tertiary hospital staffed with 4 internists, 1 gastroenterologist, 1 nephrologist, 4 general surgeons, 2 neurosurgeons, 3 orthopedic surgeons, 2 ophthalmologists, 3 obstetricians, and 2 pediatricians. The distance between the two hospitals is 43 kilometers, with an average ground transport time of 30 minutes.

When a transfer decision is determined, a primary care doctor will contact the transfer operation center in the receiving hospital. After receiving the referral request, the center, operated by registered nurses, will notice the specialist and present all the patient information. The teleconsultant will be provided for initial management. If the referral request is accepted, the patient will be transported to the emergency department (ED) of the tertiary hospital, where the patient's conditions are reevaluated before a decision for hospitalization. ER patients deemed a need for IHT are accompanied by an ambulance staffed with a nurse and a nurse assistant. As there is no clinician accompanies the ambulance, the emergency patient needs to be stabilized enough before transfer.

Study design

A retrospective cohort study was conducted during March 2018 and February 2019. We included adult patients aged 16 or above who were transferred from ER of the transferring hospital and hospitalized at the tertiary care hospital. We excluded obstetric patients, pediatric patients, IHT patients not hospitalized at the receiving hospital and patients with incomplete data. Patients with multiple transfers were considered the same episode.

The authors, working independently in two teams, reviewed all the extracted data from electronic and/or paper-based medical records using a standard data form.

The first team, working as primary care doctor in the community hospital, documented patients' characteristics consisting of demographics, health insurance status, primary diagnosis categories based on the International Statistical Classification of Diseases and Related Health Problems (ICD-10), underlying diseases, past medical history, physiological parameters and severity categories according to the Emergency Severity Index (ESI). The ESI is a five-level triage scale, ranging from level 5 (Non-urgent) to ESI level 1 (Resuscitative), based on patient acuity and resource needs.[14] The ESI system has been used primarily in Thailand for triaging ER patients.[15] National Early Warning Score 2 (NEWS2) for each patient was calculated from the physiological parameters on arrival at the ER to represent acute severity index of IHT patients. This aggregated scoring system is built from six basic parameters including respiratory rate, oxygen saturation, temperature, systolic blood pressure, heart rate, and level of consciousness.[16] Underlying diseases and past medical history were reviewed and calculated into the Charlson's comorbidity score.[17] Apart from those variables, the following were also included: events before the transfer (cardiac arrest, use of vasoactive drugs, and endotracheal intubation); transfer time in minutes (starting from a patient's arrival at the transferring hospital until admission at the receiving hospital). The second team, working as a general practitioner at the receiving hospital, extracted patient outcomes from electronic health records, consisting of diagnosis based on ICD-10, length of stay, and discharge status. Within 72-hour mortality after IHT was considered primary outcome and overall hospital mortality as secondary outcome.

Data analysis

Data analysis was conducted using STATA statistical software version 14. Continuous and categorical variables were presented as means with standard deviation (SD) and as frequencies with percentages, respectively. To identify potential predictors, patient characteristics of those with or without the outcomes were compared using Student's t-test for continuous variables and Chi-square test for categorical variables.

Multivariate logistic regression models using backward stepwise regression for variables selection were developed to identify predictors of the outcomes. Parameters associated with a p-value below 0.25 were included in the initial model. Highly related parameters were removed to diminish multicollinearity. Least significant factors were deleted one by one according to a backward elimination algorithm until reaching the final models. The receiver operating characteristic curve (ROC) was developed with a calculated area under the curve(AUC) to inform model performance. P-values (p) less than 0.05 were considered as statistically significant.

RESULTS

There were 519 patients transferred from ER of the community hospital to the designated receiving hospital during the study period (Fig 1). After applying the inclusion and exclusion criteria, 412 patients were entered into the study. Among them, 11 patients revisited ER of the transferring hospital and were re-hospitalized to the tertiary hospital twice, and 3 more patients faced these experiences for three times. Thirty-seven patients (9.0%) died upon discharge, half of them died within

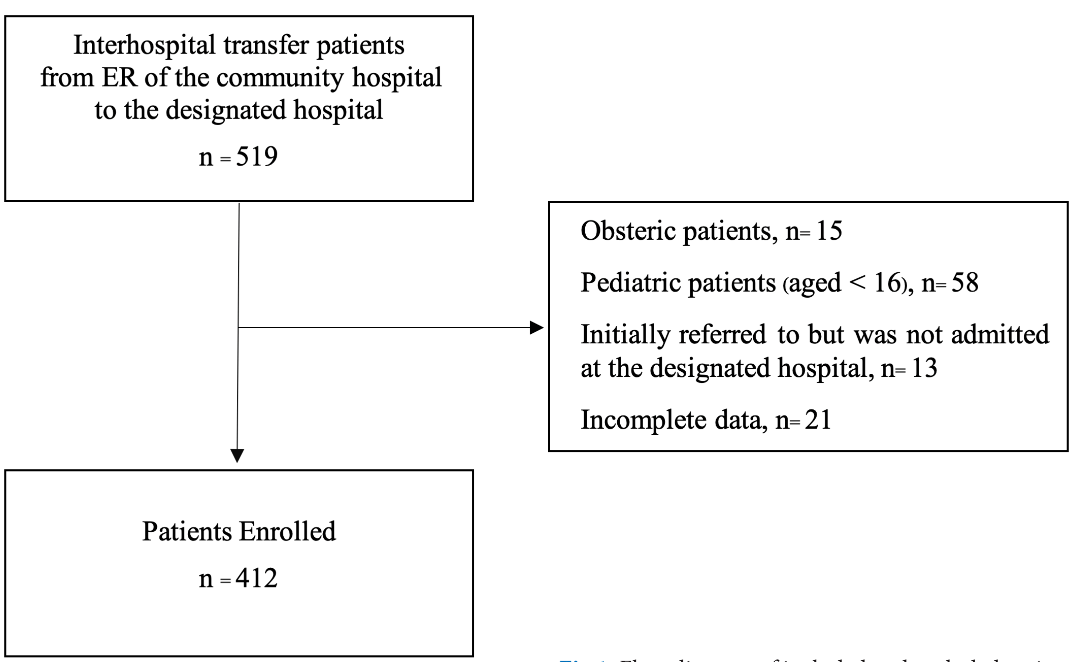

Fig 1. Flow diagram of included and excluded patients.

three days after a transfer). Thirty-eight patients were discharged home or transferred back to the community hospital or transferred to a higher-level hospital within 72 hrs of the admission.

Out of 412 patients, a total of 37 patients (9.0%) died during the stay in receiving hospital and 18 (4.4%) of them died within 72 hrs after transfer (Table 1). Table 2 demonstrates top ten primary diagnostic categories including road traffic injuries (19.7%), acute appendicitis (9.7%), and acute myocardial infarction (5.1%). Univariate analysis (Table 1) reveals early mortality (<72 hrs) was associated with NEWS2, Emergency Severity Index (ESI), cardiac arrest prior to transfer, use of vasoactive agents, endotracheal intubation and admitting service. For overall mortality, univariate analysis identified age and Charlson's co-morbidity score as predictors in addition to those for early mortality. Using multiple logistic regression model adjusted for the predictors identified by univariate analysis (Table 3), we found early mortality was independently associated with NEWS2 ≥ 9 (compared to NEWS2 0-6) with OR= 17.51(95%CI 3.16 – 97.00) and use of vasoactive medication (OR= 5.46, 95%CI 1.39-21.46). Similarly, overall mortality was also independently associated with NEWS2 ≥ 9(OR= 4.76, 95%CI 1.31 – 17.36) and use of vasoactive medications (OR= 7.51,95%CI 2.76 – 20.45) (Table 4). Performance of the multivariate models were validated with AUC 0.91 (95% CI 0.82-0.99) for the first model (Table 3) and 0.88 (95% CI 0.83-0.94) for the second model (Table 4).

DISCUSSION

Applying multiple logistic regression analysis to the cohort data (N=412), we were able to identify two independent predictors for early mortality: NEWS2 score ≥ 9 (OR: 17.51; 95% CI 3.16-97.00, p=0.001) and vasoactive agent use (OR 5.46; 95% CI 1.39-21.46, p=0.015). NEWS2 is used internationally as an early warning score for triaging in ER and monitoring hospitalized patients. From the Royal College of Physicians report, the aggregated score of 7 or more is defined as a threshold for emergency response, and patient transfer to a higher setting facility should be considered.[16] Our findings are comparable with previous studies that reported high acute severity index and events such as cardiac arrest, mechanical ventilation, and vasoactive drug use as mortality predictor in IHT patients.[12,13,18] With ROC 0.91(95% CI 0.82-0.99), our model performs as high as that of other studies in HICs and LMICs, although the results, in this regard, may not be directly comparable given different sets of predictors and study settings.[19,20]

The predictors discovered from our study allow healthcare providers to estimate the severity of the ER patients who might need transfer to other hospitals capable of providing definitive care. Scoring systems such as NEWS2 provided a standardized tool for clinical monitoring and assessment. By combining physiological variables into scores, it reduces variation in assessing patient status among healthcare professionals. Several triage systems, including ESI, have been developed for use in the ER. However, they are not designed to detect deterioration in patients.[21] NEWS can further risk stratifying patients within higher ESI risk categories, both for death and need for admission.[22] Patients with a high NEWS score have not only been identified as being at risk of a poor outcome but have already physiologically deteriorated to the extent where urgent medical review and intervention is required. With a common scoring system between facilities, it also functions as a standard language in communication on patient's clinical acuity.[23]

Out of 412 transfer patients (mean age 53) from the transferring hospital to the receiving hospital (43 km apart), 9.0% died upon discharge with a half died within 72-h after the transfer. We could not identify other studies in a similar setting both in high-income countries (HICs) and low-middle income countries (LMICs) for mortality comparison. Our overall-mortality figure is, at most, one-third of the reported figures from several other studies dealing with intensive care patients.[12,24] This indicates our patients were in much less critical conditions than those in other studies. Finally, similar to findings from other studies[7,8], the patients' profiles of our study were heterogeneous (Table 2).

In our study, we found no association between transfer time and patient mortality, which is compatible with previous similar studies.[12,13] As suggested from many guidelines for the interfacility transport, our finding also supports a "stabilize and shift" approach rather than a "scoop and run" strategy.[25-27] However, even though there is no significant relationship between transfer times and hospital mortality, some studies have demonstrated the benefit of appropriate, timely referrals in lessening complications, length of stay, and morbidity of IHT patients.[28,29] Additionally, certain diseases such as ST-segment elevation myocardial infarction or expanding intracranial hematoma, are considered as time-sensitive emergency conditions.[30,31] Delays to definite treatment in such diseases could result in lethal outcomes. We conclude that, in general, critically ill patients should be resuscitated until achieving possibly maximum stabilization by the referring hospital before the interhospital transport without unnecessary delays.

TABLE 1. Patient characteristics and admitting service categorized by the outcome status.

Variables	All patients (*n* = 412)	Within 72 hrs Alive (*n* = 394)	Dead (*n* = 18)	p-value	Overall Alive (*n* = 375)	In-hospital Death (*n* = 37)	p-value
Patient characteristics							
Age, mean years (±SD)	53 (±20)	53 (±20)	59 (±20)	0.18	52 (±19)	64 (±19)	<0.001
Gender, male, n (%)	245 (59.5)	235 (59.6)	10 (55.6)	0.73	220 (58.7)	25 (67.6)	0.293
Health insurance status, n (%)				0.733			0.204
Universal Coverage	268 (65.1)	254 (64.5)	14 (77.8)		235 (62.7)	30 (81.1)	
Compulsory Motor Insurance	78 (18.9)	75 (19.0)	3 (16.7)		77 (20.5)	4 (10.8)	
Social Security Scheme	17 (4.1)	17 (4.3)	0 (0.0)		17 (4.5)	0 (0.0)	
CSMBS	42 (10.2)	41 (10.4)	1 (5.6)		39 (10.4)	3 (8.1)	
Out-of-pocket	7 (1.7)	7 (1.8)	0 (0.0)		7 (1.9)	0 (0.0)	
Transfer time, mean minutes (±SD)	226 (±97)	227 (±98)	212 (±74)	0.531	226 (±98)	232 (±81)	0.733
Charlson's co-morbidity score, n (%)				0.533	19 (5.1)	0 (0.0)	0.002
0 149 (36.2)	145 (36.8)	4 (22.2)		144 (38.4)	5 (13.5)		
1-2	137 (33.3)	131 (33.3)	6 (33.3)		125 (33.3)	12 (32.4)	
3-4	94 (22.8)	88 (22.3)	6 (33.3)		81 (21.6)	13 (35.1)	
>4	32 (7.8)	30 (7.6)	2 (11.1)		25 (6.7)	7 (18.9)	
NEWS2, mean (±SD)	4 (±4)	3 (±3)	12 (±4)	<0.001	3 (±3)	9 (±4)	<0.001

TABLE 1. Patient characteristics and admitting service categorized by the outcome status. (Continue)

Variables	All patients (*n* = 412)	Within 72 hrs Alive (*n* = 394)	Dead (*n* = 18)	p-value	Overall Alive (*n* = 375)	In-hospital Death (*n* = 37)	p-value
The ESI (Level of urgency), n (%)				<0.001			<0.001
1 (Resuscitative)	35 (8.5)	27 (6.9)	8 (44.4)		22 (5.9)	13 (35.1)	
2 (Emergent)	101 (24.5)	95 (24.1)	6 (33.3)		86 (22.9)	15 (40.5)	
3 (Urgent)	161 (39.1)	157 (39.9)	4 (22.2)		153 (40.8)	8 (21.6)	
4 (Less urgent)	111 (26.9)	111(28.2)	0 (0.0)		110 (29.3)	1 (2.7)	
5 (Non-urgent)	4 (1.0)	4 (1.0)	0 (0.0)		4 (1.1)	0 (0.0)	
Cardiac arrest prior to transfer, yes (%)	8 (1.9)	2 (0.5)	6 (33.3)	<0.001	1 (0.3)	7 (18.9)	<0.001
Any vasoactive agent, yes (%)	32 (7.8)	20 (5.1)	12 (66.7)	<0.001	13 (3.5)	17 (46.0)	<0.001
Endotracheal intubation prior to transfer, yes (%)	68 (16.5)	55 (14.0)	13 (72.2)	<0.001	46 (12.3)	22 (59.5)	<0.001
Admitting service							
Inpatient department, n (%)				0.003			<0.001
Internal Medicine	136 (33.0)	123 (31.2)	13 (72.2)		108 (28.8)	27 (73.0)	
General Surgery	161 (39.1)	159 (40.4)	2 (11.1)		96 (25.6)	5 (13.5)	
Neurosurgery	49 (11.9)	46 (11.7)	3 (16.7)		74 (19.7)	4 (10.8)	
Orthopedic	47 (11.4)	47 (11.9)	0 (0.0)		42 (11.2)	1 (2.7)	
Others*	19 (4.6)	19 (4.8)	0 (0.0)		36 (9.6)	0 (0.0)	

Abbreviations: CSMBS, Civil Servant Medical Benefit Scheme; ESI, Emergency Severity Index; ETT, Endotracheal tube; NEWS2, National Early Warning Score 2; SD, Standard deviation.
* Others include Gynecology, Ophthalmology, and Otorhinolaryngology

Supplementary Table 1. Characteristics of study patients according to mortality status within the same admission after transfer.

Variables	All patients (n = 412)	Alive (n = 375)	In-hospital Death (n = 37)	*p*-Value
Age, mean years (±SD)	53 (±20)	52 (±19)	64 (±19)	<0.001
Gender, male (%)	245 (59.5)	220 (58.7)	25 (67.6)	0.293
Health Insurance status, n (%)				0.234
Universal Coverage	268 (65.1)	238 (63.5)	30 (81.1)	
Compulsory Motor Insurance	78 (18.9)	74 (19.7)	4 (10.8)	
Social Security Scheme	17 (4.1)	17 (4.5)	0 (0.0)	
CSMBS	42 (10.2)	39 (10.4)	3 (8.1)	
Out-of-pocket	7 (1.7)	7 (1.9)	0 (0.0)	
Transfer time, mean minutes (±SD)	226 (±97)	226 (±98)	232 (±81)	0.733
Inpatient department, n (%)				<0.001
Internal Medicine	136 (33.0)	109 (29.1)	27 (73.0)	
General Surgery	161 (39.1)	154 (41.1)	7 (18.9)	
Neurosurgery	49 (11.9)	46 (12.3)	3 (8.1)	
Orthropedic	47 (11.4)	47 (12.5)	0 (0.0)	
Others*	19 (4.6)	19 (5.1)	0 (0.0)	
Charlson's co-morbidity score, n (%)				0.002
0	149 (36.2)	144 (38.4)	5 (13.5)	
1-2	137 (33.3)	125 (33.3)	12 (32.4)	
3-4	94 (22.8)	81 (21.6)	13 (35.1)	
>4	32 (7.8)	25 (6.7)	7 (18.9)	
NEWS2, mean (±SD)	4 (±4)	3 (±3)	10 (±4)	<0.001
ESI scores (Level of urgency), n (%)				<0.001
1 (Resuscitative)	35 (8.5)	22 (5.9)	13 (35.1)	
2 (Emergent)	101 (24.5)	86 (22.9)	15 (40.5)	
3 (Urgent)	161 (39.1)	153 (40.8)	8 (21.6)	
4 (Less urgent)	111 (26.9)	110 (29.3)	1 (2.7)	
5 (Non-urgent)	4 (1.0)	4 (1.1)	0 (0.0)	
Cardiac arrest prior to transfer, yes (%)	8 (1.9)	1 (0.3)	7 (18.9)	<0.001
Any vasoactive agent, yes (%)	32 (7.8)	14 (3.7)	18 (48.7)	<0.001
ETT insertion prior to transfer, yes (%)	68 (16.5)	46 (12.3)	22 (59.5)	<0.001

Abbreviations: CSMBS, Civil Servant Medical Benefit Scheme; ESI, Emergency Severity Index; ETT, Endotracheal tube; NEWS2, National Early Warning Score 2; SD, Standard deviation.
* Others include Gynecology, Ophthalmology, and Otorhinolaryngology.

TABLE 2. Most common primary diagnoses according to ICD-10.

Primary diagnostic categories with ICD-10 All patients (n = 412)	Early mortality*, n (%)		Overall mortality, n (%)	
	Alive (n = 394)	Dead (n = 18)	Alive (n = 375)	Death (n = 37)
C15-C26 Malignant neoplasms of digestive organs (n=9, 2.2%)	9 (2.3)	0 (0.0)	7 (1.9)	2 (5.4)
I21 Acute myocardial infarction (n=21, 5.1%)	19 (4.8)	2 (11.1)	16 (4.3)	5 (13.5)
I61 Intracerebral haemorrhage (n=20, 4.9%)	20 (5.1)	0 (0.0)	20 (5.3)	0 (0.0)
I63 Cerebral infarction (n=16, 3.9%)	16 (4.1)	0 (0.0)	16 (4.3)	0 (0.0)
J12-J18 Pneumonia (n=15, 3.6%)	13 (3.3)	2 (11.1)	11 (2.9)	4 (10.8)
K27 Gastric ulcer with perforation (n=9, 2.2%)	9 (2.3)	0 (0.0)	9 (2.4)	0 (0.0)
K35 Acute appendicitis (n=40, 9.7%)	40 (10.2)	0 (0.0)	40 (10.7)	0 (0.0)
K92.2 Gastrointestinal haemorrhage, unspecified (n=17, 4.1%)	17 (4.3)	0 (0.0)	17 (4.5)	0 (0.0)
S72 Fracture of femur (n=11, 2.7%)	11 (2.8)	0 (0.0)	11 (2.9)	0 (0.0)
V01-V99 Road traffic injuries (n=81, 19.7%)	78 (19.8)	3 (16.7)	77 (20.5)	4 (10.8)
Other diagnoses (n=173, 42.0%)	162 (41.1)	11 (61.1)	151 (40.3)	22 (59.5)

ICD-10, the International Statistical Classification of Diseases and Related Health Problems.
* Defined as death within 72 hrs after an inter-hospital transfer

TABLE 3. Multivariate logistic regression analysis of factors associated with early mortality (< 72 hrs) (n = 412).

Variables	OR	95% CI	*p*
NEWS2			
7-8 vs. 0-6	6.61	0.77-56.62	0.085
≥ 9 vs. 0-6	17.51	3.16-97.00	0.001
Cardiac arrest prior to transfer	5.37	0.79-36.54	0.086
Vasoactive agent use			
Yes vs. No	5.46	1.39-21.46	0.015

Abbreviations: NEWS2, National Early Warning Score 2; OR, Odds ratio; *p*, p-value

TABLE 4. Multivariate logistic regression analysis of factors associated with overall mortality (n = 412).

Variables	OR	95% CI	*p*
NEWS2			
7-8 vs. 0-6	1.49	0.32-6.84	0.608
≥ 9 vs. 0-6	4.76	1.31-17.36	0.018
Age	1.02	1.00-1.05	0.076
Endotracheal intubation prior to transfer	2.28	0.73-7.17	0.158
Vasoactive agent use			
Yes vs. No	7.51	2.76-20.45	<0.001

Abbreviations: NEWS2, National Early Warning Score 2; OR, Odds ratio; *p*, p-value

Another interesting finding from our study is an apparent degree of unplanned ER revisits and re-transfers. These events may be explained either by the nature and severity of individual diseases or inappropriate post-discharge follow-up care. Because most patients would receive follow-up care after discharge at their transferring hospital, appropriateness of discharge communication about a follow-up plan from the receiving hospital could improve the quality of care at the transferring hospital.[32] Future studies should explore deeper to clarify the causes of repeated transfers in our area.

Our present study has three potential limitations which need consideration. Firstly, this study was conducted in a single hospital in a rural area of Thailand and its designated tertiary care hospital. Patient characteristics and performance in transfer practices may be different from other hospital settings. For this reason, external validity is uncertain, so results from this research should be carefully examined before application. Secondly, the number of included patients in the retrospective cohort may not be large enough, as indicated by wide confidence intervals. With a small sample size, the power of tests may not be sufficient to detect a statistically significant association in some clinically relevant parameters. Lastly, we have not accounted for adverse incidents during inter-hospital transport as a predictor variable in our study due to inaccessible data and/or unavailability of data. Those unexpected events are common during transport and could greatly influence the outcomes in critically ill patients.[33] Hence, further studies are needed to explore this key area of healthcare with complexity, which is understudied, especially in LMICs.

CONCLUSION

To our best knowledge, our study may be the first demonstrating outcome predictors of inter-hospital transfer patients in Thailand and low- and middle-income countries. We managed to identify predictors of hospital mortality for transfer patients from a rural hospital ER to a receiving hospital i.e., high NEWS2 scores and use of vasoactive agents. These factors could be used to standardize rationale and clinical care processes in ER patients transferred from rural community hospitals to other hospitals capable of providing definitive care. With NEWS2 included among the predictors, we were able to suggest using NEWS2 as a value-added tool to better monitoring of the patients' status during the transfer and facilitate a mutual agreement between clinicians.

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Data availability: The datasets used to support the findings of this study are available upon request.

Conflicts of interest: The authors state that they have no Conflict of Interest (COI).

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