ORIGINAL ARTICLE

Agreement of Telephone Triage and Emergency Department Triage in Kalasin Hospital

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Background: Accurate patient triage is crucial for efficient resource management and optimal patient outcomes in emergency medical services (EMS). In Thailand, telephone triage commonly uses the Criteria-Based Dispatch (CBD) system, while emergency departments (EDs) use the Emergency Severity Index (ESI). Discrepancies between pre-hospital and in-hospital assessments can lead to over-triage, thus excessive resource use, or under-triage, thus delayed care, potentially impacting patient morbidity and mortality.

Objective: To assess the agreement between the CBD and ESI triage systems at Kalasin Hospital.

Materials and Methods: The present study was a retrospective descriptive study. Data was collected from the Emergency Medical Information System (ITEMS), dispatched records, and patient medical records of 931 patients who reported incidents via the Kalasin Provincial EMS Dispatch Center and were transported to Kalasin Hospital ED between March 1 and August 31, 2024. Data analyses included descriptive statistics, Cohen's κ statistics to measure agreement, and chi-square or Fisher's exact tests to examine group differences.

Results: Most patients were male (54.67%), with an average age of 54.68 years. Overall agreement between CBD and ESI was fair (89.9%, κ=0.28, 95% CI 0.22 to 0.34, p<0.001). Red codes showed higher agreement with ESI 1 to 2 (78.12%, κ=0.37, 95% CI 0.31 to 0.43, p<0.001). However, Yellow codes with ESI 3 (56.44%, κ=0.12, 95% CI 0.07 to 0.17, p<0.001) and Green codes with ESI 4 to 5 had lower agreement at 71.95% (κ=0.08, 95% CI 0.04 to 0.14, p<0.001). The overall under-triage rate was 14.61% (highest in Red codes at 35.90%). The over-triage rate was 24.38% (highest in Green codes at 58.46%) and notable in non-specific symptom groups like headache/neck pain (41.18%) and fatigue (31.03%). There was no statistically significant difference in 24-hour mortality between under-triaged and correctly triaged patients (p=0.21).

Conclusion: While the CBD system offers speed, its accuracy in triage with ESI at Kalasin Hospital was low to moderate, especially for non-specific symptoms or critical conditions that might be under-evaluated. Improving existing assessment criteria and integrating advanced technologies like artificial intelligence (e.g., machine learning, data analysis, and predictive modeling) are essential to enhance EMS efficiency and accuracy, mitigating adverse impacts on patient lives in critical situations.

Keywords: Criteria-based dispatch; Emergency severity index; Over-triage; Under-triage; Emergency medical dispatcher

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The Kalasin Provincial Emergency Medical Services (EMS) Dispatch Center serves as a critical hub, managing 100 to 130 emergency calls daily. These calls are categorized for dispatching into advanced life support (ALS), basic life support (BLS), emergency medical response (EMR), and volunteer services, representing 11.5%, 8.7%, 78.9%, and 0.9% of dispatches, respectively. Upon receiving an emergency call, emergency medical dispatchers (EMDs) assess the situation and provide crucial pre-arrival instructions to callers before the EMS team arrives on scene.

The Emergency Medical Act 2008, Section 28, mandates that operational units, medical facilities, and practitioners triage emergency patients and provide care based on their medical urgency. The established criteria for triaging and dispatching emergency patients align with the National Institute for Emergency Medicine (NIEM) regulations 2013, serving as essential tools for EMDs and dispatch operators[(1)].

Currently, the most prevalent telephone triage systems are Criteria-Based Dispatch (CBD) and Medical Priority Dispatch (MPD). A comparative study by Hardeland et al.[(2)] on cardiac arrest cases found no significant difference in patient classification between CBD and MPD. However, CBD demonstrated

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superiority in providing pre-arrival instructions more rapidly and comprehensively, leading to faster chest compression initiation (3.7 versus 4.3 minutes) and quicker EMS arrival times (15 versus 33 minutes)[2]. A study assessed the impact of CBD on EMS efficiency. After implementation, unnecessary ALS responses for febrile seizures and strokes significantly decreased. BLS requests for ALS support also declined, with no delay in dispatch time. CBD improved EMS efficiency by reducing inappropriate ALS use without affecting response time[3].

In Thailand, CBD is widely adopted for telephone triage. Upon arrival at the incident scene, EMS teams conduct a secondary assessment using START triage or JumpSTART triage for pediatric patients[4]. Within emergency departments (EDs), the Ministry of Public Health (MOPH) ED triage system, an adaptation of the Emergency Severity Index (ESI), is employed[5]. Effective patient triage is paramount for optimizing resource allocation. Over-triage, classifying patients as more severe than their actual condition, results in unnecessary resource utilization and inappropriate personnel deployment, leading to inefficiencies. Conversely, under-triage, categorizing patients as less severe than they truly are, can lead to inadequate staffing and delayed responses, potentially causing adverse patient outcomes, including increased morbidity or mortality[6].

Objective

The present study aimed to assess the agreement between telephone triage using CBD and ED triage using ESI.

Materials and Methods

Study design

The present study employed a retrospective descriptive design.

Study population

The study population included patients who reported incidents via the Kalasin Provincial EMS Dispatch Center and were subsequently transported to the Kalasin Hospital Emergency Department between March 1 and August 31, 2024.

Inclusion criteria

1. Incidents reported via the 1669 telephone number and triaged by the Kalasin Provincial EMS Dispatch Center.
2. Patients who were transported to the Kalasin Hospital Emergency Department.

Exclusion criteria

1. Reported incidents where no patient was found at the scene.
2. Incomplete dispatch or vital sign records.

Sample size

The sample size was determined using the formula for proportion:

$n = (Z_{\alpha/2})^2 \times p(1-p) / d^2$

where:

- n=sample size
- $Z_{\alpha/2}$=standard normal deviate for a 95% confidence level, which is 1.96.
- d=absolute error, set at 1.84% (derived as 20% of the proportion: 0.2×0.092=0.0184).
- p=population proportion or prevalence, referenced from the study by Winthachai & Hengrussamee[7], which reported 1.7% under-triage (p=0.017).

Based on this calculation, a sample size of 190 participants was estimated.

Research instruments and data collection

Data were collected retrospectively from the Emergency Medical Information System (ITEMS), dispatched records, and patient medical records.

Data analysis

Statistical analysis was performed using Stata Statistical Software, version 18 (StataCorp LLC, College Station, TX, USA).

- Descriptive statistics: Frequencies, percentages, means (with standard deviations, SD), or medians (with interquartile ranges, IQR) were used to characterize the study sample and baseline data, depending on data distribution.
- Agreement analysis: Overall agreement was assessed using quadratic weighted Cohen's kappa. Category-specific agreement was further evaluated using unweighted Cohen's kappa based on binary classification for each triage level. Interpretation was based on Landis and Koch criteria[8].
- Group differences: Chi-square tests and Fisher's exact tests were used to assess differences between groups, with 95% confidence intervals (CIs) and a statistical significance level set at p-value less than 0.05.

Definition

ED triage was performed using the MOPH ED triage system, which is adapted from the ESI version 4[5].

Telephone triage followed the CBD protocol according to the NIEM guidelines (2013)[1].

Over-triage and under-triage were defined by comparing telephone triage using the CBD system with ED triage using the ESI.

CBD response codes were mapped to ESI levels as follows: CBD Red → ESI 1 to 2, CBD Yellow → ESI 3, CBD Green → ESI 4 to 5.

Under-triage was defined as cases in which the CBD assigned a lower acuity than the corresponding ESI level (e.g., CBD Yellow or Green with ESI 1 to 2, or CBD Green with ESI 3).

Over-triage was defined as cases in which the CBD assigned a higher acuity than the corresponding ESI level (e.g., CBD Red with ESI 3 to 5, or CBD Yellow with ESI 4 to 5).

Ethical approval

The present study was approved by the Ethics Committee of Kalasin Hospital, approval number 008-2024E.

Results

Table 1 summarizes the general characteristics of the patients. The present study enrolled 931 patients who received emergency services. The majority were male, with 509 cases (54.67%), with females accounting for 422 cases (45.33%). The average age of the patients was 54.68 years (IQR 54 to 68).

Initial telephone triage using the CBD system categorized patients as Red (78 cases, 8.38%), Yellow (788 cases, 84.64%), and Green (65 cases, 6.98%). Upon arrival at the ED, ESI triage categorized patients as ESI 1 (critical) (45 cases, 4.83%), ESI 2 (severe) (106 cases, 11.39%), ESI 3 (moderate) (552 cases, 59.29%), ESI 4 (minor) (132 cases, 14.18%), and ESI 5 (general) (96 cases, 10.31%).

Analysis of the agreement between CBD and ESI, as shown in Table 2, revealed an overall fair agreement of 89.9% (κ=0.28, 95% CI 0.22 to 0.34, p<0.001). Agreement of CBD and ESI, categorized by CBD code as shown in Table 3. For "Red" codes, which were expected to align with ESI 1 to 2, agreement was 86.14% (κ=0.37, 95% CI 0.31 to 0.43, p<0.001), indicating moderate agreement. For "Yellow" codes, expected to align with ESI 3, agreement was 61.55% (κ=0.12, 95% CI 0.07 to 0.17, p<0.001), indicating slight agreement. For "Green" codes, expected to align with ESI 4 to 5, agreement was 74.33% (κ=0.08, 95% CI 0.04 to 0.14, p<0.001), categorized as low. While these findings showed statistical significance, the practical level of agreement remained low to moderate, particularly for the "Yellow" and "Green" groups.

Over-triage and under-triage of CBD compared to ESI are reported in Table 4. Overall, CBD telephone triage exhibited an under-triage rate of 14.61% and an over-triage rate of 24.38%. For "Red"

Table 1. General characteristics of patients (n=931)

Characteristic	
Sex; n (%)	
Male	509 (54.67)
Female	422 (45.33)
Age (years); median (IQR)	54.68 (54, 68)
CBD response code; n (%)	
Red	78 (8.38)
Yellow	788 (84.64)
Green	65 (6.98)
ED triage level (ESI); n (%)	
Critical (ESI 1)	45 (4.83)
Severe (ESI 2)	106 (11.39)
Moderate (ESI 3)	552 (59.29)
Minor (ESI 4)	132 (14.18)
General (ESI 5)	96 (10.31)
Clinical outcomes; n (%)	
Hospital admission	405 (43.50)
Discharged home	511 (54.89)
Death within 24 hours	11 (1.18)
Transfer	4 (0.43)

CBD=Criteria-Based Dispatch; ED=emergency department; ESI=Emergency Severity Index; IQR=interquartile range

Table 2. Agreement of telephone triage (CBD) and emergency department triage (ESI)

	CBD Red (n)	CBD Yellow (n)	CBD Green (n)
ESI 1, 2	50	98	3
ESI 3	26	491	35
ESI 4, 5	2	199	27
Overall agreement: 89.9%, κ: 0.28, 95% CI 0.22 to 0.34, p<0.001			

CBD=Criteria-Based Dispatch; ESI=Emergency Severity Index; CI=confidence interval

Table 3. Agreement of telephone triage (CBD) and emergency department triage (ESI) (by CBD code)

CBD level	ESI level	Agreement†	Kappa	95% CI	p-value
Red code	ESI 1, 2	86.14%	0.37	0.31 to 0.43	<0.001
Yellow code	ESI 3	61.55%	0.12	0.07 to 0.17	<0.001
Green code	ESI 4, 5	74.33%	0.08	0.04 to 0.14	<0.001

CBD=Criteria-Based Dispatch; ESI=Emergency Severity Index; CI=confidence interval

† Percentages were calculated using the total number of patients within each CBD category as the denominator.

Table 4. Over-triage and under-triage of telephone triage (CBD) compared to emergency department triage (ESI)

Code	Under triage n (%)	Over triage n (%)
Overall (n=931)	136 (14.61)	277 (24.38)
Red code (n=78)	28 (35.90)	-
Yellow code (n=788)	98 (12.44)	199 (25.25)
Green code (n=65)	-	38 (58.46)

Percentages were calculated based on the total number of patients in each CBD triage level.

codes, under-triage was notably high at 35.90%. For "Yellow" codes, under-triage was 12.44%, and over-triage was 25.25%. For "Green" codes, over-triage was particularly high at 58.46%, suggesting a significant number of non-urgent patients were over-assessed.

When analyzed by symptom group (Table 5), over-triage was frequently observed in headache/neck pain (41.18%), fatigue (31.03%), children/infants (31.67%), chest pain (30.43%), seizure (29.41%), and abdominal/back/pelvic pain (27.59%). Conversely, under-triage was noted in airway obstruction/choking (100%), assault/injury (33.33%), burns/electrocution (33.33%), agitation/psychiatric (30.00%), falls (30.61%), and dyspnea (37.04%).

The CBD system may face limitations in accurately assessing patient severity based solely on initial information, especially for symptom groups with general or non-specific manifestations (e.g., fatigue, dyspnea, children/infants). This often leads to high rates of over- or under-triage.

Among patients initially under-triaged by CBD, the 24-hour mortality rate was 2.2% (three out of 136), compared to 1.0% (eight out of 795) in the correctly triaged group. This difference was not statistically significant (p=0.21). Some symptom groups had very small sample sizes (e.g., airway obstruction with only one case); therefore, percentages for these categories should be interpreted with caution.

Discussion

The CBD system serves as a standard triage criterion within Thai EMS dispatch centers due

Table 5. Under-triage and over-triage by symptom group

CBD	Symptom group	Number of patients	Over-triage n (%)	Under-triage n (%)
1	Abdominal, back, pelvic pain	116	32(27.59)	7(6.03)
2	Allergic reactions, anaphylaxis	12	1 (8.33)	0 (0.00)
3	Animal bites	18	6 (33.33)	2 (11.11)
4	Bleeding	13	2(15.38)	2(15.38)
5	Dyspnea	81	16(19.75)	30(37.04)
6	Cardiac arrest	1	0 (0.00)	0 (0.00)
7	Chest pain	23	7 (30.43)	4 (17.39)
8	Airway obstruction, choking	1	0 (0.00)	1 (100.00)
9	Diabetes	46	8 (17.39)	7 (15.22)
12	Headache, neck pain	17	7 (41.18)	1 (5.88)
13	Agitation, psychiatric	10	2 (20.00)	3 (30.00)
14	Toxins, overdose	4	1 (25.00)	1 (25.00)
15	Childbirth, gynecological	12	2 (16.67)	0 (0.00)
16	Seizure	17	5 (29.41)	0 (0.00)
17	Fatigue	232	72 (31.03)	25 (10.78)
18	Limb weakness, speech difficulty, facial droop	10	2 (20.00)	2 (20.00)
19	Unconsciousness, syncope	30	11 (36.67)	0 (0.00)
20	Children, infants	60	19 (31.67)	8 (13.33)
21	Assault, injury	12	0 (0.00)	4 (33.33)
22	Burns, scalds, electrocution	3	0 (0.00)	1 (33.33)
23	Drowning, water injury	1	1 (100.00)	0 (0.00)
24	Falls	98	15 (15.31)	30 (30.61)
25	Traffic accidents	114	18 (15.79)	8 (7.02)

CBD=Criteria-Based Dispatch
Percentages were calculated using the number of patients within each symptom group as the denominator.

Table 6. Comparison of triage agreement, over-triage, and under-triage across various studies

Location	Bangkok[7]	Chonburi[9]	Finland[10]	South Africa[11]
Triage system	CBD vs. ESI	CBD vs. ESI	ERICA vs. on-scene assessment	EMD system (similar to CBD) vs. SAT
Population	950	500	6,416	242,576
Agreement	Low (κ=0.17, p<0.001)	Moderate (κ=0.31, 95% CI 0.241 to 0.376)	Efficiency 72%, Sensitivity 85%, Specificity 71%, PPV 29%, NPV 97%	Sensitivity 53.71%, Specificity 74.31%, NPV 84.71%, PPV 37.72%
Over-triage	26.2%	32.6%	-	62.2%
Under-triage	1.7%	11.2%	-	15.3%

CBD=Criteria-Based Dispatch; ESI=Emergency Severity Index; EMD=emergency medical dispatch; CI=confidence interval; PPV=positive predictive value; NPV=negative predictive value

to its speed and suitability for initial telephone assessment before the operational team arrives. Triage primarily relies on patient symptom reports. However, information conveyed by patients or their relatives may lack medical precision, leading to potential misjudgments. Therefore, the accuracy of telephone triage heavily depends on the clarity of information from the caller and the EMD's knowledge and understanding of the situation. In contrast, the ESI system, used in EDs, relies on direct patient assessment, including vital signs and clinical presentation, typically leading to higher accuracy.

At the Kalasin Hospital EMS Dispatch Center, the agreement between the CBD and ESI systems was found to be 89.9% (κ=0.28). Specifically, for "Red" codes, agreement with ESI 1 and 2 was 78.12% (κ=0.37), indicating moderate agreement. However, for "Yellow" codes and ESI 3, agreement was 56.44% (κ=0.12), suggesting slight agreement, and for "Green" codes and ESI 4 and 5, agreement was 71.95% (κ=0.08), classified as low. This trend indicates better agreement for clearly critical conditions but lower agreement for non-specific symptoms such as fatigue or headache, or in vulnerable populations like children and the elderly. These findings are consistent with previous studies (Table 6)[7,9-11], by Winthachai & Hengrussamee[7] reported an overall agreement of 72.10% (κ=0.17).

Regarding misclassification, under-triage was observed in 14.61% of the cases, with the highest incidence (35.90%) occurring in critically ill patients. Over-triage was found in 24.38% of cases, most frequently (58.46%) in general patients. These figures are comparable to a study at Chonburi Hospital[9] that reported 32.6% over-triage and 11.2% under-triage. These findings are within the NIEM's performance indicators, which aim for telephone triage of critical severity to be no more than 15% lower than hospital triage and no more than 30% higher. Nevertheless, the persistent under-triage of critically ill patients indicates a potential risk to patient outcomes, underscoring the need for improved assessment.

Common symptom groups associated with high over-triage rates included headache/neck pain (41.18%), fatigue (31.03%), children/infants (31.67%), and chest pain (30.43%). This suggests a tendency for EMDs to overestimate severity when presented with non-specific or difficult-to-articulate information, particularly from children and the elderly who may struggle to communicate their symptoms effectively. While the study found no statistically significant difference in in-hospital mortality rates between under-triaged patients and correctly triaged patients, efforts to improve triage accuracy remain crucial for optimal patient care and resource management.

To enhance the precision of triage, strategies could include refining CBD question sets to better suit complex or non-specific symptom presentations. Furthermore, integrating artificial intelligence (AI), specifically through machine learning, data analysis, and predictive modeling, offers a promising avenue for improving EMD performance[12-14]. For instance, a study by Blomberg et al. found that AI could triage out-of-hospital cardiac arrest patients with improved sensitivity, though with lower specificity. Concurrently, educating the public on how to effectively use the 1669 services could improve the quality of information received by EMDs, thereby contributing to more accurate triage decisions[13]. While self-triage mobile applications are emerging, their widespread adoption remains constrained by issues of standardization, accuracy, and algorithmic transparency, which require further development[12].

Limitation

The present study has limitations. First, this was a single-center study conducted at one provincial hospital, so the results may not represent other hospitals or EMS systems. Second, the study used retrospective data from dispatched records and medical charts. Some data may be incomplete or

inaccurate. Third, misclassification bias may have occurred because telephone triage depended on information provided by callers and recorded by dispatchers. Fourth, the number of outcome events, especially death within 24 hours, was small, which may limit the ability to detect differences between groups. Fifth, the predefined mapping of CBD response codes to ESI categories may oversimplify clinical severity and may not fully capture patient complexity. Finally, other factors such as dispatcher experience, patient comorbidities, and call conditions were not analyzed and may have affected triage accuracy.

Conclusion

The CBD system offers advantages in speed and suitability for telephone assessment but demonstrates limitations in accuracy when compared to the ESI system, with an overall agreement of 89.9%. While agreement is better for clearly critical conditions, it is lower for symptom groups that are non-specific or ambiguous. The present study revealed an under-triage rate of 14.61% and an over-triage rate of 24.38%. To enhance the efficiency and precision of EMS and minimize adverse patient outcomes in critical situations, it is imperative to improve the triage system. This can be achieved through refining existing assessment protocols and, significantly, by leveraging advanced technologies such as AI, particularly in machine learning, data analysis, and predictive modeling, to improve the accuracy of initial patient assessment.

What is already known about this topic?

Existing research consistently shows low to moderate agreement in telephone triage, leading to problematic rates of over- and under-triage that waste resources or delay critical care. However, no studies have explored this agreement within a provincial hospital setting, leaving a critical gap in understanding how local symptom knowledge and dispatch administration impact triage accuracy in such communities.

What does this study add?

This study is the first to provide empirical data on the agreement between CBD telephone triage and ESI hospital triage in a Thai provincial setting. It reveals that while agreement is moderate for critical cases, it is low for non-critical ones. The study also identifies specific symptom groups, such as fatigue, pediatric cases, and airway issues, that are particularly prone to triage misclassification. These findings highlight key areas for improvement in dispatch protocols, training, and AI-supported triage systems in Thailand.

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Authors' contributions

SK: Conceptualization, methodology, supervision, writing-original draft, and writing-review & editing. SS: Data curation, investigation, formal analysis, and writing-original draft. WS: Data curation, investigation, and validation. PK: Data curation, investigation, and visualization.

Data availability statement

The data used in this study were obtained from ITEMS, dispatch records, and hospital medical records. Due to patient confidentiality and institutional regulations, the data are not publicly available but may be obtained from the corresponding author upon reasonable request and with permission from Kalasin Hospital.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Kalasin Hospital (approval number 008-2024E). The requirement for informed consent was waived due to the retrospective nature of the study and the use of anonymized data.

Clinical trial registration

Not applicable, as this study is a retrospective observational study and does not involve a clinical trial.

Use of artificial intelligence

AI tools, specifically Grammarly, were used to improve the clarity and language of the manuscript. The authors reviewed and edited all outputs and are fully responsible for the content.

Conflicts of interest

No conflicts of interest were declared by the authors.

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