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RISK FACTORS ASSOCIATED WITH 24-HOUR MORTALITY IN THE EMERGENCY DEPARTMENT: A SYSTEMATIC REVIEW

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ABSTRACT
The Emergency Department (ED) is the frontline of hospital care with a high risk of early mortality, particularly within the first 24 hours. Delayed recognition of critical conditions and variability in clinical assessment remain major challenges in reducing early deaths. This study aims to identify and synthesize risk factors associated with 24-hour mortality among patients in the ED. Methods: This study is a systematic review conducted in accordance with PRISMA guidelines using the PICO framework. Literature searches were performed in Scopus, PubMed, and Google Scholar databases from 2015 to 2025. Of 3,599 identified articles, 11 studies met the inclusion criteria and were analyzed qualitatively. Early mortality within 24 hours is influenced by multiple factors, including initial clinical conditions such as decreased consciousness, hypotension, hypoxia, and respiratory abnormalities; demographic factors such as advanced age; comorbidities, particularly cardiovascular and respiratory diseases; and healthcare system factors such as waiting time and ED length of stay. Additionally, clinical scoring systems (e.g., NEWS, qSOFA) and machine learning models demonstrated strong predictive performance for early mortality. Twenty-four-hour mortality in the ED is multifactorial, resulting from the interaction between patient clinical conditions and healthcare system factors. Reducing mortality requires an integrated approach, including improved triage accuracy, optimized early management, and enhanced ED service systems.

Keywords: early mortality; emergency department; risk factors; systematic review; triage

INTRODUCTION
The Emergency Department (ED) serves as the frontline of hospital care, managing patients with a wide spectrum of acute and life-threatening conditions. The increasing global demand for emergency services has led to significant challenges in patient prioritization, timely diagnosis, and rapid intervention. With millions of ED visits annually worldwide, healthcare systems are under constant pressure to identify high-risk patients early and allocate resources efficiently. Effective early risk stratification is therefore essential to improve patient outcomes and reduce preventable mortality (Son et al., 2023).

Early mortality, particularly within the first 24 hours of ED presentation, is a critical indicator of both disease severity and the effectiveness of initial management. This time window represents a highly vulnerable period during which rapid clinical deterioration may occur. Evidence suggests that a substantial proportion of early in-hospital deaths are associated with delayed recognition of clinical deterioration, highlighting the importance of timely identification of high-risk patients at the point of ED admission (Naemi et al., 2021).

In clinical practice, initial patient assessment in the ED relies heavily on readily available parameters, including vital signs, level of consciousness, and basic laboratory findings. These indicators have been widely recognized as important predictors of adverse outcomes. Recent studies have demonstrated that abnormalities in physiological parameters—such as hypotension, tachypnea, hypoxia, and altered mental status—are strongly associated with early mortality in ED patients. Such

findings underscore the value of rapid clinical assessment in guiding early decision-making (Naemi et al., 2021).

In addition to individual clinical parameters, various scoring systems, such as the Early Warning Score (EWS), National Early Warning Score (NEWS), and quick Sequential Organ Failure Assessment (qSOFA), have been developed to enhance the prediction of patient deterioration. These tools aim to standardize risk assessment and improve clinical judgment. However, their predictive performance varies across different patient populations and clinical settings, limiting their universal applicability in the ED context (Jiang et al., 2026).

Advances in data analytics and machine learning have introduced new approaches to mortality prediction in emergency care. These models integrate multiple variables simultaneously and have shown promising results in improving predictive accuracy compared to traditional scoring systems. Recent evidence indicates that machine learning-based models can effectively identify patients at high risk of early mortality, offering potential support for clinical decision-making in high-pressure ED environments (Son et al., 2023).

Despite these advancements, triage and risk assessment in the ED often remain influenced by subjective clinical judgment, which may lead to variability in patient prioritization. Inconsistencies in triage decisions can result in delayed management of critically ill patients, thereby increasing the risk of early mortality. This highlights the need for more objective and evidence-based approaches to identify patients at risk within the first hours of ED care (Zairinal & Amanah, 2026).

Furthermore, demographic factors and pre-existing comorbidities play a significant role in determining patient outcomes. Older age, chronic illnesses—particularly cardiovascular and respiratory diseases—and poor baseline health status have been consistently associated with increased mortality risk. Laboratory abnormalities, such as elevated lactate levels and renal dysfunction, have also been identified as important predictors of early death in acute care settings (Serra & Yuguero, 2024).

System-level interventions, including early warning systems and clinical alert protocols (e.g., sepsis alert systems), have demonstrated effectiveness in improving patient outcomes by facilitating early recognition and timely treatment. Recent systematic reviews have shown that such interventions are associated with reduced mortality and improved adherence to clinical guidelines in emergency settings. (H.-J. Kim et al., 2024). These findings emphasize the importance of integrating predictive tools with actionable clinical pathways.

However, most existing studies focus on in-hospital or long-term mortality outcomes, while evidence specifically addressing mortality within the first 24 hours of ED presentation remains limited. Additionally, the available literature exhibits considerable heterogeneity in terms of study populations, methodologies, and reported risk factors. This variability poses challenges in synthesizing evidence and translating findings into clinical practice (Naemi et al., 2021).

Given these gaps, there is a clear need for a comprehensive synthesis of current evidence to identify risk factors associated with 24-hour mortality in the ED. Therefore, this systematic review aims to evaluate and summarize the existing literature on predictors of early mortality among ED patients. The findings are expected to support evidence-based clinical decision-making, improve risk stratification processes, and ultimately enhance the quality of emergency care.

METHOD

Research Design

This systematic review was conducted to synthesize the current scientific evidence on risk factors associated with 24-hour mortality in the Emergency Department (ED), based on previous research

findings. The research questions were presented in the PICO format as follows: (1) Population: patients in the Emergency Department; (2) Exposure: risk factors or clinical characteristics and the care system; (3) Comparison: patients without risk factors or with normal conditions; and (4) Outcome: 24-hour mortality. This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines.

Eligibility Criteria
Studies included in this systematic review met the following criteria: (1) the study was a primary research design; (2) the study population was patients in the Emergency Department (ED); (3) the predictors studied were risk factors or clinical characteristics or care systems associated with mortality; and (4) the full text of the article was available in English.

Literature Search Strategy
To conduct this study, a search was conducted in English focusing on risk factors associated with mortality in the Emergency Department (ED) through Scopus, PubMed, and Google Scholar databases from 2015 to 2025 using the keywords ("mortality" OR "early death" OR "24-hour mortality") AND "emergency department" AND ("risk factors" OR "predictors" OR "determinants").

Eligibility Criteria
We determined inclusion criteria using the PICO framework, a modification of the PICO framework. This framework considers the population, exposure of interest, context, and study design (Methley et al., 2014). This study included studies involving risk factors or predictors associated with mortality in patients in the Emergency Department (ED). Selected articles must be available in full-text format.

Study Selection
The screening process was conducted independently by all authors. In the initial stage, titles and abstracts were screened to identify relevant studies related to mortality risk factors in patients in the Emergency Department (ED). Studies that met the initial criteria then proceeded to the full-text review stage. Full-text articles were then assessed and evaluated based on the established inclusion criteria. Studies that met all criteria were then included in the data extraction and quality assessment stage.

Data Extraction
The following data were extracted from each study: author name, year of publication, country of publication, study design, statistical test, sample size, PICO (population, intervention, comparison, outcome), weaknesses, and findings.

Ethics Statement
This article is not an original primary study, but rather a systematic observation using secondary data extracted from original published articles, each of which has met ethical clearance requirements. Therefore, no additional ethical clearance is required.

RESULT
The search for articles in this study was conducted through databases including Scopus, PubMed, and Google Scholar. The keywords used included: ("mortality" OR "early mortality" OR "24-hour mortality") AND "emergency department" AND ("risk factors" OR "predictors" OR "determinants"). The literature selection process for this study was conducted systematically following the PRISMA protocol.

In the initial identification stage, a total of 3,599 relevant articles were identified from the search results across various databases. After checking for duplication, 75 articles were removed, leaving 3,524 articles for the screening stage.

In the initial screening stage, based on title and abstract, 3,454 articles were eliminated because they did not meet the study criteria. Next, 70 articles were evaluated in full text to assess their suitability for the established inclusion criteria. Based on this evaluation, 57 articles were excluded for not meeting the criteria, leaving 11 studies deemed eligible for inclusion in the systematic review.

It can be seen in Figure 2 that the research articles come from 4 continents, namely Asia, Europe America, Africa.

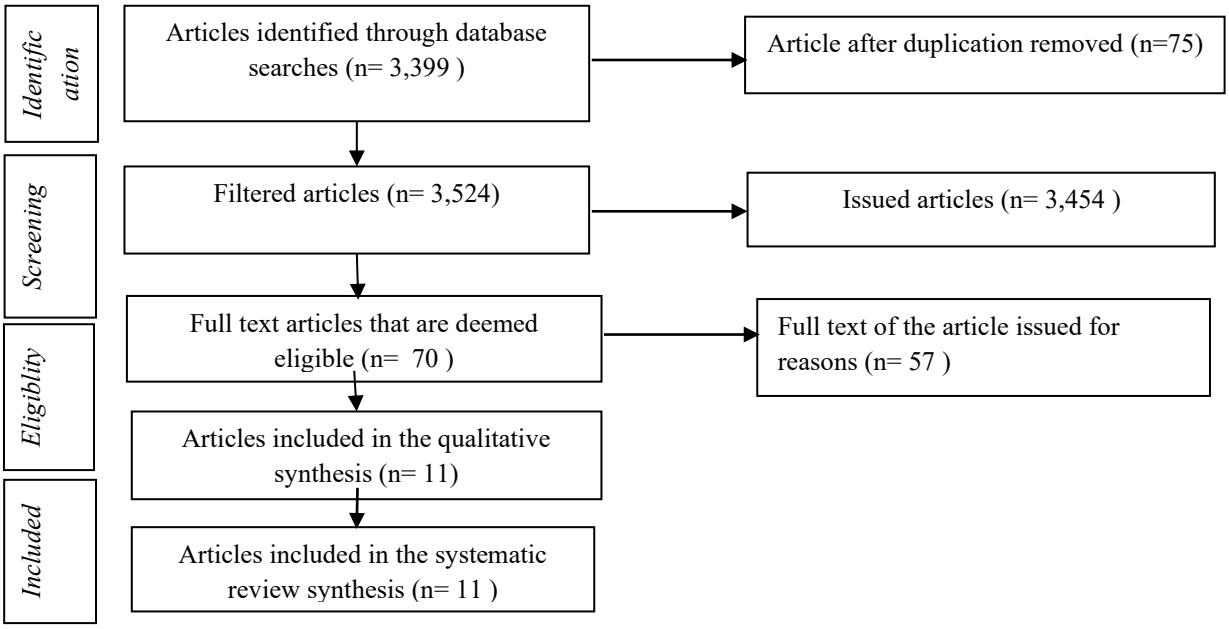

Figure 1. Flow chart diagram

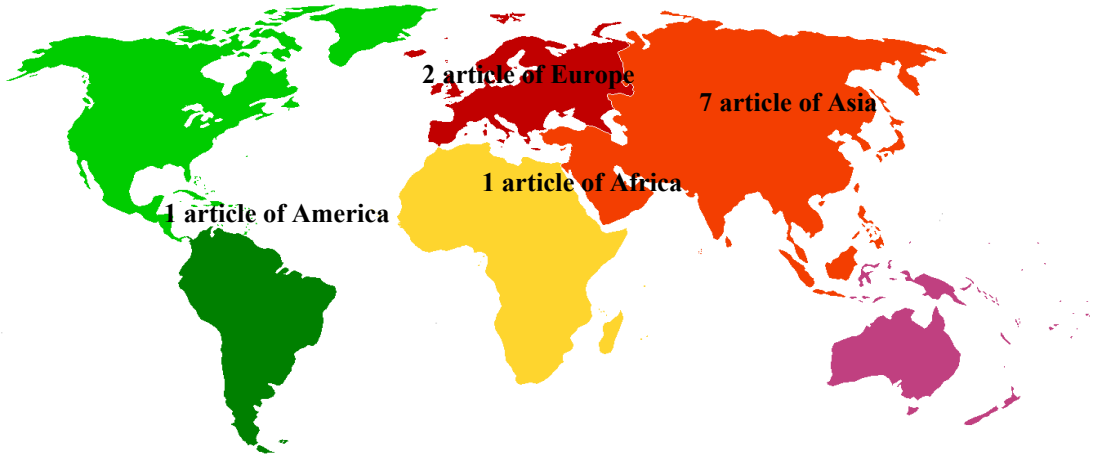

Figure 2. Research area map

Table 1.
Description Primary Study of Risk Factors Associated with 24-Hour Mortality in the Emergency Department

Title	Author (Year)	Country	Population	Method	Results
Risks of Early Mortality and Associated Factors at Adult Emergency Department of	Abebe et al., (2023)	Ethiopia	261 patient (87 case, 174 control)	Case-control	Risk factors for early mortality: red triage (AOR 2.3), age ≥65 years (AOR 3.2), cardiovascular disease (AOR 4.79), respiratory

Title	Author (Year)	Country	Population	Method	Results
Jimma University Medical Center					failure, and rural residence
Machine learning-based mortality prediction models for emergency department patients: a comparative analysis	Jiang et al., (2026)	China	1.389 patient ED	Retrospective cohort (ML)	The LightGBM model had the highest accuracy (AUROC 0.96); main factors: lactate, GCS, albumin, BE, SBP
Incident and predictors of 30-day mortality in critically ill patients after ED admission	Sangsongrit et al., (2026)	Thailand	442 critical patients	Prospective observational	Predictors of 30-day mortality: impaired consciousness, ESI level 1, sepsis, NEWS ≥5, high comorbidity, and inter-hospital transfer
Association Between Emergency Department Length of Stay and In-Hospital Mortality	Habib & Sudaryo, (2023)	Indonesia	18.553 patient	Retrospective cohort	LOS ≥8 hours increases the risk of mortality (RR 2.69)
Predicting high-risk return at ED presentation (HANDLE-24 score)	Chen et al., (2025)	Taiwan	±2.200 patient revisit ED	Retrospective cohort	Mortality/ICU risk factors: hypertension, ACS, dyspnea, electrolyte disturbances, altered triage
Clinical factors of patients who die in an emergency department	Serra & Yuguero (2024)	Spanyol	116.870 patient (317 dead)	Retrospective descriptive	Risk factors: advanced age, emergent triage, hypotension, hypoxia, tachypnea, increased creatinine & lactate
Relationship between ED triage data and 24- and 48-hour mortality	Zairinal & Amanah (2026)	Indonesia	1.976 patient	Retrospective cohort	Predictors of 24-hour mortality: triage & RR; 48-hour mortality: age, RR, SBP, mental status
Prediction of 24-h mortality by ROX index vs NEWS	Candel et al., (2022)	Belanda	270.665 patient	Multicenter retrospective	ROX & NEWS effectively predict 24-hour mortality; NEWS AUC 0.92
Improved patient mortality predictions in ED with deep learning	Son et al., (2023)	Korea Selatan	7.325 patient	Retrospective ML study	ML model improves mortality prediction (AUC 0.97)
ED utilization and risk factors for mortality in older patients	Kim et al., (2021)	Korea Selatan	>8 million patients	Cross sectional	Risk factors: advanced age, abnormal vital signs, high triage, mental status

Title	Author (Year)	Country	Population	Method	Results
Prediction of In-hospital Mortality in ED Patients With Sepsis	(Taylor et al., 2018)	Amerika	5,278 ED visits	Retrospective ML	Random forest outperforms traditional model (AUC 0.86)

DISCUSSION

Review systematic This aim For identify and synthesize factors associated risks with mortality within 24 hours in patients in the Installation Emergency Emergency (ER). Based on results analysis against 11 studies that met the criteria criteria inclusion , found that mortality early in the ER is phenomenon complexes influenced by interactions between factor clinical characteristics patients , as well as factor system service health .

Review results systematic This show that mortality within 24 hours in patients in the Installation Emergency Emergency (ER) is influenced by various factors that are multifactorial , including characteristics patient , condition clinical beginning , and factor system service health . Findings This consistent with literature previously confirmed that death early in the ER no only influenced by conditions medical patients , but also by the response system available services (Tesfaye et al., 2023).

One of factor main related with mortality in 24 hours is condition clinical beginning patient moment enter the ER. Parameters such as decline consciousness (low Glasgow Coma Scale), hypotension , and hypoxia in a way consistent reported as predictor strong death early (Handayani et al., 2022) . In addition , the increase rate breathing and disorders oxygenation is also proven own connection significant with mortality within 24 hours, so that can used as indicator beginning in the triage process (Kellett & Deane, 2023) . Findings This confirm importance stabilization initial and assessment fast condition physiological patient For lower risk death .

Comorbidity factors also play a role role important in increase risk mortality . Patients with disease chronic like disease cardiovascular , cancer , and disorders metabolic own greater vulnerability tall to worsening condition acute in the ER (Phungoen et al., 2024) . Index high comorbidity , such as the Charlson Comorbidity Index (CCI), has been shown to correlated with improvement mortality , especially in patients age continue . This is show that approach management patients in the emergency room need consider condition underlying chronic , not only acute diagnosis .

Apart from the factors clinical and patient factors system service health also contributes significant to mortality early . Long waiting times, overcrowding, and duration patient being in the IGD (emergency department length of stay) is associated with improvement risk death (Sun et al., 2023). Other studies also show that the boarding time is prolonged can worsen patient outcomes consequence delay handling definitive (Çınar et al., 2022) . Condition This reflect importance efficiency channel service and availability source Power in lower number death in the emergency room.

In a way overall , results review This confirm that mortality within 24 hours in the ER is results interaction complex between factor clinical characteristics patients and systems service . Therefore that , the strategy for lower mortality must done in a way comprehensive , including improvement accuracy triage , use score prediction clinical , optimization management beginning patients , as well as repair system emergency room services comprehensive .

CONCLUSION

Mortality within 24 hours in Installation Emergency Emergency (ER) is influenced by factors clinical beginning , characteristics patients and systems service . Decline consciousness , hypotension , hypoxia , and comorbidities is predictor main death early , while factor system such as length of stay in the ER and delays handling participate worsening outcomes.

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