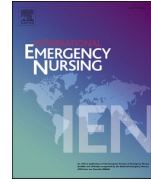




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## Prehospital triage in emergency medical services system: A scoping review

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## ABSTRACT

**Background:** During the prehospital phase, paramedics consider patients' condition according to illness, injury, disease and decide on transport to an appropriate hospital according to severity. This can affect patient survival and treatment prognosis, because despite intervention at this early stage, problems such as incorrect triage of severity and inappropriate hospital selection may occur, indicating a need for improvement in the process.

**Purpose:** The aim of this review is to identify the overall trend of research conducted on prehospital triage by analyzing the emergency medical services system and presenting future studies to practitioners and researchers. **Methods:** A scoping review was conducted of existing literature on research trends in relation to prehospital triage. The studies reviewed were identified using electronic databases such as PubMed, CINAHL, Cochrane Library, Web of Science, and Scopus.

**Results:** Ninety-eight documents were finally selected and analyzed that focused on prehospital triage status, process accuracy, tools, guidelines, and protocols.

**Conclusion:** Research is proposed that focuses on various non-traumatic patient types, prehospital triage education, and development of training programs to reduce errors in the emergency patient handover process between prehospital and hospital health professionals and to improve patient health and quality of life.

## 1. Introduction

Prehospital emergency medical services (EMS) are an essential part of emergency medical care [1]. Prehospital EMS provide emergency assessment and treatment for seriously ill or injured patients and transportation by ambulance to an emergency department [2]. Within the emergency medical system, triage helps classify emergency patients' symptoms according to severity and prioritizes the provision of limited medical resources to patients. This means they can be assessed and classified to enable placement for the correct treatment in emergency rooms or disaster situations [3].

During the prehospital phase, paramedics classify various patient conditions and decide on transport to an appropriate hospital, accounting for the patient's condition and severity [4]. This is undertaken through the triage process [5]. Properly classifying trauma patients and transporting them to a hospital for suitable treatment can affect patient survival and treatment prognosis and can shorten treatment time and medical preparation in the hospital [6]. Thus, appropriate categorization at the prehospital stage is also important for addressing overcrowding in the emergency room and preparing treatment resources, as

well as reducing treatment time for critically ill patients and preparation of medical staff [7–9]. Despite these factors, triage has limitations because it is completed within a short time and mild patients may be classified as severe (overtriage) while severe patients may be classified as mild (undertriage) [10,11]. Incorrect triage can lead to poor treatment and prognosis among emergency patients: Overtriage can lead to overuse of limited medical resources and cause unnecessary transfer to tertiary hospitals [12], while undertriage may result in a delay in treatment for critically ill patients that could ultimately negatively affect patient prognosis and safety [13–15]. In addition, paramedics use on-site first aid standard guidelines for prehospital triage, but these are sometimes unnecessary or make it difficult to address the nature of the problem without advanced intervention; for example, in the case of traffic collisions, fractures, physiological signs, or amputation [16]. While studies have shown that in Canada and Japan, the development and application of the five-level prehospital triage system could increase the concordance between prehospital and in-hospital triage [17,18], there is still a mismatch between prehospital and hospital triage [15,19,20]. Prehospital and hospital-based health professionals communicate patient information at the handover stage to ensure that

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critically ill patients receive high-quality acute care in a timely manner [21]. However, it has been found that undertriage during the prehospital phase for pediatric patients means that approximately a quarter of patients with potentially serious injuries and illnesses requiring treatment in high-resource hospitals are transferred to general emergency departments, delaying treatment initiation [15].

A scoping review is used to map literature on a particular subject or study area to identify the type of evidence, data, key concepts, and differences to suggest the direction of future research [22]. In addition, unnecessary repetitive research in a specific field can be avoided; it may be used as basic data for setting the subject range and priority of systematic literature reviews to be conducted in the future [23].

Therefore, the aim of this study is to identify the overall trend of research conducted on prehospital triage by analyzing and organizing research by the subject range literature review method and to present the research fields necessary for improving future prehospital triage to clinical practitioners, policymakers, and researchers.

## 2. Methods

This scoping review identifies research trends from papers published in international journals under the theme of triage in the prehospital phase within the emergency medical system. The study procedure was conducted by reflecting the Preferred Reporting Items for Systematic Reviews extension for Scoping Reviews (PRISMA-ScR) [24] results reporting guidelines, and based on the five-step procedure of the subject-range literature review presented by Arksey and O'Malley [25] as follows: Step 1: setting research questions; Step 2: checking related research; Step 3: selecting research; Step 4: recording data; and Step 5: collecting data and summarizing results. Steps 1–4 are described in the research method section, and Step 5 is described in the research results section.

### 2.1. Setting research questions

Research questions must be clear to conduct a scoping review. Because the categories of papers to be analyzed are determined through research questions, the questions should be specific and clearly described [23]. The research question of this study is “How is the study of patient triage in the prehospital phase studied?”

### 2.2. Checking related research

#### 2.2.1. Search strategy

This study targeted papers published in academic journals on subjects related to the classification of patient severity during the prehospital phase of treatment. The databases used for the search were PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library, Web of Science, and Scopus, and the search period for the studies was set to December 2020. The search terms used for the review were: “prehospital triage,” “prehospital emergency care,” and “field triage”. The search formula was constructed by referring to previous studies [26–28], and the nursing/medical librarian at the university to which the researcher belongs was advised on the search formula (see Appendix 1).

#### 2.2.2. Data selection and exclusion criteria

The criteria for selecting the literature included in the data analysis are research papers published in academic journals until December 2020 that address triage in the prehospital phase. Studies that were not focused on triage in the prehospital phase were excluded.

#### 2.2.3. Study selection

As a result of the search, a total of 5,257 articles were found, including 1,065 studies in PubMed, 510 studies in CINAHL, 61 studies in Cochrane Library, 2,382 studies in Web of Science, and 1,239 studies in

Scopus. After removing all duplicates, 2,994 articles were retained for preliminary analysis. After screening, further articles were excluded because the title and abstract did not match with our primary subject. In cases that were difficult to judge based on the title and abstract alone, the original text was checked. Following this process, a total of 2,896 documents were excluded (72 studies that did not correspond to research papers, 2,081 studies that did not discuss triage, 727 studies that did not deal with prehospital EMS, and 16 studies on disaster situations). This left 98 documents to be included in the final analysis (Fig. 1) (Appendix 2).

#### 2.2.4. Recording data

To extract data from the final 98 documents, the main contents were organized by recording data using a data entry form with Microsoft Excel (Microsoft, Redmond, WA).

## 3. Results

### 3.1. Characteristics related to publication and research of literature

Table 1 shows the general characteristics of the 98 articles finally selected for this study, for which the research publication year was from 1995 to 2020, with only three papers published before 2000. As a result of classification by subject, it was found that there were 42 studies on trauma patients, 27 studies on non-traumatic patients, 7 studies on patients who did not distinguish between trauma and non-traumatic studies, and 22 studies on prehospital EMS systems. Among the papers on non-trauma patients, there were nine studies on stroke patients and eight studies on myocardial infarction (MI) patients.

Classification by region showed there were 46 studies in the United States, 4 in Denmark, 3 in the Netherlands, 1 in Germany, 1 in Poland, and 1 in Sweden (from 62 studies that specified the study area). In addition, there were two multi-country studies and one study each in China, Singapore, Taiwan, and Australia (Table 1).

### 3.2. Analysis of literature topics and contents

In this study, the direction and effect of the prehospital patient triage study were analyzed as two topics: classification by study subject, and classification by study purpose.

#### 3.2.1. Classification by study subject

In terms of classification by study subject, there were 42 studies on trauma patients, 27 studies on non-trauma patients, and 7 studies on general patients who did not disclose trauma and non-trauma. There were 22 studies on the prehospital EMS system; for example, prehospital EMS protocols, decision-making processes, and prehospital EMS providers.

With regard to trauma patients, three studies addressed head trauma (A30, A67, A68) and 39 studies focused on unclassified trauma patients. Among the studies on non-trauma patients, nine were conducted on stroke patients (A7, A13, A14, A23, A37, A40, A49, A75, A76) and eight were conducted on myocardial infarction (MI) patients (A3, A15, A80, A86, A87, A89, A92, A98).

For other non-trauma patients, studies included two on mental illness (A20, A73), one on anaphylaxis (A26), one study on alcoholism (A74), one study on COVID-19 (A77), two studies on sepsis (A22, A81), one study on drug addiction (A93), one study on non-traumatic cardiac arrest (A96), and one non-specific study (A82). Among non-trauma patients, there were two studies (A22, A93) targeting pediatric patients (Table 2).

#### 3.2.2. Classification by study purpose

Classification by purpose of the study showed that there were 21 studies on the status of the prehospital triage and 26 studies on the accuracy of the prehospital triage process. There were 19 studies on the

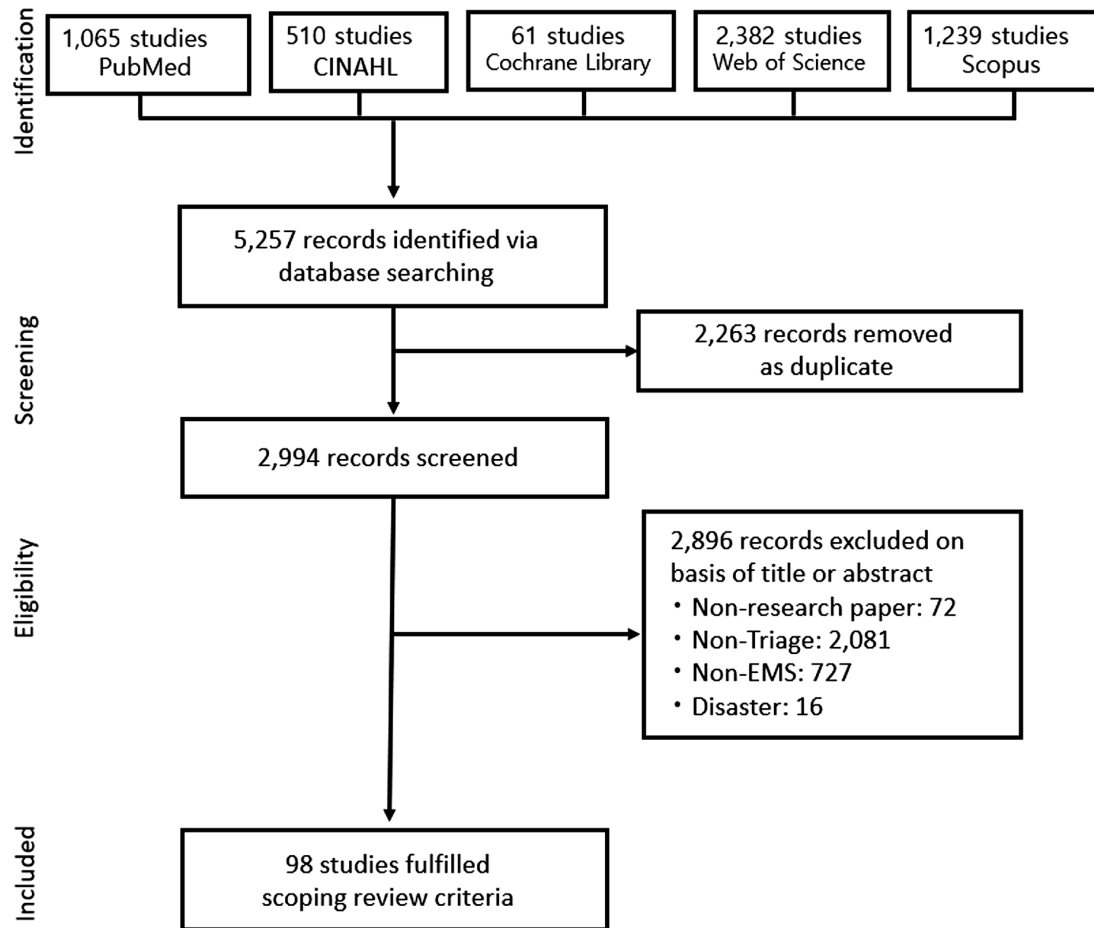


Fig. 1. PRISMA flow diagram of literature screening process.

**Table 1**  
Summary of the Characteristics of Included Studies (N = 98).

Variables	Categories	N (%)
Publication year	1995 ~ 1998	3 (3.1)
	2003 ~ 2010	19 (19.3)
	2011 ~ 2020	76 (77.6)
Study design	Quantitative study	86 (87.8)
	Qualitative study	5 (5.1)
	Quantitative-Qualitative mixed methods	4 (4.1)
	Experimental study	1 (1.0)
	Systematic review	2 (2.0)
Subject	Patient	76 (77.6)
	Emergency medical services system	22 (22.4)
Country	United States	46 (47.0)
	Europe	10 (10.2)
	Asia	3 (3.0)
	Australia	1 (1.0)
	Multi-country	2 (2.0)
	Non-classified	36 (36.8)

accuracy of prehospital triage tools and 32 studies on the prehospital triage guidelines and protocols (Table 3).

We identified 21 studies on the status of the prehospital triage, of which 8 focused on the status and results of prehospital triage for trauma patients, 7 studies addressed the status and characteristics of non-trauma patients transported by prehospital EMS, 1 study examined prehospital EMS usage and patient characteristics, 2 studies addressed the economic effects of proper operation of prehospital EMS, 2 studies

**Table 2**  
Summary of the Subject (N = 98).

Subject	Condition	N (%)
Emergency medical services system	–	22 (22.5)
	Patient	
Trauma patient	Head trauma	3 (3.1)
	Non-classified	39 (39.9)
	Stroke	9 (9.2)
	Myocardial infarction	8 (8.2)
	Mental illness	2 (2.0)
	Anaphylaxis	1 (1.0)
	Alcohol abuse	1 (1.0)
	COVID-19	1 (1.0)
	Sepsis	2 (2.0)
	Toxic ingestion	1 (1.0)
	Cardiac arrest	1 (1.0)
	Non-classified	1 (1.0)
Non-trauma patient	–	7 (7.1)
	General patient	

focused on criteria for defining prehospital EMS healthcare needs, and 1 study examined prehospital stroke triage protocols training outcomes for prehospital EMS providers.

We identified 26 studies on the accuracy of prehospital triage processes. Ten studies were focused on accuracy, sensitivity, and evaluation of prehospital triage processes for trauma patients, 4 studies evaluated the adequacy of the prehospital triage process for non-trauma patients, 3 evaluated prehospital EMS triage processes for general patients, 2 studies evaluated the appropriateness of prehospital triage processes of

**Table 3**  
Summary of Studies by Theme (N = 98).

Theme	Sub-theme	N (%)
Prehospital triage status	Status and results of prehospital triage for trauma patients [A10, A18, A20, A37, A60, A64, A84, A98]	8(8.2)
	Status and characteristics of non-trauma patients transported by prehospital EMS [A14, A19, A21, A72, A79, A85, A92]	7(7.2)
	Prehospital EMS usage and patient characteristics [A40]	1(1.0)
	Economic effects of proper operation of prehospital EMS [A16, A96]	2(2.0)
	Criteria for defining prehospital EMS healthcare needs [A17, A50]	2(2.0)
	Prehospital stroke triage protocols training outcomes for prehospital EMS providers [A22]	1(1.0)
	Accuracy, sensitivity, and evaluation of prehospital triage process for trauma patients [A2, A23, A29, A45, A58, A59, A61, A67, A93, A94]	10 (10.2)
	Evaluation of the adequacy of the prehospital triage process for non-trauma patients [A3, A39, A74, A80]	4(4.1)
	Evaluation of prehospital EMS triage process for general patients [A9, A11, A31]	3(3.1)
	Evaluation of the appropriateness of prehospital triage process of prehospital EMS among pediatric patients [A46, A49]	2(2.0)
Accuracy of Prehospital triage process	Joint model evaluation of law enforcement officers and prehospital EMS [A4]	1(1.0)
	Accuracy evaluation of helicopter-EMS guidelines [A70, A90]	2(2.0)
	Comparison of prehospital and in-hospital triage scales [A47, A56]	2(2.0)
	Comparison of regional differences in prehospital triage [A57, A68]	2(2.0)
	Accuracy, sensitivity, and evaluation of prehospital triage tools for trauma patients [A1, A5, A6, A8, A32, A33, A42, A54, A65]	9(9.2)
	Evaluation of the effectiveness of age, anatomical awareness, and physiological information among trauma patients [A43, A44, A55, A63]	4(4.1)
	Accuracy, sensitivity, and evaluation of prehospital triage tool for non-trauma patients [A12, A13, A36, A73, A76, A95]	6(6.1)
	Guidelines for the use of helicopter-EMS for trauma patients' status and communication [A27, A28, A30, A82, A87, A89]	6(6.1)
	Prehospital triage protocol and guidelines for trauma patient [A52, A62, A66, A69, A77, A78]	6(6.1)
	Prehospital triage protocol and guidelines for non-trauma patients in prehospital EMS [A7, A25, A48, A75, A81, A86, A88, A91, A97]	9(9.2)
Prehospital triage Guidelines and Protocols	Prehospital triage protocol for low-acuity patients [A24, A71, A83]	3(3.1)
	Patient transport and care protocol in prehospital EMS [A15, A35, A38, A41, A53]	5(5.1)
	Prehospital EMS triage protocol for COVID-19[A34, A51]	2(2.0)
	Communication during prehospital triage process [A26]	1(1.0)

EMS: Emergency medical services.

prehospital EMS among pediatric patients, 1 study was a joint model evaluation of law enforcement officers and prehospital EMS, 2 studies presented accuracy evaluations of helicopter-EMS guidelines, 2 studies compared prehospital and in-hospital triage scales, and 2 studies compared regional differences in prehospital triage.

We identified 19 studies concerning the accuracy of prehospital triage tools. Of these, nine studies examined the accuracy, sensitivity, and evaluation of prehospital triage tools for trauma patients, four studies evaluated the effectiveness of age, anatomical awareness, and physiological information among trauma patients, and six studies examined the accuracy, sensitivity, and evaluation of prehospital triage

tools for non-trauma patients.

We identified 32 studies on prehospital triage guidelines and protocols. Of these, six studies were guidelines for the use of helicopter-EMS for trauma patients' status, and communication, six studies were on prehospital triage protocols and guidelines for trauma patients, nine studies were on prehospital triage protocols and guidelines for non-trauma patients in prehospital EMS, three studies were on prehospital triage protocols for low-acuity patients, five studies were on patient transport and care protocols in prehospital EMS, two studies were on prehospital EMS triage protocols for COVID-19, and one study was on communication during prehospital triage processes.

#### 4. Discussion

In this study, we applied a scoping review method to examine the overall trend of research concerning prehospital phase triage in order to identify potential future research directions for future prehospital triage for clinical practitioners, policymakers, and researchers.

As a result of this study, 98 papers were identified from 1995, with a focus was on the frequency and accuracy of diagnosis of acute stroke (A39), and since 2011, have shown a distinct trend related to the use of The Centers for Disease Control and Prevention (CDC) Guideline for the field triage of injured patients [29], which was strongly recommended by the Federal Interagency Committee on EMS and the National EMS Advisory Council.

In terms of research method, 86 studies applied a quantitative approach, 2 were literature reviews, 5 applied a qualitative approach and 4 studies used a mixed methods approach. One experimental study was mainly conducted as a quantitative study. It is necessary to study the difficulties and needs experienced by prehospital EMS providers in the process of prehospital triage in the same way as one previous study that explored the needs of emergency nurses for pain evaluation through a qualitative study [30]. These results could provide a background for research on the development and improvement of prehospital patient classification tools.

The 98 studies finally selected in this study were analyzed by classification, by study subject, and by research purpose. Studies on trauma and stroke patients were the most common in the classification by study subject. This is similar to the results of trauma and stroke prehospital triage tools in the scoping review study of the prehospital triage tool, which accounts for more than two-thirds of 55 studies [31]. This is thought to be a clinically important result of trauma-related injuries and stroke as one of the major causes of death [32].

Classification by research purpose focused on prehospital triage status, accuracy of prehospital triage processes, and accuracy of prehospital triage tools, guidelines, and protocols.

With regard to the status of prehospital triage, most of the studies on pre-hospital triage were the conditions and characteristics of trauma patients and non-traumatic patients. There was one study on how pre-hospital EMS providers learn about prehospital triage protocols. Although this was presented in a single training session, this brief educational intervention alone demonstrated significant improvement in the knowledge of prehospital stroke triage among EMS providers [33]. Through prehospital triage education and National Medical Rescue Team (NMRT) basic training, the success rate of prehospital triage can be increased for mass casualty incidents [34]. Triage is a complex role and is directly related to patient safety; thus, education was found to be important even at the hospital stage. Therefore, a triage education program is needed not only for beginner triage nurses, but also for prehospital EMS providers, and extensive research is recommended for the standardization of triage education [35].

The prehospital triage of prehospital EMS for trauma patients was the most studied, followed by non-trauma patients and general patients. In particular, a study on the appropriateness of prehospital triage for trauma patients was conducted among patients with injuries to the head, chest, and cervical vertebrae, which is likely to result in a high risk

of rapid deterioration, meaning proper prehospitalization for transport to high-level trauma centers is important [36]. Adequate triage enables rapid identification and treatment of patients requiring immediate treatment in the hospital phase and transfer to a hospital suitable for treatment according to symptoms in the prehospital phase [37,38].

Studies on the adequacy of prehospital triage tools such as the International Classification of Injury Severity Score (ICISS) or CDC-based field triage were conducted for trauma patients, together with studies on non-trauma triage tools such as the Field Assessment Stroke Triage for Emergency Destination (FAST-ED), Ontario Prehospital Stroke Screening Tool, and Rapid Arterial Occlusion Evaluation (RACE). Although no single tool for prehospital triage emerged as standard, a recent study of COVID-19 patients found that prehospital classification tools, such as the quick Sequential Organ Failure Assessment (qSOFA), National Early Warning Score (NEWS), and the Prehospital Early Sepsis Detection (PRESEP), currently available, were ineffective in predicting death, ICU hospitalization, and disease severity among COVID-19 patients [39]. It is important to triage patient symptoms during the prehospital phase and transfer them to an appropriate hospital according to severity [14,15]. In Canada and Japan, the pre-Canadian Triage and Acuity Scale (pre-CTAS), which was developed based on CTAS and a five-level prehospital triage system in Japan, are used for high-quality prehospital triage [17,18]. However, a difference in severity classification between prehospital triage and hospital triage remained. By transferring a patient in need of high-level hospital treatment to low-level hospital, the initiation of treatment for critically ill patients may be delayed, and emergency resources may be wasted by transferring low-acuity patients to high-level hospitals [18,20]. Therefore, research on improving prehospital triage tools is required; furthermore, standards for various types of prehospital triage tools are established, for which corresponding training is required. Prehospital and hospital health professionals work together through handover, which is the only opportunity for healthcare professionals to communicate patient information and is therefore a critical moment in ensuring that critically ill patients receive timely, high-quality acute care [21]. Improvements and training in prehospital triage tools could reduce errors in this handover process.

Most of the studies in this review were on prehospital triage protocols, helicopter-EMS guidelines and protocols for trauma patients and severe trauma, as patients with an injury severity score (ISS > 16) were studied. Three studies on prehospital triage guidelines and protocols for non-emergency patients were also conducted. The use of prehospital EMS for low-acuity patients depletes resources that should be used for high-severity emergency patients and increases emergency room overcrowding [40]. Emergency medical resources are limited at the site where the emergency patient is first identified (such as an accident site) and the emergency room where they are treated, and triage is implemented to efficiently allocate limited resources. To reduce the depletion of emergency medical resources and overcrowding of the emergency room, it is considered necessary to study the prehospital EMS triage protocol for low-acuity patients. In addition, a study on the protocol of prehospital EMS for the recent COVID-19 pandemic was conducted. The protocol of such prehospital EMS can also be used as an early warning tool to help monitor future epidemics by affecting prehospital EMS systems in other regions and countries [41].

## Appendix 1. Search strategy

### PubMed

((“prehospital”[All Fields] OR “prehospitally”[All Fields] OR “emergency care”[All Fields] OR “Emergency Medical Services”[MeSH Terms] OR “paramedic s”[All Fields] OR “paramedical”[All Fields] OR “paramedics”[All Fields] OR “paramedics”[MeSH Terms] OR “paramedics”[All Fields] OR “paramedic”[All Fields] OR “Emergency Medical Technicians”[MeSH Terms] OR (“emergency”[All Fields] AND “medical”[All Fields] AND “technicians”[All Fields]) OR “Emergency Medical Technicians”[All Fields]) OR “Emergency Medical Technicians”[MeSH Terms] OR “emergency

## 5. Limitations

This study has several limitations. First, terms used to represent prehospital triage are mixed with prehospital emergency care and field triage. Thus, it is possible that while several word combinations were used to search, some related literature may not have been identified. Second, this study only looked for published studies, and unpublished papers (such as theses) or grey documents were not included in the final selection. There is a possibility that such documents may discuss the current status and other content relating to prehospital triage. Despite these limitations, this study is meaningful in that it identifies the overall direction of prehospital triage research and suggests future research directions accordingly.

## 6. Conclusion

This study is a scoping review of prehospital triage. By analyzing the research trends for prehospital triage that have been conducted so far, the research fields necessary for future prehospital triage classification are presented to clinical practitioners, policy makers, and researchers. This study is meaningful in that it identifies the overall direction of prehospital triage research. As a result of this review, it was found that studies on the status of prehospital triage, accuracy of the prehospital triage process, prehospital triage tools, and prehospital triage guidelines and protocols have been conducted. Based on this review, clinical practitioners, policy makers, and researchers should be able to develop research and education programs that can increase the appropriateness and sensitivity of prehospital triage through prehospital triage education or training programs. In addition, we suggest a study on a more extensive range of non-trauma patients and a study that can standardize various types of prehospital triage tools. This can contribute to improving prehospital triage education for prehospital EMS providers and reduce treatment delays for critically ill patients due to inappropriate prehospital triage. Moreover, it can reduce errors in the emergency patient handover process between prehospital and hospital health professionals, and can contribute to improving patient health and quality of life.

## Ethical statement

Ethical approval for this study, as well as the requirement for informed consent, was waived by the institutional review board of the Chung-Ang University (IRB No.1041078–202110-HR-280–01).

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



medical technician\*\*[All Fields] OR "rescue personnel"[All Fields] OR "paramedical personnel"[All Fields] OR "prehospital emergency care"[All Fields]) AND ("prehospital triage"[All Fields] OR "pre-hospital triage"[All Fields] OR ("field"[All Fields] OR "field s"[All Fields] OR "fields"[All Fields]) AND ("triage"[MeSH Terms] OR "triage"[All Fields] OR "trriages"[All Fields] OR "triaged"[All Fields] OR "triaging"[All Fields])))) AND (1973:2020[pdat]).

## Appendix 2. List of articles included in the scoping review

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