## REVIEW ARTICLE

# Enhancing Triage Systems in Emergency Units: An Extensive Review

**Dipankar Maiti[1]\*, Tincy Mariam Easow[2], Jyothi R[3]**

[1]Critical Care Nursing, NDRK College of Nursing, Bangalore, Karnataka, India

[2]Department of Pediatric Nursing, AECS Maaruti College of Nursing, Bangalore, Karnataka, India

[3]Department of Medical Surgical Nursing, Sushrutha College of Nursing, Bangalore, Karnataka, India

**\*Corresponding author:**

Mr. Dipankar Maiti, PG Scholar in Critical Care Nursing, NDRK College of Nursing, Bangalore, Karnataka, India.
Email Id: dipankarmaiti2015@gmail.com

## Abstract

Triage systems in emergency units play a crucial role in prioritizing patient care and optimizing resource allocation during mass casualty incidents or high-demand situations. This article provides a comprehensive review of triage systems, concentrating on their evolution, key components, challenges, and future directions. By synthesizing existing literature and incorporating insights from healthcare professionals, this research aims to inform policymakers and practitioners about the latest developments in triage systems and recommend strategies for enhancing their effectiveness. Triage systems in emergency units play a crucial role in prioritizing patient care and resource allocation. This abstract delivers an overview of triage systems, focusing on their structure, function, challenges, and potential enhancements. Drawing upon a comprehensive review of literature, including academic studies, healthcare guidelines, and expert opinions, this research elucidates the multifaceted nature of triage systems and their impact on emergency care delivery. In contemporary emergency units, triage systems operate on standardized protocols and algorithms aimed at rapidly assessing patients upon their arrival and assigning them to priority categories based on the severity of their condition. However, these systems face challenges such as overcrowding, resource constraints, and variability in patient presentations, which can impact their effectiveness and efficiency. To address these challenges, opportunities for enhancing triage systems abound. Technological advancements, such as the integration of Electronic health records (EHRs) and real-time data analytics, offer promising avenues for improvement. Furthermore, ongoing training and education programs for triage personnel can enhance their skills and decision-making abilities, leading to more consistent and accurate triage assessments. Ultimately, by embracing innovation and collaboration, emergency units can enhance the efficiency and effectiveness of their triage systems, ultimately improving patient outcomes.

**Keywords:** Triage system, Emergency room, Ethical dilemmas, Triage accuracy, AIIMS Triage System

## Introduction

Triage systems in emergency units serve as vital mechanisms for efficiently prioritizing patient care based on the severity of their condition. Originating from military medicine, where it was used to allocate resources to wounded soldiers on the battlefield, triage has become an essential process in civilian healthcare settings. The primary goal of triage is to ensure that patients with life-threatening or time-sensitive conditions receive timely interventions, while also managing patient flow and optimizing resource utilization within the emergency department.

Triage systems employ standardized protocols and algorithms to assess patients upon their arrival at the emergency unit and assign them to priority categories based on the urgency of their condition. These protocols typically consider factors such as vital signs, chief complaints, presenting symptoms, and potential risks of deterioration. By stratifying patients into priority levels, triage systems enable healthcare providers to allocate resources effectively, streamline patient flow, and reduce waiting times for critical interventions.

The evolution of triage systems has been marked by the development of standardized tools and scales designed to improve the accuracy and consistency of triage assessments. Examples of widely used triage scales include the ESI (Emergency Severity Index), CTAS (Canadian Triage and Acuity Scale), MTS (Manchester Triage System), ATS (Australasian Triage Scale). These scales incorporate evidence-based criteria and decision algorithms to guide triage nurses or physicians in making rapid and informed decisions about patient prioritization.[1]

Despite their importance in emergency care, triage systems face several challenges that can impact their effectiveness and reliability. Overcrowding in emergency departments, staff shortages, limited resources, and variability in patient presentations pose significant challenges to triage accuracy and efficiency. Moreover, the subjective nature of triage assessments and the potential for human error can lead to inconsistencies in patient prioritization and resource allocation.

In response to these challenges, ongoing research and quality improvement initiatives aim to enhance the performance and outcomes of triage systems in emergency units. Efforts focus on refining triage protocols, optimizing resource allocation strategies, leveraging technology and data analytics, and improving staff training and education. By addressing these challenges and embracing innovative approaches, healthcare providers can continue to enhance the effectiveness and efficiency of triage systems, ultimately improving patient outcomes in emergency care settings.[2]

### Historical Evolution of Triage Systems

The concept of triage dates back to ancient times, with historical accounts of battlefield medics categorizing wounded soldiers based on the severity of their injuries and likelihood of survival. However, modern triage systems emerged during the Napoleonic Wars in the early 19th century, pioneered by Dominique Jean Larrey, a French military surgeon. Larrey's principles of prioritizing treatment based on medical need rather than rank laid the foundation for contemporary triage practices. Over the years, triage systems have evolved in response to changing healthcare landscapes, technological advancements, and lessons learned from major incidents such as natural disasters and terrorist attacks. Today, triage algorithms incorporate evidence-based guidelines, standardized assessment tools, and interoperable information systems to facilitate rapid decision-making and coordination across healthcare settings.[3]

## Methodology

We performed a PubMed, Google Scholar expedition in the month of January and February 2024 by using the phrases "Triage System in Emergency Room", "AIIMS Triage System", "Triage System in India" and "Worldwide Triage System in Emergency Unit". The search borne almost 86 papers together with reviews, case reports, case series, and small clinical studies. After excluding the 36 non-English reports, we comprehended the remaining 50, regardless of publication date.

### Definition

Triage is a fundamental process in emergency medicine, allowing healthcare professionals to prioritize patient care based on the severity of their condition. Over the years, triage systems have evolved significantly, adapting to changes in healthcare delivery, patient demographics, and technological advancements. Despite these advancements, emergency units continue to face challenges in effectively managing patient flow, allocating resources, and ensuring timely interventions for critical cases. This paper examines the evolution of triage systems, their key components, and explores opportunities for enhancing their effectiveness in emergency units.

**Etymology**

The term "triage" originates from the French word "trier," meaning to sort or classify. Its etymology can be traced back to the Napoleonic era, where it was first used in military medicine to describe the process of sorting wounded soldiers on the battlefield based on the severity of their injuries and the likelihood of survival. The concept of triage evolved over time, becoming synonymous with the systematic prioritization of patients in emergency medical settings to ensure that those with the greatest need receive timely care.[4]

In civilian healthcare, the term "triage" gained prominence during World War I when it was adopted by medical personnel to manage mass casualties and allocate resources efficiently. Triage systems were developed to categorize patients according to the urgency of their condition, with the aim of maximizing the number of lives saved and minimizing morbidity and mortality. These early triage protocols laid the foundation for modern emergency medical triage practices.[5]

The principles of triage were further refined in the post-war era, with the establishment of formalized triage protocols and training programs in civilian emergency departments. Organizations such as the American College of Surgeons played a significant role in standardizing triage practices and promoting the adoption of evidence-based triage algorithms. Today, triage remains an essential component of emergency medicine, guiding healthcare providers in prioritizing patient care based on clinical urgency and resource availability.[6]

**Triage Systems in Emergency Units Across Different Countries**

*Triage Systems in India*

In India, the triage system in emergency units plays a crucial role in prioritizing patient care and optimizing resource allocation amidst diverse healthcare challenges. Triage practices vary across different healthcare settings, ranging from government-run hospitals to private healthcare facilities, reflecting the complexity of India's healthcare landscape. Despite variations in practice, the overarching goal of triage remains consistent - to ensure that patients receive timely and appropriate care based on the severity of their condition.[7]

In government hospitals and public healthcare facilities in India, triage systems often face challenges related to overcrowding, limited resources, and high patient volumes. Triage nurses or physicians utilize standardized assessment tools, such as the Modified Early Warning Score (MEWS) or locally adapted protocols, to categorize patients into priority levels based on their clinical urgency. However, resource constraints and staff shortages can impact the effectiveness of triage assessments and delay patient care.[8] In contrast, private hospitals and tertiary care centers in India may have more resources and infrastructure to support robust triage systems. These facilities may implement advanced triage protocols, such as the MTS or ESI, to prioritize patient care effectively. Furthermore, private hospitals often offer faster access to care for patients who can afford it, leading to differences in triage experiences based on socioeconomic factors.[9]

Despite challenges, efforts are underway to improve triage practices in Indian emergency units through initiatives such as staff training and capacity building, infrastructure upgrades, and the adoption of standardized triage protocols. Collaborative efforts between government agencies, healthcare providers, and non-governmental organizations aim to enhance the quality and efficiency of emergency care delivery across India.[7]

*Triage Systems in Western Countries*

In many Western countries such as the United States, Canada, and several European nations, triage systems are typically based on standardized protocols and algorithms designed to assess patients' clinical urgency and prioritize their care accordingly. Systems like the ESI and MTS are widely utilized, incorporating criteria such as vital signs, chief complaints, and symptom severity to categorize patients into priority levels. These systems aim to ensure timely interventions for critical cases while optimizing resource utilization in emergency departments.[10]

*Triage Systems in Developing Countries*

In contrast, triage systems in developing countries often face unique challenges related to limited healthcare infrastructure, inadequate resources, and large patient volumes. In some regions, such as sub-Saharan Africa and parts of Asia, triage protocols may be less formalized, relying on basic assessments and clinical judgment due to resource constraints. Additionally, cultural factors and community perceptions of healthcare may influence triage practices, emphasizing the importance of culturally sensitive approaches to patient assessment and prioritization.[11]

## Emerging Trends in Triage Systems

Across various countries, emerging trends in triage systems include the integration of technology, telemedicine, and advanced decision support tools to enhance triage accuracy and efficiency. Tele triage platforms, for example, allow remote assessment and triage of patients, enabling timely access to emergency care in underserved areas. Furthermore, efforts to standardize triage education and training for healthcare providers are underway, aiming to improve consistency and quality of triage assessments globally.[12]

## United States

In the United States, emergency departments typically utilize the ESI for triage, a five-level acuity scale that stratifies patients based on their clinical urgency and resource needs. The ESI assigns patients to one of five categories, ranging from level 1 (most vital) to level 5 (least urgent), guiding healthcare providers in allocating resources and determining treatment priorities. Triage nurses or physicians assess patients using a standardized algorithm that considers vital signs, chief complaints, and potential life-threatening conditions.[1]

## United Kingdom

In the United Kingdom, the most widely used triage system is the MTS, which categorizes patients into five color-coded priority levels based on the urgency of their condition. Triage nurses assess patients using a structured algorithm that considers presenting symptoms, vital signs, and anticipated resource requirements. The MTS aims to ensure timely access to appropriate care for patients while managing emergency department flow and resource utilization efficiently.[2]

## Australia

In Australia, emergency departments commonly employ ATS, a five-level triage system similar to the ESI and MTS. The ATS classifies patients into priority categories ranging from 1 (most imperative) to 5 (least urgent), based on the severity of their condition, potential deterioration, and resource requirements. Triage nurses utilize standardized assessment tools and decision algorithms to prioritize patient care, with an emphasis on timely interventions for critical cases.[13]

## Canada

In Canada, the CTAS is the predominant triage system used in emergency departments nationwide. The CTAS categorizes patients into five levels of acuity, with level 1 representing the highest priority and level 5 indicating non-urgent cases. Triage nurses assess patients based on a standardized set of criteria, including vital signs, presenting symptoms, and potential risks of deterioration, to ensure timely and appropriate care delivery.[14]

Detailed comparison of three-tier All India Institute of Medical Science (AIIMS) Triage Protocol with Internationally available five-tier triage systems, i.e., ESI, CTAS, MTS, ATS

**Table 1:** Description of Emergency Severity Index

| ATP | ESI | Description |
| --- | --- | --- |
| Red | 1 | Requires immediate life-saving interventions |
| Red | 2 | High-risk situation or confused/lethargic/ disoriented or severe pain/distress or danger-zone vitals |
| Yellow | 3 | Needing "many" resources but non danger zone vital signs |
| Yellow | 4 | Needing only one resource |
| Green | 5 | No resource needed |

**Table 2:** Canadian Triage and Acuity Scale

| ATP | CTAS | Description |
| --- | --- | --- |
| Red | I | Resuscitation |
| Red | II | Emergent |
| Red | III | Urgent |
| Yellow | IV | Less urgent |
| Green | V | Nonurgent |

**Table 3:** Manchester Triage System

| ATP | MTS | Description |
| --- | --- | --- |
| Red | 1 | Resuscitation |
| Red | 2 | Emergent |
| Yellow | 3 | Urgent |
| Green | 4 | Less urgent |
| Green | 5 | Nonurgent |

**Table 4:** Australasian Triage Scale

| ATP | ATS | Description |
| --- | --- | --- |
| Red | 1 | Immediately life-threatening |
| Red | 2 | Imminent life-threatening or time-critical condition |
| Red | 3 | Potentially life-threatening or situational urgency |
| Yellow | 4 | Potentially serious |
| Green | 5 | Less urgent |

Colour coding in ATP column denotes colour codes of AIIMS Triage Protocol. Colour codes in the rest two columns denote the colour codes being used by respective triage protocols.[15,16]



**Figure 1:** Example of Triage ZONE A-RED

• Physical Assault case (Amputated Right Index finger)
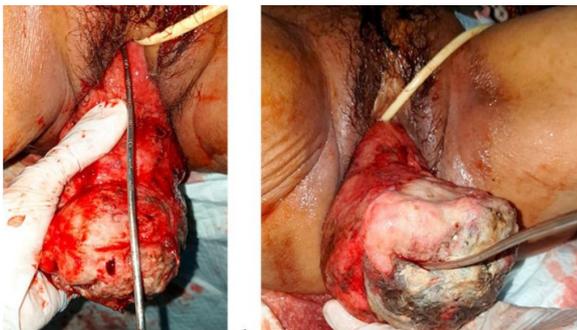


**Figure 2:** Example of Triage ZONE B-YELLOW

• The mass protruded 14 cm outside the vagina with some necrotic and bleeding area resembling cervical malignancy (a), and the soundage was retrained 4 cm (b).



**Figure 3:** Example of Triage ZONE C-GREEN

• Abdominal pain

• As per Wong-Baker's Pain Rating Scale Score is 6 and falls in Moderate category of pain.

**Key Components of Triage Systems**

Effective triage systems consist of several key components designed to streamline the assessment process, allocate resources efficiently, and ensure equitable access to care. The primary components include:

Triage Categories: Triage categories classify patients into priority levels (e.g., immediate, delayed, minor, expectant) based on the severity of their condition and the urgency of medical intervention required. Commonly used triage scales include the MTS, the ESI, and the ATS.

• **Triage tools:** Triage tools such as vital signs assessment, symptom-based algorithms, and decision support systems help healthcare providers rapidly evaluate patients and assign appropriate triage categories. These tools may vary depending on the clinical setting, available resources, and patient population.

• **Triage training:** Adequate training and education are essential for healthcare professionals involved in triage decision-making. Training programs should cover triage protocols, communication skills, team dynamics, and stress management techniques to ensure consistent and effective triage practices.

• **Triage facilities:** Dedicated triage areas within emergency units facilitate the rapid assessment and segregation of patients according to their triage category. These facilities should be equipped with essential medical supplies, monitoring equipment, and communication systems to support initial stabilization and treatment.

• **Triage communication:** Effective communication channels between triage personnel, healthcare teams, and ancillary services are crucial for coordinating patient care, sharing critical information, and managing surge capacity during emergencies. Clear communication protocols and interdisciplinary collaboration enhance the efficiency and safety of triage operations.

**Challenges in Triage Implementation**

Despite their importance, triage systems face several challenges that can impact their accuracy, reliability, and efficiency in real-world settings. Some of the common challenges include:

1. **Triage accuracy:** Assessing patient acuity and predicting clinical outcomes accurately can be challenging, especially in complex cases or mass casualty incidents with limited information available. Variability in triage decision-making among different providers and settings may result in inconsistencies and disparities in patient outcomes.

2. **Resource constraints:** Limited staffing, equipment shortages, and overcrowding in emergency units can strain triage resources and impede timely patient assessment and treatment. Inadequate surge capacity planning and resource allocation strategies may exacerbate delays and compromise patient safety during peak demand periods.

3. **Communication barriers:** Poor communication among triage personnel, language barriers, and ineffective information exchange systems can hinder the flow of critical patient data, leading to delays in triage decision-making and treatment initiation. In high-stress environments, communication breakdowns may increase the risk of errors and adverse events.

4. **Ethical dilemmas:** Triage decisions involving resource allocation during emergencies raise ethical dilemmas related to distributive justice, patient autonomy, and professional obligations. Balancing the competing interests of individual patients and the collective welfare of the population requires careful consideration of ethical principles and decision-making frameworks.

5. **Technological integration:** Integrating triage system's Electronic health records (EHRs), telemedicine platforms, and other digital health technologies presents technical challenges related to interoperability, data security, and user interface design. Successful implementation of digital triage solutions require robust infrastructure, user training, and ongoing support to maximize their potential benefits.[17]

**Future Directions in Triage Innovation**

To address these challenges and enhance the effectiveness of triage systems, ongoing innovation and research efforts are needed across multiple domains. Some promising directions for future triage innovation include:

- AI and machine learning: Leveraging Artificial Intelligence (AI) algorithms and machine learning techniques to analyze large datasets, identify patterns, and predict patient outcomes could improve triage accuracy and decision support capabilities. AI-powered triage tools have the potential to enhance risk stratification, resource allocation, and clinical decision-making in emergency settings.

- Tele triage and remote monitoring: Implementing tele triage systems and remote monitoring technologies allows healthcare providers to assess patients remotely, prioritize care delivery, and monitor their condition in real-time. Tele triage platforms enable virtual consultations, triage assessments, and referral coordination, expanding access to emergency care services and reducing unnecessary hospital visits.

- Mobile triage applications: Developing mobile triage applications and wearable devices enables patients to self-assess their symptoms, receive personalized triage recommendations, and access virtual care services from anywhere. Mobile triage apps empower users to make informed healthcare decisions, seek timely medical advice, and navigate the healthcare system more effectively, particularly in underserved or remote areas.

- Human-centered design: Applying human-centered design principles to triage system development fosters user engagement, usability, and satisfaction among healthcare providers and patients. Co-design approaches involving interdisciplinary teams and end-users promote empathy, creativity, and innovation in designing user-friendly triage tools and interfaces tailored to diverse user needs and preferences.

- Data analytics and quality improvement: Utilizing data analytics techniques and quality improvement methodologies enables healthcare organizations to monitor triage performance, identify areas for improvement, and implement evidence-based interventions to enhance triage effectiveness and patient outcomes. Continuous quality monitoring, feedback mechanisms, and benchmarking initiatives support ongoing learning and optimization of triage processes in emergency units.

## Conclusion

It can be concluded that triage systems play a pivotal role in emergency medicine by facilitating rapid patient assessment, prioritization, and resource allocation in high-demand situations. Despite their importance, triage systems face various challenges related to accuracy,

resource constraints, communication, ethics, and technology integration. Addressing these challenges requires interdisciplinary collaboration, innovative solutions, and ongoing research efforts to advance triage science and practice. By embracing emerging technologies, enhancing training programs, improving communication infrastructure, emergency units can enhance the efficiency and effectiveness of their triage systems, ultimately improving patient outcomes.

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Have no conflict of interest among the authors about this article.

## ETHICAL clearance

**Figure 1 and 3:** Ethical clearance has been taken from the patient and their family side.

**Figure 3:** Sample photo has been collected from Research Gate.

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