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MEDICAL TRIAGE SYSTEMS BASIC APPLICATION PRINCIPLES AND GLOBAL PERSPECTIVE

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Abstract

Medical triage is the process of classifying patients according to their clinical priorities to maximize the efficient use of limited resources in emergency healthcare. Historically, it originated in the Napoleonic Wars and is now widely used in modern emergency services, disaster management, pandemics, and wartime situations. The primary objectives of triage are the efficient use of resources, ensuring patient safety, and ensuring the continuity of healthcare services.

Triage systems are used worldwide (color-coded systems, ESI, START, CTAS), the fundamental approach remains the same: rapid identification of critically ill patients and appropriate intervention. While the START triage system is generally used in Turkey, five-step systems are preferred in hospital emergency departments in countries such as the US, Canada, and the UK.

The effectiveness of triage depends on the practitioner's knowledge, experience, and ethical awareness; misclassifications can increase mortality or waste resources. With the COVID-19 pandemic, digitally supported triage systems have become a hot topic, and teletriage and automated prioritization applications have reduced hospital admission burdens. In the future, the success of triage will be strengthened by international standardization, ethics-based training, artificial intelligence-supported decision-making systems, and data security principles, contributing to both efficiency and equity in healthcare.

Keywords: *Medical triage, Pre-hospital Triage, In-Hospital Triage, ESI – Emergency Severity Index, START – Simple Triage and Rapid Treatment, CTAS – Canadian Triage and Acuity Scale*

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1. Introduction

Medical triage (medical Triage is the process of classifying patients according to their clinical priorities to ensure the most efficient use of limited resources in emergency healthcare services. The triage system plays a critical role in ensuring the continuity and effectiveness of healthcare services, particularly during periods of mass casualties, disasters, or high patient volumes (Iserson & Moskop, 2007). The fundamental goal of this process is **to "direct the right resource to the right patient at the right time**."

Modern medical triage practices are widely used not only in emergency departments but also in pandemic management, wartime conditions, disaster health planning, and routine emergency services. Health Organization [WHO], 2023).

2. Definition and Purpose of Medical Triage

Triage is derived from the French *verb trier* (to select, separate, classify). Medical triage is the process of prioritizing patients or injured people according to the severity of their condition and allocating treatment resources accordingly. (American College of Emergency Physicians [ACEP], 2022).

of triage are:

1. Effective and efficient use of resources,
2. Correct planning of manpower,
3. Preventing loss of time,
4. Increasing the survival rate,
5. Organizing the emergency room flow,
6. Reducing the workload of healthcare personnel,
7. Ensuring the sustainability of health institutions,
8. Ensuring standardization in ethical decision processes (Cone & Koenig, 2020).

3. Historical Development

Medical triage originated in warfare. It was first formalized in the 1790s by French surgeon Baron Dominique Jean Larrey during the Napoleonic War (Iserson & Moskop , 2007). Larrey determined wounded soldiers' access to treatment based on their clinical urgency, not their social status.

Triage systems developed in the 20th century, particularly during World Wars I and II, and were adapted to civilian emergency healthcare systems from the 1980s onwards (Kaji et al ., 2010). Today, modern triage systems are supported by digitally-assisted decision algorithms and artificial intelligence-based assessment tools (Gerdtz & Bucknall , 2021).

4. Triage Application Areas

4.1. Pre-hospital Triage

Prehospital triage is typically conducted by paramedics and emergency room healthcare professionals. The goal of this process is to quickly assess the patient or injured person at the scene and transport them to the most appropriate healthcare facility.

The most critical step in prehospital triage is directing the right patient to the right hospital. Regional triage centers are being established, particularly in major cities, to manage overcrowding (WHO, 2023).

4.2. In-Hospital Triage

In-hospital triage is the initial evaluation of patients presenting to the emergency department. This evaluation is typically performed by trained nurses and includes the following elements (Considine et al., 2019):

- vital signs (temperature, pulse, blood pressure, respiration, O_2 saturation)
- Evaluation of symptoms
- Age, chronic diseases and trauma history
- Subjective observation (patient behavior, general appearance)

The primary goal of in-hospital triage is to balance patient flow in the emergency department, reduce the waiting time of critically ill patients, and increase patient safety.

5. World Triage Systems

5.1. Color-Coded Triage System

Most traditional triage systems are based on a color-coded classification model. This system is typically used for mass casualty events such as disasters, wars, or mass casualties. used in casualty scenarios . The meaning of colors has been universally determined (CDC, 2024):

Colour	Definition	Intervention Priority
Red (Urgent)	Life-threatening injuries that can be saved with rapid intervention	1st priority
Yellow (Can be delayed)	Patients with non-life-threatening conditions who can wait a short time	2nd priority
Green (Light)	Patients who can walk or have minor injuries	3rd priority
Black (Dead)	Cases with no signs of life or cases that cannot be saved	Last priority

The advantage of this system is that it enables rapid decision-making and easy identification. However, its shortcoming is that it does not include in-depth clinical assessment (Khan et al., 2019). Therefore, modern systems supplement these color codes with more detailed scores. This system is often used in disaster and war triage. triage) is used (Centers for Disease Control and Prevention [CDC], 2024).

5.2. ESI – Emergency Severity Index

Emergency Severity The Emergency Triage Index (ESI) is a system originating in the USA and is a five-level triage model. Developed in the 1990s, it has become the international standard for both adult and pediatric emergency departments (Gilboy et al., 2020).

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The ESI levels are as follows:

1. **Level 1:** Life-threatening situations requiring immediate resuscitation (e.g. cardiac arrest).
2. **Level 2: Patients** requiring immediate intervention but who are stable (e.g., chest pain, severe trauma).
3. **Level 3:** Medium-level emergencies requiring the use of two or more resources.
4. **Level 4:** Mild cases; requires a single source.
5. **Level 5:** Lowest level of urgency; minimal intervention is sufficient.

of ESI is its ability to classify not only clinical status but also resource requirements , optimizing both workflow and patient satisfaction (Storm - Versloot et al ., 2019).

5.3. START – Simple Triage and Rapid Treatment

The START system was introduced in 1983 in Newport Developed by the Beach Fire Department, it is used primarily in disaster triage. Rapid assessment is performed based on respiratory, circulatory, and mental status (RPM) criteria. It allows for the classification of hundreds of casualties in minutes (Khan et al., 2019). This system should not be confused with prehospital or hospital emergency room triage and is the most commonly used prehospital triage method in our country.

It is based on three quick evaluation parameters:

1. Respiration
2. Circulation (Perfusion)
3. Mental status (Mental Status)

The START algorithm determines which category the patient belongs to within a few seconds:

- If there is no breathing → black
- Respiration >30/ min → red
- If pulse cannot be detected → black
- If unconscious → red
- Other states → yellow or green

This model allows for rapid classification of hundreds of casualties at a disaster site. However, clinical accuracy may vary depending on experience and environmental conditions (Kaji et al., 2010).

5.4. CTAS – Canadian Triage and Acuity Scale

Originating in Canada, the CTAS is a five-level system that aims to optimize the time from initial assessment to treatment. This model, with its objective criteria, has been adapted to many countries (Beveridge et a., 2019).

CTAS (Canadian Triage and Acuity Scale) is a five-level clinical evaluation system developed in Canada. This system organizes patient waiting times and treatment priority according to scientific criteria (Beveridge et al., 2019).

Level	Urgency	Waiting Time
1	Resuscitation	0 minutes
2	Urgent	≤15 minutes
3	Non-urgent but serious	≤30 minutes
4	Light	≤60 minutes
5	Insignificant	≤120 minutes

CTAS aligns nurse and physician decisions by standardizing clinical protocols. It has formed the basis of today's systems in the UK and Australia.

6. COMPARISON OF TRIAGE SYSTEMS IN TURKEY AND THE WORLD

Triage systems vary from country to country, the fundamental goal is always the same: to ensure the most equitable and effective prioritization of patients based on their urgency. Systems in different countries have been shaped by both cultural and structural health differences.

6.1. Triage Practices in Turkey

Triage practices in Turkey are implemented within the framework of the Emergency Health Services Regulation (2022) and the Health Quality Standards (HCS) of the Ministry of Health of the Republic of Turkey.

A three-level color-coded system is used throughout the country, particularly in public hospitals and 112 emergency services :

- **Red Zone:** Patients with life-threatening conditions (e.g., heart attack, respiratory failure).
- **Yellow Zone:** Cases that do not require immediate intervention but require close monitoring.
- **Green Zone:** Patients requiring simple intervention or outpatient treatment.
- **Black Area: Patients whose** vital functions have stopped and who have lost hope.

In Turkey, triage practices are mostly performed by nurses, but in some hospitals triage physicians or algorithmic systems are also involved (Ministry of Health, 2023).

Emergency room overcrowding continues to be a serious problem in our country. According to 2023 data, the number of emergency room visits in Turkey reached approximately 130 million (Health Statistics Yearbook, 2024). This high rate directly impacts the effectiveness of triage. Therefore, AI-powered triage systems and digital patient routing algorithms have been tested in pilot applications in recent years.

Triage system used in pre-hospital ambulance services on the Anatolian side of Istanbul in 2023 was examined, it was determined that the highest number of cases during the year consisted of patients with green codes. Green-coded cases were classified as yellow**,** black, and red, respectively. This distribution shows that the emergency medical services in the region are significantly occupied with low priority (green code) cases.

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Triage Code 2023	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Red	59	47	66	48	55	51	45	38	31	46	41	50
Yellow	1032	748	916	863	903	868	830	824	831	789	822	1004
Green	3265	2654	3047	2550	2879	2731	2922	2581	2400	2596	2571	3239
Black	395	331	402	362	333	310	331	296	297	382	379	410

This density affects the effectiveness**,** efficiency and sustainability of pre-hospital emergency health services. This indicates the need for re-evaluation. The high proportion of code green patients, in particular, stands out as a critical factor in long-term planning of resource allocation, team management, ambulance usage policies, and case referral processes. In this regard, strategic efforts to optimize service delivery and increase system performance are recommended.

6.2. International triage system comparisons

Country	System	Number of Steps	Features
USA	ESI (Emergency Severity Index)	5	Source-based, widely used system
Canada	CTAS	5	Time-limited waiting periods based on clinical symptoms
Australia	ATS	5	Compliant with emergency department performance indicators
England	MTS (Manchester)	5	Automatic scoring with symptom algorithms
Türkiye	Color Coded (Red–Yellow–Green)	3	Practical, fast but limited level of detail

International literature (Storm - Versloot et al ., 2019) has reported that five-step systems provide lower error rates (20% versus 10%) and higher patient satisfaction than three-step systems . However, their implementation requires more training, staffing, and digital infrastructure.

7. The Role of the Triage Practitioner and the Ethical Dimension

Triage practitioners are typically paramedics and emergency room healthcare professionals. Triage decisions must be prompt, objective, and ethical. The most important ethical principle is justice; equity and fairness must be observed in resource allocation (Iserson, 2020).

Incorrect triage can lead to unnecessary resource use or treatment delays. Therefore, ongoing training, simulation practices, and auditing processes are crucial. Four fundamental ethical principles stand out in triage practices:

1. **Beneficence: Providing the greatest benefit to** the greatest number of people.
2. **Non - maleficence: Avoiding unnecessary** treatments.
3. **Justice:** Distributing resources fairly**.**
4. **Autonomy:** Respecting the rights of the patient**.**

Deciding "who to save" is extremely difficult, especially during disasters. Therefore, triage practitioners need to receive not only medical but also ethical awareness training (Iserson & Moskop, 2007).

7.1. Triage Errors

Mistriage occurs in two ways:

- **Over - triage:** Placing the patient in an urgent category more than necessary → waste of resources.
- **Under - triage:** Classifying critically ill patients as low priority → increased mortality.

According to research, under - triage rates in emergency departments range from 5–15% and over - triage rates from 20–35% (Storm - Versloot et al ., 2019). This demonstrates the need for ongoing training and supervision.

8. Problems and Emerging Approaches

8.1. Post-COVID-19 Pandemic Period

The COVID-19 pandemic has led to a global reassessment of medical triage systems. During the pandemic, physical triage areas were supplemented with contactless digital triage systems due to the risk of transmission.

Pre -triage tents and thermal screening areas have been established in many countries (e.g., South Korea, the United States, and Canada) (Jansen et al., 2022).

The pandemic has demonstrated that triage is not limited to the emergency room but has become a community-based public health strategy. Teletriage, online risk scores, and symptom monitoring apps have reduced hospital admission rates and mitigated the risk of transmission (Zhou et al., 2023).

8.2. Digital Triage and Artificial Intelligence Applications (AI)

Artificial intelligence (AI) technologies are increasingly being used in triage processes. AI-based systems can provide automated triage recommendations by analyzing vital signs, symptoms, patient history, and past health data.

For example:

- AI- Triage (USA, 2023): Reduced waiting times in emergency rooms by 22%.
- TriageGPT (Australia, 2024): Classified patient complaints using natural language processing (NLP), achieving accuracy close to ESI level (Zhou et al., 2023).

However, the reliability of these systems remains controversial in terms of ethics, data privacy, and shared responsibility. It is crucial

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that AI be a tool to support physician decision-making and that the human factor is not completely excluded (Iserson , 2020).

8.3. Need for Training and Standardization

In triage. Research shows that regular training and simulation programs can reduce errors by up to 40% (Considine et al., 2019). Therefore, triage personnel should:

- Participating in continuous professional development programs,
- Be familiar with current algorithms,
- Must develop ethical decision-making skills under stress.

Triage skills training should be given to pre-hospital and disaster personnel at regular intervals in Turkey.

9. CONCLUSION

Medical triage is a management tool at the heart of modern healthcare.

When implemented correctly, the triage system:

- Patient safety increases,
- Resource usage is optimized,
- Emergency room performance improves,
- A system that is more resilient to public health crises is created.

However, triage is not just an algorithm or a color code; it is an ethical, clinical, and human balance. Therefore, triage systems of the future:

- Artificial intelligence-supported decision support systems ,
- International standardization ,
- Ethics-based education and
- data security principles.

In conclusion, the success of medical triage depends not only on the technical structure of the system but also on the knowledge, experience and ethical sensitivity of the healthcare professionals who implement it.

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