Triage and Decision-Making in Prehospital Settings: Improving Patient Outcomes

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The Scientific and Technological Research Institution of Türkiye (TÜBİTAK)

EPAT ATUDER 26 YEARS Silver Jubilee 1999-2025

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WACEM World Academic Council of Emergency Medicine

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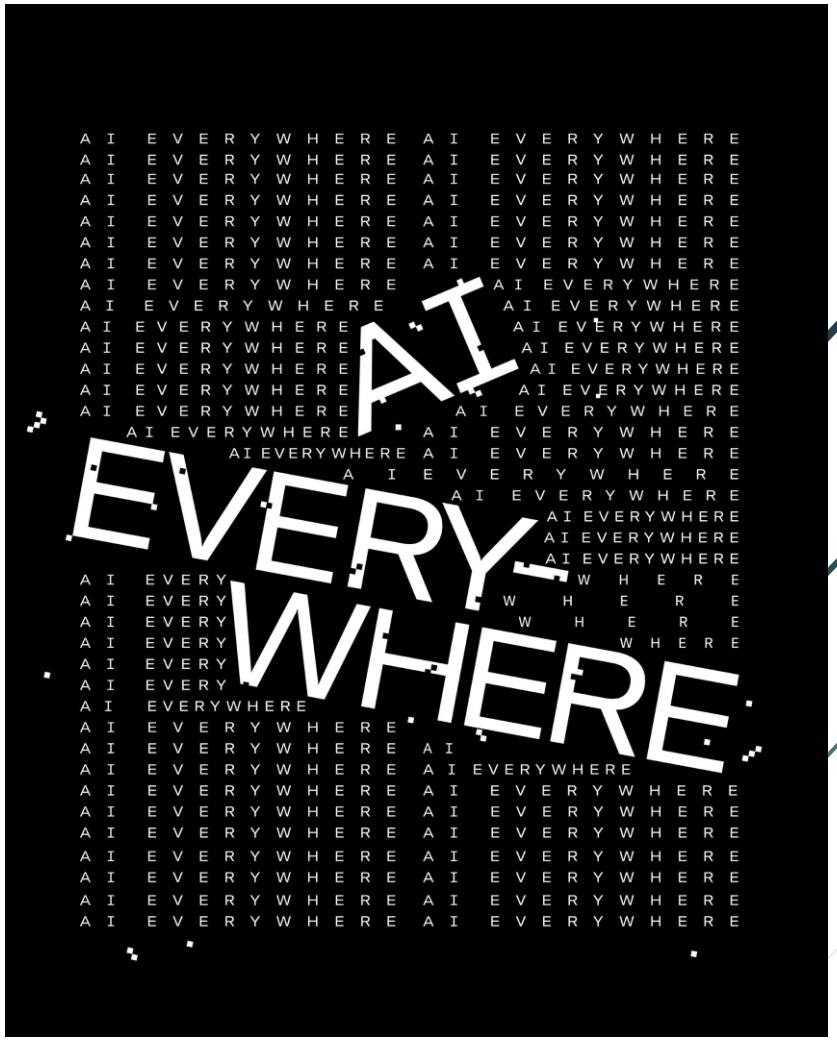
First of all

- Thanks to [ ] for contributions of this presentation

ChatGPT

Meta

Why?



Introduction

- **Prehospital triage** is the rapid assessment of patients before they reach the hospital.
- It helps determine how serious patients condition.
- Patients are then prioritized based on urgency.
- It help ensure the right care is given at the right time

"Decisions made in the first minutes can determine outcomes for hours."

Ref: Cone DC et al., Prehosp Emerg Care, 2012

Impact on Patient Outcomes

- Early triage = Faster care
- Reduced trauma and cardiac mortality
- Better hospital resource use

Ref: Seymour CW et al., NEJM, 2017

Challenges in Prehospital Triage

- Limited information
- Communication barriers
- Stress and cognitive load
- Urban vs rural settings

Ref: Wurmb TE et al., Eur J Emerg Med, 2015

Goals of Prehospital Triage

- Identify critically ill patients quickly
- Match patients to the right facility
- Prevent ED overcrowding
- Optimize resource use

Widely used prehospital triage systems

START

(Simple Triage and Rapid Treatment)

Ref: Lerner EB et al., J Trauma, 2011

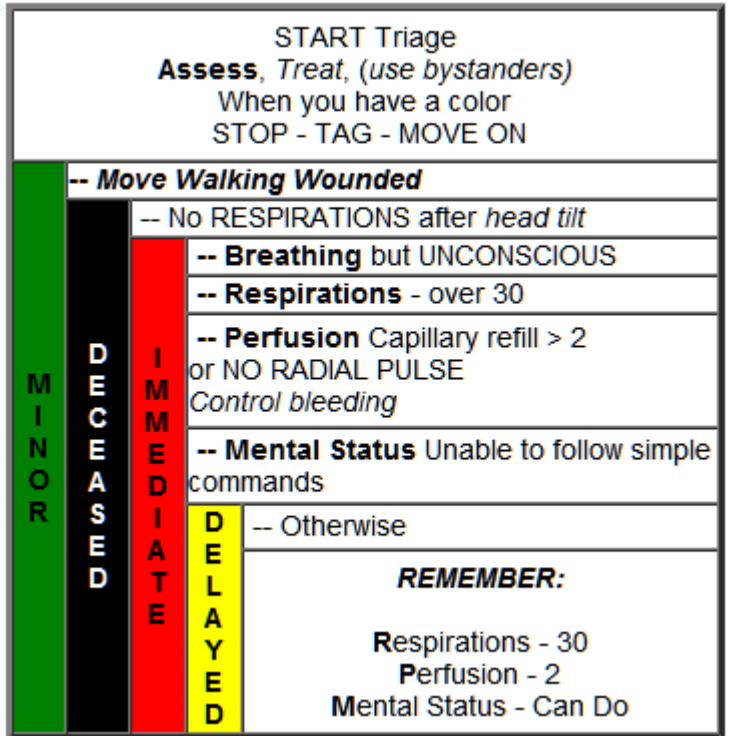
SALT

(Sort, Assess, Lifesaving Interventions, Treatment/Transport)

Refs: Jenkins JL et al., 2008; Benson M et al., 2016

START Triage System

1. **Ambulatory Check – Can the person walk?**
    1. If yes → Tag as **Green (Minor)** and direct to a safe area.
2. **Breathing – Is the person breathing?**
    1. **Not breathing:** Open the airway.
        1. If still no breathing → **Black (Deceased/Expectant)**
        2. If breathing starts → Continue evaluation
    2. **Breathing rate >30/min → Red (Immediate)**
    3. **Breathing rate ≤30/min** → Go to perfusion check
3. **Perfusion – Capillary refill >2 seconds or no radial pulse**
    1. If delayed → **Red (Immediate)**
    2. If normal → Go to mental status check
4. **Mental Status – Can the patient follow commands?**
    1. If not → **Red (Immediate)**
    2. If yes → **Yellow (Delayed)**

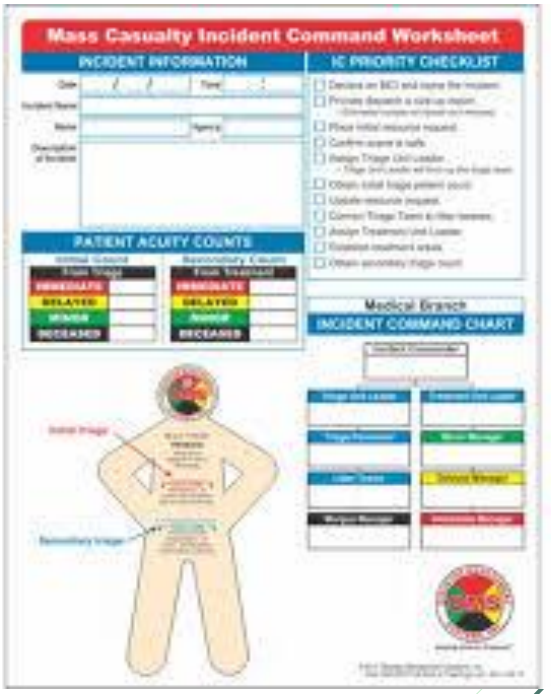


START Triage System

Color	Priority	Description
Red	Immediate	Life-threatening but survivable injuries, requires urgent care
Yellow	Delayed	Serious but not immediately life-threatening injuries
Green	Minor	Walking wounded, minor injuries
Black	Deceased/Expectant	Not breathing after airway opened or unsurvivable injuries

SALT Triage System

- Designed for mass casualty incidents, including chemical, biological, radiological, and nuclear (CBRN) events.
- Recommended by organizations like the CDC and National Disaster Life Support Foundation.
- Suitable for all age groups, including children and the elderly.
- Allows for limited but critical lifesaving interventions.



Mass Casualty Incidents

TRAUMA

SALT Triage System

1. **SORT (Global Sorting):**

   Call out to patients:
   "If you can walk, come to me!"
   - Those who walk → **Green (Minor)**

   - Next, visually identify those who are:
     - **Still and obviously lifeless**
     - **Waving or purposeful movement**
     - **Still but breathing**

2. **ASSESS (Individual Assessment):**

   Assess remaining individuals **one by one** in priority order:

SALT Triage System

3. LIFESAVING INTERVENTIONS:

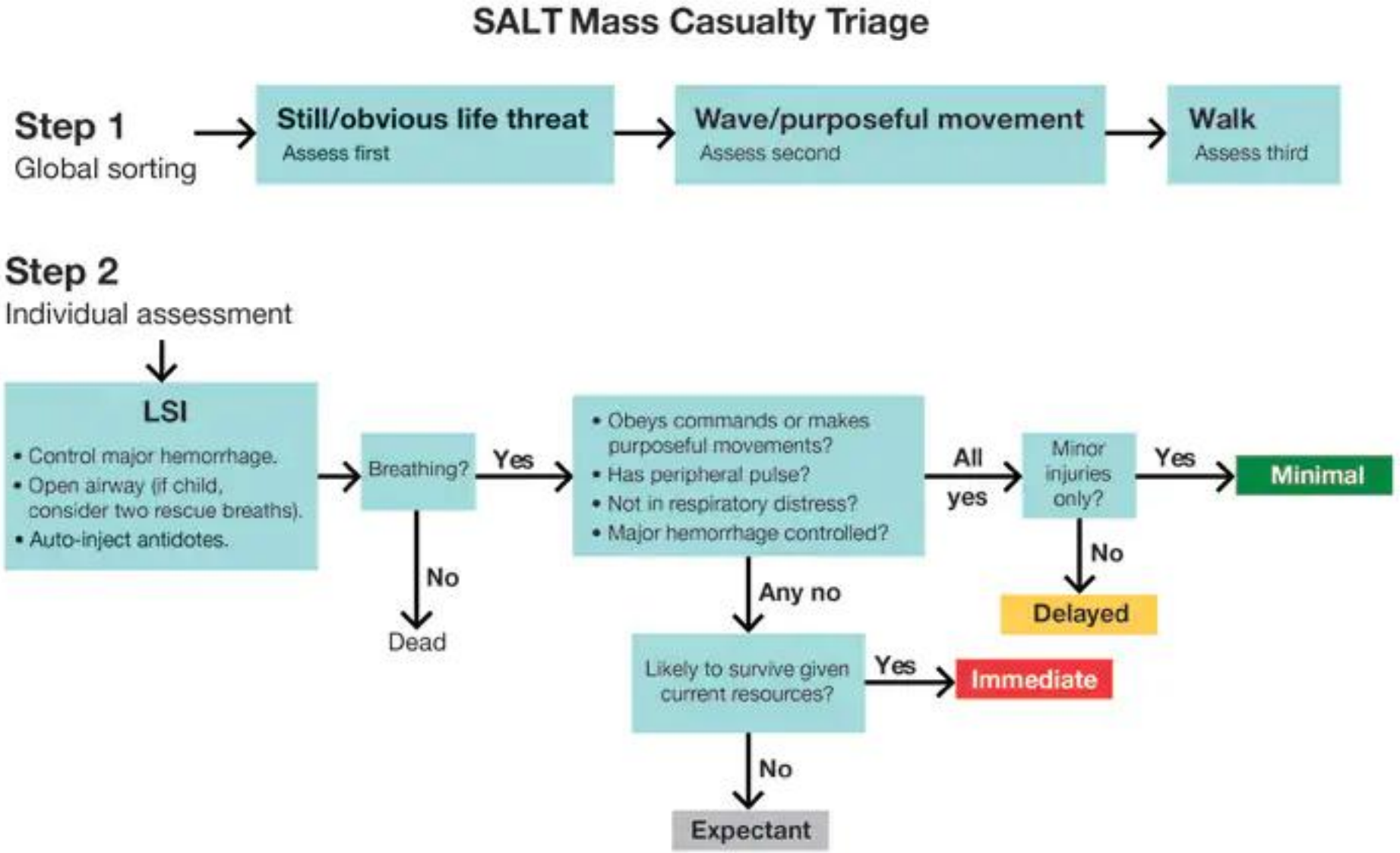
Apply **only if resources allow** and patient is likely to survive.
Allowed interventions include:

- Opening the airway (with positioning or adjuncts)
- Control of major bleeding (e.g., tourniquet)
- Needle decompression for tension pneumothorax
- Auto-injector antidotes (e.g., for chemical exposure)

4. TREATMENT / TRANSPORT PRIORITY:

Assign a category based on:

Category	Description
Immediate	Life-threatening injuries, responsive to basic interventions
Delayed	Serious but stable injuries; can wait for treatment
Minimal (Minor)	Able to walk; minor injuries
Expectant	Unlikely to survive even with maximal care
Dead	No signs of life, not breathing after opening airway



Sort, Assess, Lifesaving Interventions, Treatment/Transport (SALT) triage system replaces Simple Triage and Rapid Treatment (START).

Source: U.S. National Library of Medicine.

RAMP Triage System

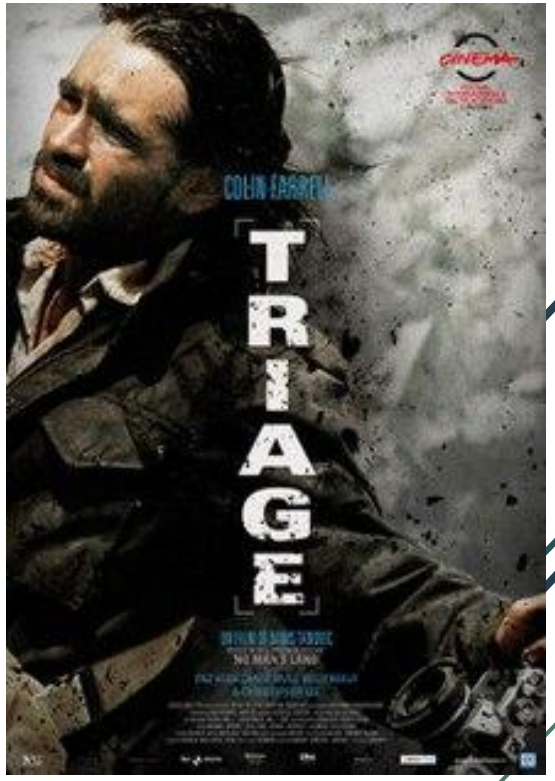
- Designed for rapid response in mass casualty incidents (MCIs), particularly in battlefield scenarios or large-scale emergencies.
- Primarily used by military and emergency response teams.
- Applicable to CBRN events, accidents, or high-intensity trauma scenarios.
- Focuses on rapid assessment with a minimal intervention approach.

RAMP Triage System

- **1. Rapid Assessment:**
  - A **quick, visual survey** is performed to determine the **immediate needs** of each patient.
  - Patients are sorted into categories based on **obvious life-threatening injuries** or their ability to walk.

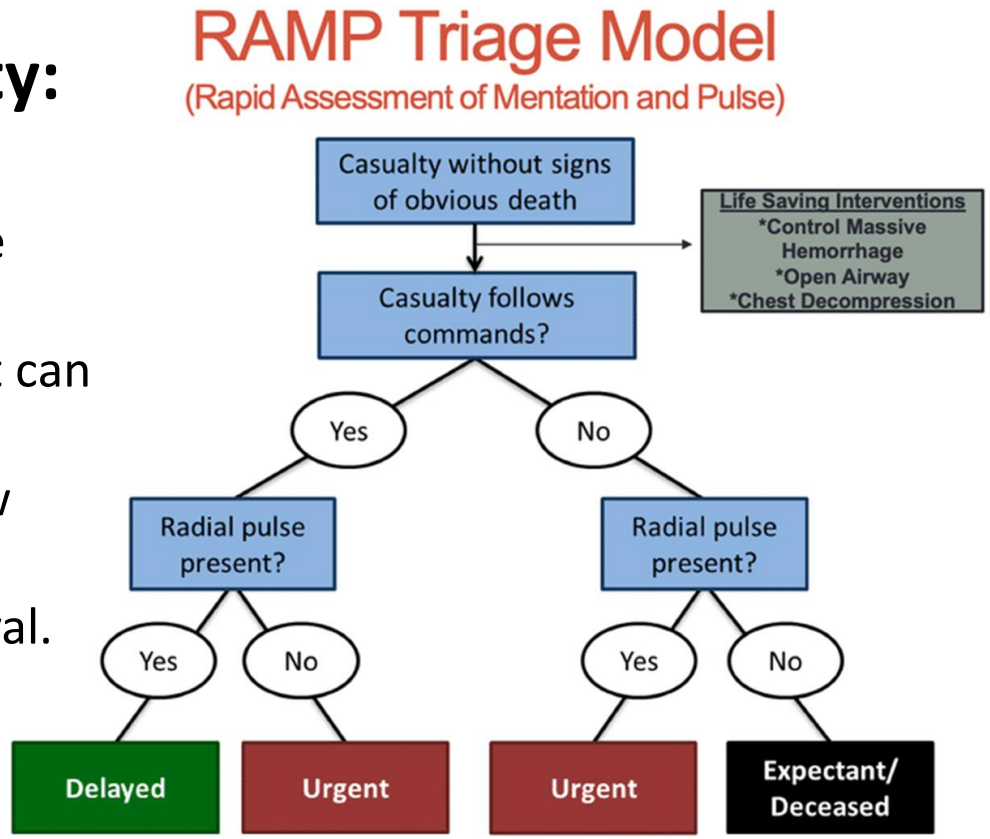
- **2. Immediate Categorization:**
  - **Walking patients → Green (Minor)**
  - **Non-walking patients**:
    - **Breathing but unable to follow commands → Red (Immediate)**
    - **Non-breathing after airway opened → Black (Deceased/Expectant)**

- **3. Limited Intervention:**
  - Life-saving interventions are **minimal** (e.g., airway opening, stopping severe bleeding).
  - Focus on **quick stabilization** to prioritize transport.



RAMP Triage System

- **4. Treatment and Transport Priority:**
  - Patients are categorized into:
    - **Red (Immediate)** – Requires immediate treatment to survive.
    - **Yellow (Delayed)** – Serious injuries that can wait for treatment.
    - **Green (Minor)** – Walking wounded, low priority.
    - **Black (Deceased)** – No chance of survival.



Feature	START	SALT	RAMP
Usage Area	General mass casualty incidents	Broad scope (including CBRN scenarios)	Rapid response, battlefield, CBRN events
Assessment Time	Moderate	Longer (more comprehensive)	Very fast
Sensitivity	Limited (mainly for adults)	High (includes children, elderly, etc.)	Moderate
Includes Interventions	❌ No (basic assessment only)	✅ Yes (basic lifesaving interventions included)	❌ No (focused on rapid evaluation)
Required Training Level	Basic	Intermediate to Advanced	Basic


START: Immediate
SALT: Imed/Exp
RAMP: Urgent
START: Minor
SALT: Delayed
RAMP: Delayed
START: Delayed
SALT: Delayed
RAMP: Delayed

Other Prehospital Triage Systems

- **CareFlight Triage**
  - Developed in Australia.
  - Uses a **simple flowchart** based on ability to walk, breathing, and consciousness.
  - Designed for **quick use** by first responders.
  - Often used in mass casualty incidents (MCIs).

- **MPTT / MPTT-24 (Modified Physiological Triage Tool)**
  - Developed in the UK for **major incident response**.
  - Focuses on **physiological parameters** like respiratory rate, heart rate, and consciousness.
  - More accurate than START in predicting need for life-saving intervention.

- **CESIRA (Spain)**
  - Spanish model for prehospital triage.
  - Focuses on clinical assessment, vital signs, and mobility.
  - Used in both MCIs and standard emergency care.

Other Prehospital Triage Systems

- **JumpSTART**
  - Pediatric version of START.
  - Designed for children under 8 years old.
  - Considers developmental differences (e.g., apneic child gets rescue breaths before triage category is assigned).
  - Categories: Green, Yellow, Red, Black—same as START.

- **Sieve and Sort (UK Model)**
  - Used in **UK ambulance services**.
  - **Sieve**: initial rapid triage at the scene.
  - **Sort**: more detailed secondary triage by trained personnel.
  - Based on **Triage Revised Trauma Score (TRTS)** and physiological signs.

Which one is best?

- Lets focus on prehospital triage goals again?
  - Identify critically ill patients quickly
  - Match patients to the right facility
  - Prevent ED overcrowding
  - Optimize resource use

Next Question :

Which system meets all of these criteria?

What do they ignore?

The Psychological Impact of Triage on the Responder

These individuals are:

- The **first to make life-and-death decisions**,
- **Directly exposed to the chaos and trauma** of mass casualty events,
- And often left with lingering questions:

  “Did I choose the right patient?”
  “What if they could have survived?”
  “Was I fast enough?”

Lack of information from hospital

OPEN ACCESS

Association between delays to patient admission from the emergency department and all-cause 30-day mortality

Simon Jones [1,2] Chris Moulton [3,4] Simon Swift [2,5] Paul Molyneux,[2] Steve Black [6] Neil Mason [2] Richard Oakley [2] Clifford Mann [3,7]

Handling editor Simon Carley

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ABSTRACT

Background Delays to timely admission from emergency departments (EDs) are known to harm patients.

Objective To assess and quantify the increased risk of death resulting from delays to inpatient admission from EDs, using Hospital Episode Statistics and Office of National Statistics data in England.

Methods A cross-sectional, retrospective observational study was carried out of patients admitted from every type 1 (major) ED in England between April 2016 and March 2018. The primary outcome was death from all causes within 30 days of admission. Observed mortality was compared with expected mortality, as calculated using a logistic regression model to adjust for sex, age, deprivation, comorbidities, hour of day, month, previous ED attendances/emergency admissions and crowding in the department at the time of the attendance.

Results Between April 2016 and March 2018, 26 738 514 people attended an ED, with 7 472 480 patients

Key messages

What is already known on this subject

⇒ Small studies from Canada and Australia have indicated that there is an increased mortality rate among patients who experience delays in admission to an inpatient bed from the emergency department (ED).

⇒ Counterfactual modelling has shown reduced patient mortality as a result of the NHS 4-hour operational standard. The NHS Benchmarking Network found a coefficient of determination (R^2 value) of 0.07 between time greater than 4 hours in the ED and a hospital's Summary Hospital-level Mortality Indicator.

What this study adds

⇒ This study of over five million NHS patients shows an increase in all-cause 30-day mortality that is independently associated with delays

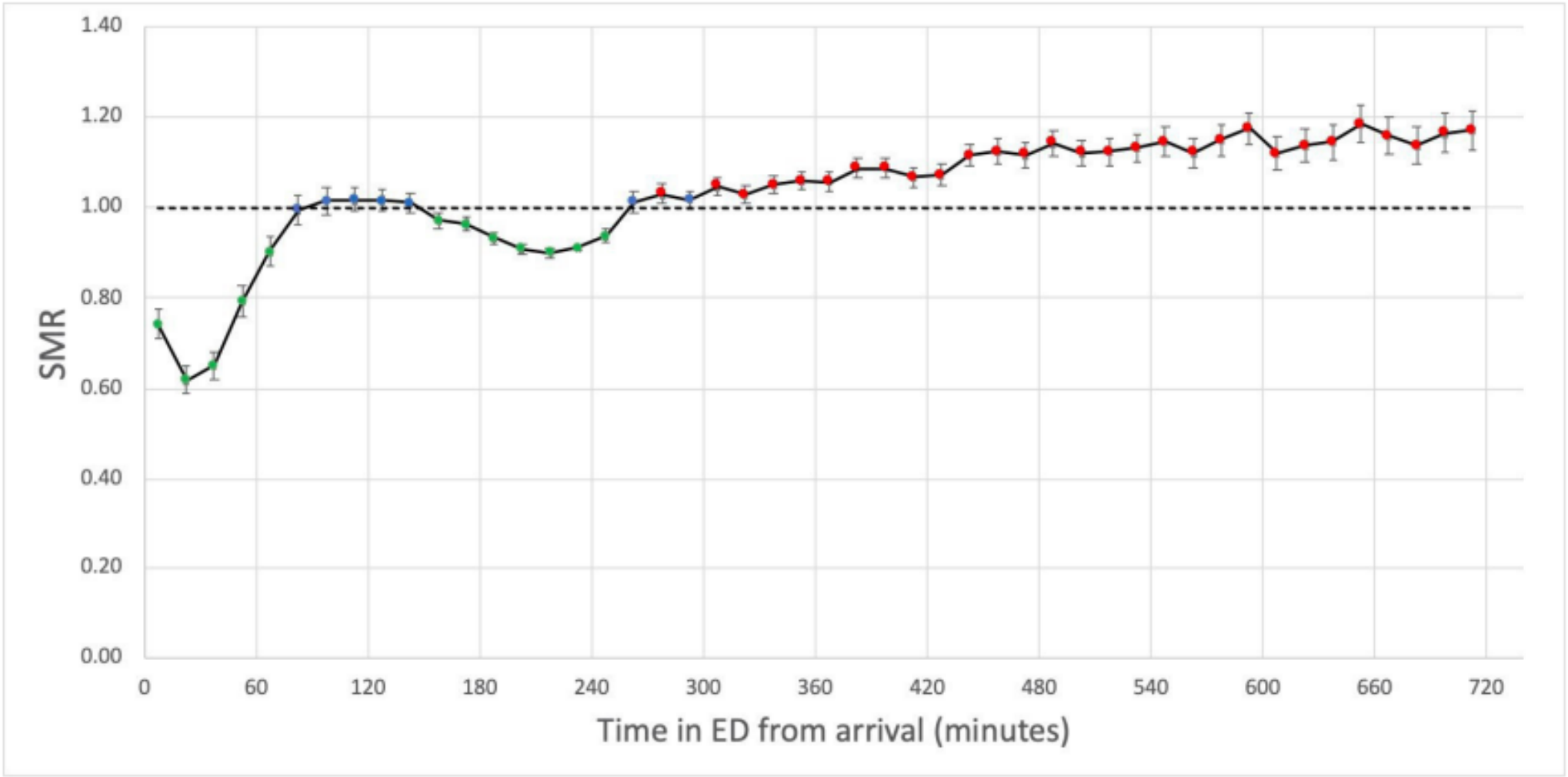


Figure 1 Thirty-day standardised mortality ratio (SMR) referenced to duration in an emergency department (ED) from time of arrival.

Country	Patient Transfer Rate	Factors Affecting Transfer	Key Characteristics
United States	15-30% of emergency patients are transferred to another hospital (especially in rural areas)	Insurance issues, bed shortages, need for specialized care	Well-developed referral network, specialized hospitals
United Kingdom	10-20% of emergency patients are transferred to another facility	NHS regional centers, resource shortages, seasonal pressures	Regionalized centers for specialized care, NHS system
Germany	5-10% of patients require transfer to specialized hospitals	Availability of local specialized care	Strong regional hospitals, good local care
Japan	20-40% of emergency patients are transferred to specialized centers, particularly in urban areas	Population aging, specialized urban centers	Efficient system, but higher transfers for specialized care
Canada	20-35% of patients in rural areas require transfer to urban centers	Geographic distances, provincial system differences	Regional care, transportation challenges in rural areas

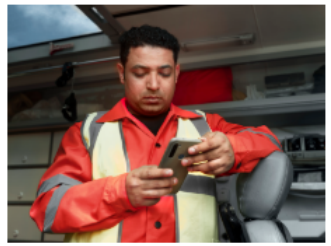
Improve System and Find Solutions

Studies and Systems Which Integrated Artificial Intelligence into Prehospital Triage

- **CONNECT-AI: AI-Enhanced EMS Network**
  - A novel digital platform called CONNECT-AI (CONnected Network for EMS Comprehensive Technical-support using Artificial Intelligence) has been developed to support emergency medical services (EMS). This system utilizes AI for real-time sharing of medical information during the prehospital phase.
  - Standardized first aid protocols
  - Prediction of critical patient conditions
  - Optimal hospital selection for patient transport
  - The platform employs **voice and image recognition technologies** and enables real-time data sharing between ambulances and emergency departments.

Published on 23.01.2025 in Vol 27 (2025)

Preprints (earlier versions) of this paper are available at https://preprints.jmir.org/preprint/58177, first published March 12, 2024.



A Novel Artificial Intelligence–Enhanced Digital Network for Prehospital Emergency Support: Community Intervention Study

Ji Hoon Kim[1]; Min Joung Kim[1]; Hyeon Chang Kim[2]; Ha Yan Kim[3]; Ji Min Sung[4]; Hyuk-Jae Chang[5]

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PMCID: 11803323

Studies and Systems Which Integrated Artificial Intelligence into Prehospital Triage

- **ARTEMIS: AI-Driven Robotic Triage System**
  - ARTEMIS (AI-driven Robotic Triage Labeling and Emergency Medical Information System) is an innovative system designed to assist in mass casualty incidents.
  - A quadruped robot equipped with speech processing and deep learning capabilities
  - Real-time victim localization and injury severity assessment
  - A graphical user interface for first responders to access updated victim information
  - In simulations, ARTEMIS achieved a triage-level classification precision of over 74% on average and 99% for the most critical victims.

ARTEMIS: AI-driven Robotic Triage Labeling and Emergency Medical Information System

Revanth Krishna Senthilkumaran, Mridu Prashanth, Hrishikesh Viswanath, Sathvika Kotha, Kshitij Tiwari, Aniket Bera

Artificial intelligence and machine learning in prehospital emergency care: A scoping review

Marcel Lucas Chee [1], Mark Leonard Chee [2], Haotian Huang [1], Katelyn Mazzochi [1], Kieran Taylor [1], Han Wang [3], Mengling Feng [3], Andrew Fu Wah Ho [4,5], Fahad Javaid Siddiqui [5], Marcus Eng Hock Ong [4,5], Nan Liu [5,6,7,*]

▸ Author information ▸ Article notes ▸ Copyright and License information

PMCID: PMC10440716 PMID: 37609632

- A comprehensive scoping review analyzed 106 studies on AI applications in prehospital emergency care (PEC).
- **AI models often outperforming clinicians and traditional algorithms in various scenarios**
- The need for rigorous prospective validation before clinical implementation
- This review underscores the promising future of AI in PEC, while also noting the challenges in adoption due to limited resources and the fast-paced nature of PEC workflows.

Systematic Review | Open access | Published: 18 November 2024

Application of artificial intelligence in triage in emergencies and disasters: a systematic review

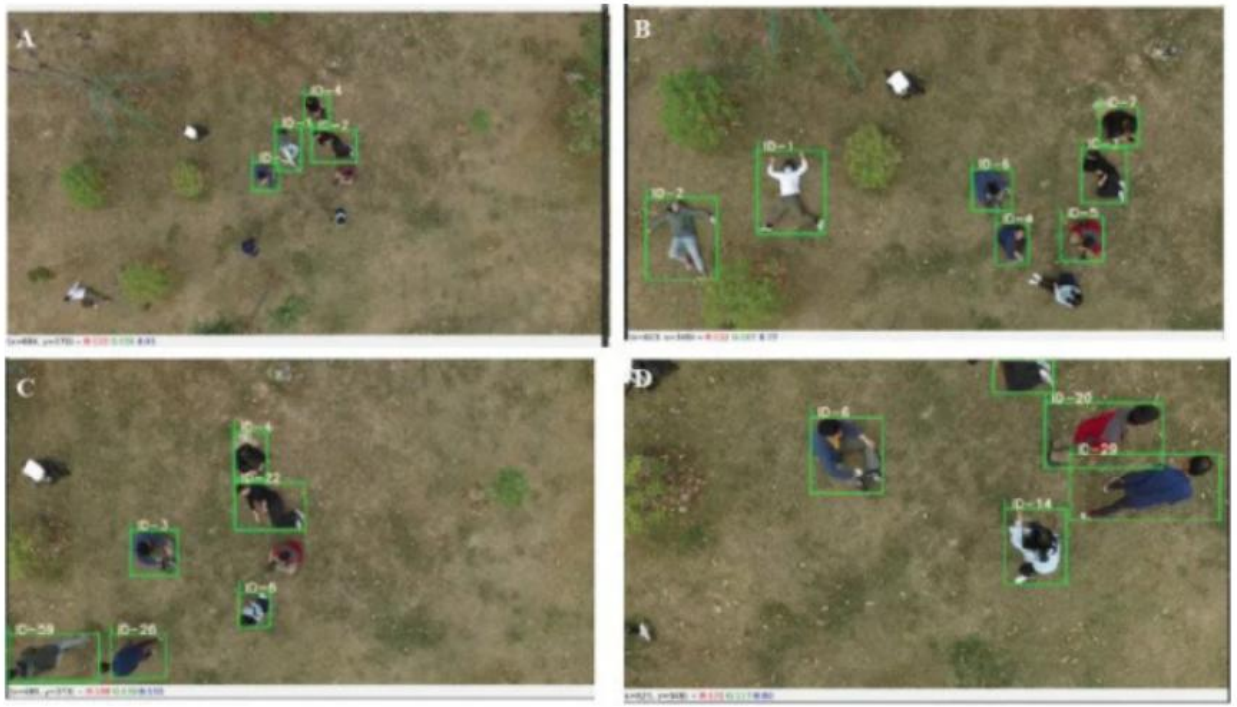
Azadeh Tahernejad, Ali Sahebi, Ali Salehi Sahl Abadi & Mehdi Safari

BMC Public Health **24**, Article number: 3203 (2024) | Cite this article

- **AI in Disaster and Emergency Triage**
  - A study investigated the application of AI in triage during disasters and emergencies.
  - The potential benefits of AI in improving the efficiency and accuracy of triage in mass casualty events

Time for the smart triage compared to conventional methods in disasters and emergencies

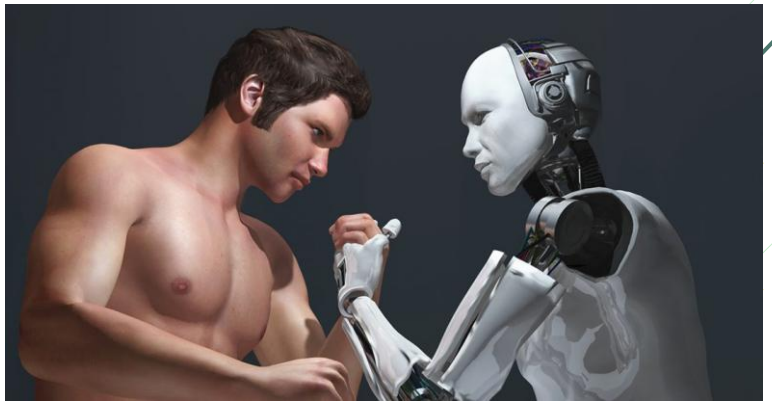
Fig. 2



The YOLO human detection from different distances. A–**D**: from far to near [37]

Next-Generation AI-Based Triage System

- **AI-Centered Decision Making:**
  - In this system, the primary decision-maker is artificial intelligence. Patient assessment and prioritization are carried out independently by AI algorithms, without human intervention.
- **Supportive Role of Human Personnel:**
  - Healthcare personnel act as assistants, following and implementing the AI's directives in the field. Human intervention is limited to exceptional situations.

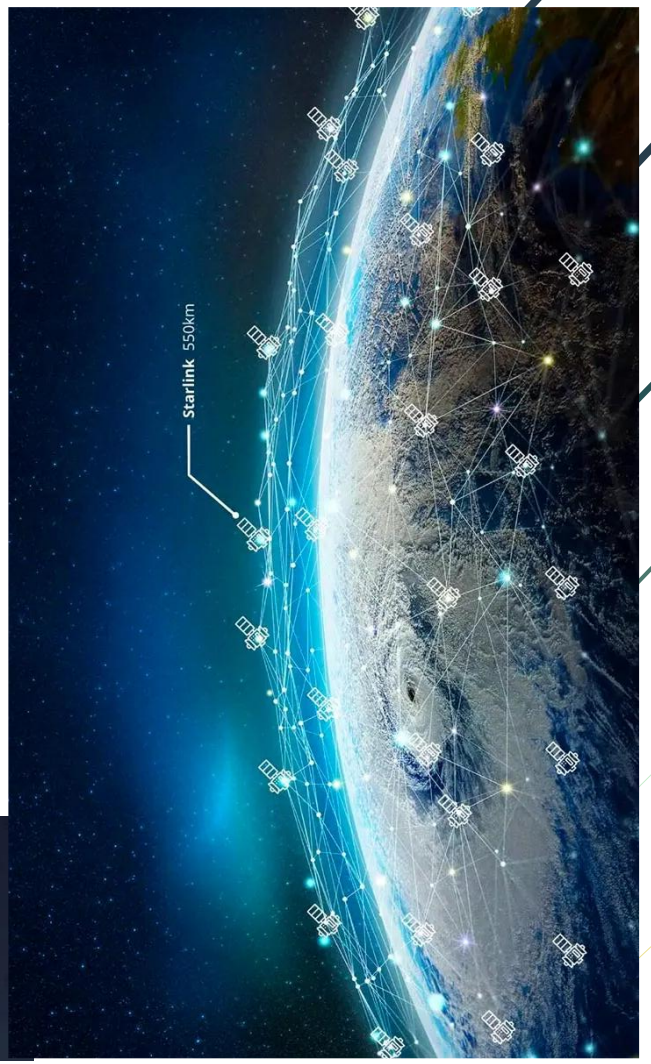


Next-Generation AI-Based Triage System

- **Advanced Facial and Identity Recognition Integration:**
  - The system can instantly identify patients at the scene using facial recognition, biometric verification, and ID scanning technologies.

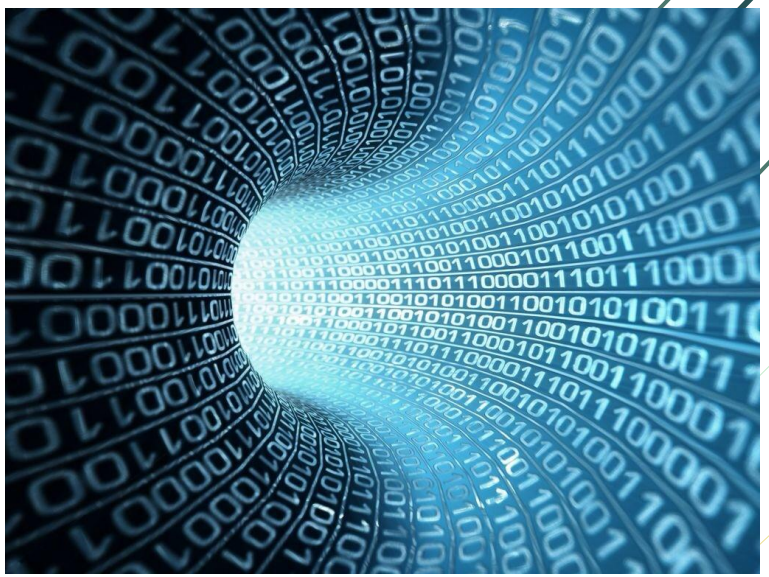
Next-Generation AI-Based Triage System

- **Uninterrupted and Reliable Internet Access:**
  - Triage devices must be equipped with continuous internet connectivity to ensure seamless data flow and system functionality under all conditions.
- **Integration with Next-Generation Satellite Technologies:**
  - The system must be compatible with low-orbit satellite internet solutions such as Starlink, ensuring high-speed and reliable connectivity even in rural or disaster-affected areas.



Next-Generation AI-Based Triage System

- **Real-Time Access to Hospital Capacity Data:**
  - The system should be able to access real-time data on bed occupancy, ICU availability, and overall hospital capacity in nearby healthcare facilities.



Next-Generation AI-Based Triage System

- **Integration with Live Hospital Patient Data:**
  - It should be capable of retrieving live data on patients already admitted to hospitals, including vital signs, diagnoses, and treatment progress, to assess overall system burden.
- **Data-Driven Triage Decisions:**
  - AI should make triage decisions not only based on the patient's clinical condition but also by considering current hospital capacity and healthcare system load. This ensures patients are directed to the most appropriate facility.

Recommendations and Takeaways

- Continuous training
- Integrate new tech tools
- Quality improvement practices
- Field feedback from EMS personnel

Conclusion

- Early triage saves lives
- Support EMS in field decision-making
- Use tools, training, and systems effectively
- And **Let's hand over our duty to AI.**

Thank you, Contributions, Questions