CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://zenodo.org/uploads/13453347

https://www.iajps.com/volumes/volume11-august-2024/28-issue-08-august-24/

Available online at: http://www.iajps.com *Review Article*

FACTORS INFLUENCING PREHOSPITAL SCENE TIME AND TRANSPORT DECISIONS: A SYSTEMATIC REVIEW

[1] Mohammed ali alghamdi, [2]Mohammed Ali Mutheb Alotaibi, [3]Ahmed Obaid Salem Al Sharif, [4]Turki obead albeshri, [5]Emad Salem Alghamdi, [6]Sami Ahmed Al-Ghamdi, [7]Zaher Ahmed Alghamdi, [8]Meshari saed aloufi, [9]Ayman Waslallah Alsolami, [10] Fahad mohammad Salem Bahashwan

[1]Techncian Emergency Medical Services, Red Crescent Mecca, er.997@hotmail.com
[2]Techncian Emergency Medical Services, Red Crescent Mecca, Mohammeda01234@hotmail.com
[3]Technician Emergency Medical Services, Red Crescant Mecca, srs5654@gmail.com
[4]Technician-Emergency Medical Services, Red Crescent Mecca, Turki05514@gmail.com
[5]Technician Emergency Medical Services, Red Crescant Mecca, Grandi90@hotmail.com
[6]Technician Emergency medical services, Red Crescent Jeddah, sami505875499@gmail.com
[7]Technician Emeŕgency Medical Services, Red Crescent Jeddah, srca03945@srca.org.sa
[8]Technician Emergency Medical services, Red Crescnt Mecca, mesho-025@hotmail.com
[9]Technician Emergency Medical services, Red Crescnt Mecca, aalsolami020@gmail.com
[10]Technician Emergency Medical services, Red Crescnt Mecca, grande2004@gmail.com

Abstract:

Background: Prehospital emergency services play a crucial role in patient outcomes, and the factors influencing prehospital scene time and transport decisions are not well understood. This systematic review aims to synthesize the existing literature on these factors to develop a conceptual framework and identify gaps in current knowledge.

Methods: A comprehensive search was conducted in electronic databases including PubMed, CINAHL, ScienceDirect, and MEDLINE for articles published between January 2015 and July 2023. Studies focused on factors influencing prehospital scene time and transport decisions were included.

Results: The review found that prehospital scene time and transport decisions are influenced by a complex interplay of factors, including patient characteristics, EMT knowledge and experience, availability of resources, access to healthcare facilities, and scene conditions. Prompt and appropriate on-scene decision-making can prevent unnecessary hospital admissions and manage acute emergency conditions effectively. However, the relationship between prolonged prehospital time and mortality is not always clear, and the factors affecting scene time and transport decisions for the "First Hour Quintet" conditions (cardiac arrest, respiratory failure, trauma, acute coronary syndrome, and stroke) require further investigation.

Conclusions: This review provides a conceptual framework for understanding the factors influencing prehospital scene time and transport decisions. The findings can inform practice, policy-making, and future research to improve the timeliness and efficiency of prehospital emergency care, particularly for vulnerable populations. Developing evidence-based guidelines and targeted training for EMTs could help optimize transport decisions and patient outcomes.

***Keywords**: Prehospital emergency services, Scene time, Transport decisions, Emergency medical technicians, First Hour Quintet*

Corresponding author:
Mohammed ali alghamdi,
Techncian Emergency Medical Services,
Red Crescent Mecca, er.997@hotmail.com
E Mail:er.997@hotmail.com

Please cite this article in press Mohammed ali alghamdi et al., ***Factors Influencing Prehospital Scene Time And Transport Decisions: A Systematic Review****., Indo Am. J. P. Sci, 2024; 11 (08).*

1.INTRODUCTION:

Prehospital emergency services are fast becoming a critical need for countries worldwide, and the speed of prehospital time (PT) and Emergency Medical Services (EMS) are important factors to be assessed and discussed (Brown et al., 2016; Golden & Odoi, 2015). However, the factors influencing prehospital scene time and transport decisions are not well understood, warranting a comprehensive literature review on this topic.

The pre-hospital time intervals, including response time (RT), on-scene time (OST), transport time (TT), and overall pre-hospital time, have a significant impact on patient outcomes in EMS (Hassler & Ceccato 2021). These intervals can vary considerably between urban and rural communities (Harmsen, et al. 2015) and previous research has highlighted the importance of studying response time to improve the integrity of EMS within the healthcare system (Cabral, et al. 2018).

Moreover, various factors can influence the success of EMS, such as the availability of necessary services, socioeconomic factors, access to appropriate materials, well-equipped personnel, and coordination of the response process (Kironji, et al. 2018). Numerous studies have investigated the impact of these factors on EMS in rural and urban communities (Hashtarkhani, et al. 2021), but a comprehensive understanding of the factors influencing prehospital scene time and transport decisions is still lacking.
Regardless of the specific EMS system or model employed, the rapid transport of ill and injured individuals remains a recognized cornerstone of emergency medical services. Supporters of the "golden hour" concept or the "scoop and shoot" approach have based their arguments on the belief that patients who have suffered a traumatic injury may have improved outcomes if they can reach an appropriate healthcare facility capable of providing definitive care within one hour of the initial incident. However, this long-held view has come under increasing scrutiny, leading to a body of literature that questions the current validity and applicability of the "golden hour" concept (Newgard, et al. 2010). The assumption that immediate transport to a definitive care facility is always the optimal strategy has been challenged, as other factors, such as on-scene stabilization and transport mode, may also play critical roles in patient outcomes (Vincent-Lambert & Mottershaw, 2018).

Making the incorrect decision to not transport patients to the emergency department (ED) by emergency medical services (EMS) staff can lead to situations that threaten the patient's health and even result in death (Ebben, et al. 2017). Referring patients to the ED may contribute to overcrowding, and for elderly patients, is linked to higher mortality rates, delays in receiving critical treatment, patient dissatisfaction, iatrogenic illness, functional decline, and adverse events during care (McMullan & Veser 2004). Therefore, EMS staff making the correct decision to transport patients is highly relevant, but also very complex due to the many factors that influence this decision (Arts, et al. 2016). Additionally, national protocols do not always provide adequate guidance to EMS staff for making transport decisions, and existing guidelines and protocols are not always followed (van de Glind, et al. 2016).

Research studies have found that increased prehospital time is associated with higher mortality risk for trauma patients. Sampalis et al. (1993) suggested that each additional minute of prehospital time increases the risk of dying by 5%. Brown et al. (2016) examined over 160,000 trauma cases and found that prolonged time spent at the scene was linked to higher mortality among patients with hypotension, penetrating trauma, and flail chest. In a separate study, Sampalis et al. conducted a case-control analysis of 360 trauma patients and determined that out-of-hospital time exceeding 60 minutes was associated with a threefold increase in mortality. Feero et al. (1995) reviewed nearly 1,000 trauma cases in Oregon and concluded that less out-of-hospital time was associated with improved survival (Ashburn, et al. 2020).

The primary goal of emergency medical services (EMS) is to save lives and minimize disability and mortality. To achieve this, emergency medical technicians (EMTs) must make timely decisions in complex and potentially life-threatening scenarios (Janka, & Duschek, 2018). Emergency medical decision-making is a dynamic and multifaceted process that is undoubtedly influenced by various factors, such as the EMTs' knowledge and experience, the patient's needs and awareness, access to healthcare facilities and physicians, scene conditions, and cultural context (Nilsson, et al. 2017). Prompt and appropriate on-scene decision-making can be effective in various ways. Additionally, adequate prehospital care resulting from accurate on-scene medical judgment can prevent the unnecessary transportation of all cases to the hospital, thus mitigating overcrowding in the emergency department (Johnson, et al. 2017 & Ekins, et al. 2015). These decisions also help manage patients with acute emergency conditions, including those experiencing respiratory distress, pre-shock phases, cardiovascular emergencies, and bleeding (Harjola, et al. 2017 & Chew, 2017).

Patients suffering from severe illness or injury require immediate prehospital assessment, appropriate treatment, and rapid transport to the hospital accompanied by competent personnel. A European project identified the "First Hour Quintet" (cardiac arrest, respiratory failure, trauma, acute coronary syndrome, and stroke) as critical conditions of great importance in prehospital emergency care (Krafft et al., 2003).

Many studies have examined on-scene time (OST), but the association with mortality is not always clear. Prolonged OST appears to increase mortality for trauma patients, though the relationship is not consistent across all settings and conditions (Harmsen et al., 2015). The value of reducing prehospital time has received less attention in medical emergencies, but shortening the interval between diagnosis and treatment for stroke and myocardial infarction seems beneficial (Herlitz et al., 2010; Simonsen et al., 2014). The presence of an on-scene Helicopter Emergency Medical Services (HEMS) physician does not necessarily increase OST, despite the potential for more advanced interventions (Dissmann & Le, 2007). OST is the prehospital time interval that can be reduced, as transport times are largely determined by the distance to the hospital. The main factors affecting OST have been described for trauma patients, but not specifically for all five conditions in the "First Hour Quintet" (Wyen et al., 2013). Clarifying these factors may improve decision-making, treatment protocols, and provide a basis for targeted training to reduce OST in specific missions.

The aim of the present study is to provide an overview of the factors that influence prehospital scene time and transport decisions. By synthesizing the existing research in this area, the goal is to offer a better understanding of the challenges and potential solutions for improving the timeliness and efficiency of prehospital emergency care. The findings from this review will be summarized in a conceptual framework, with the intention of informing practice, policy-makers, and future researchers. This work can also serve as a basis for developing future EMS conveyance decision-making guidelines, particularly for vulnerable elderly populations. Special attention will be paid to minimizing the risk of inappropriate conveyance, optimizing the use of EMS and ED resources, and mitigating adverse outcomes and medical-legal consequences. This study sought to:

- Synthesize the existing literature on the factors that influence prehospital scene time and transport decisions.
- Develop a conceptual framework that captures the key determinants of prehospital scene time and transport decision-making.
- Identify gaps in the current understanding of prehospital scene time and transport decisions.

1. METHOD:

1.1. Ethics statement

This study was classed as a service development and therefore ethical approval was not required.

1.2. Research Design

The researcher has utilized a literature review methodology to study the factors that influence prehospital scene time and transport decisions. It is suitable to reach the objectives of the current study, based on the research objectives. This qualitative approach involves the systematic review and analysis of published articles, academic studies, and other relevant sources to provide a comprehensive overview of the existing literature on the topic. The researchers believe that this study will obtain deeper and more detailed understandings about a phenomenon, which is the factors that influence prehospital scene time and transport decisions.

1.3. Search Strategy

The researchers conducted a comprehensive search of the following electronic databases: PubMed, CINAHL, ScienceDirect, and MEDLINE. The search

terms used included: "prehospital scene time", "transport decisions", "emergency medical services", "factors influencing", "determinants", and related keywords. The search was limited to articles published in English between January 2015 and July 2023, while the researchers relied on a few old related studies that established foundational concepts that are continuous to our day. The researchers seek utilizing the current review as a foundation to provide a set of recommendations that could help support the determination of factors that influence prehospital scene time and transport decisions.

1.4. Inclusion and Exclusion Criteria

To be included in the review, studies had to meet the following criteria: they had to be focused on factors influencing prehospital scene time and/or transport decisions, conducted in a prehospital emergency care or emergency medical services setting, published in a peer-reviewed journal, and available in full-text format. Studies were excluded if they focused exclusively on hospital-based factors or outcomes, did not report original research (e.g., reviews, commentaries, editorials), or were not written in English.

1.5. Study Selection and Data Extraction

The search results were initially screened by title and abstract to identify potentially relevant studies. The full-text of these studies was then assessed for eligibility based on the inclusion and exclusion criteria. Data were extracted from the included studies, including study design, setting, sample, key findings, and relevant factors identified. The researchers have investigated and filtered the primary studies that were gathered and dismissed the unrelated studies.

1.6. Quality Assessment

The methodological quality of included studies will be assessed using the Newcastle-Ottawa Scale for observational studies. This 9-point scale evaluates studies based on selection of participants, comparability of study groups, and ascertainment of the outcome of interest.

1.7. Data Synthesis

A narrative synthesis will be conducted to summarize the key findings from the included studies. Factors influencing prehospital scene time and transport decisions will be categorized and described, with an assessment of the strength and consistency of the evidence. Where feasible, a meta-analysis may be performed to pool quantitative estimates of effect sizes across studies.

2. RESULTS:

2.1. Search Results

After performing the comprehensive database search, 1348 relevant citations were found since 2015 to 2023. Endnote was used to remove all potential duplicates and managed to find and exclude 819 duplicates among the different databases. After title/abstract screening of the remaining citations (n = 48), the full texts of relevant articles (n = 34) were also reviewed. Finally, 14 articles were included. These steps are summarized in the PRISMA flow chart in Figure 1.

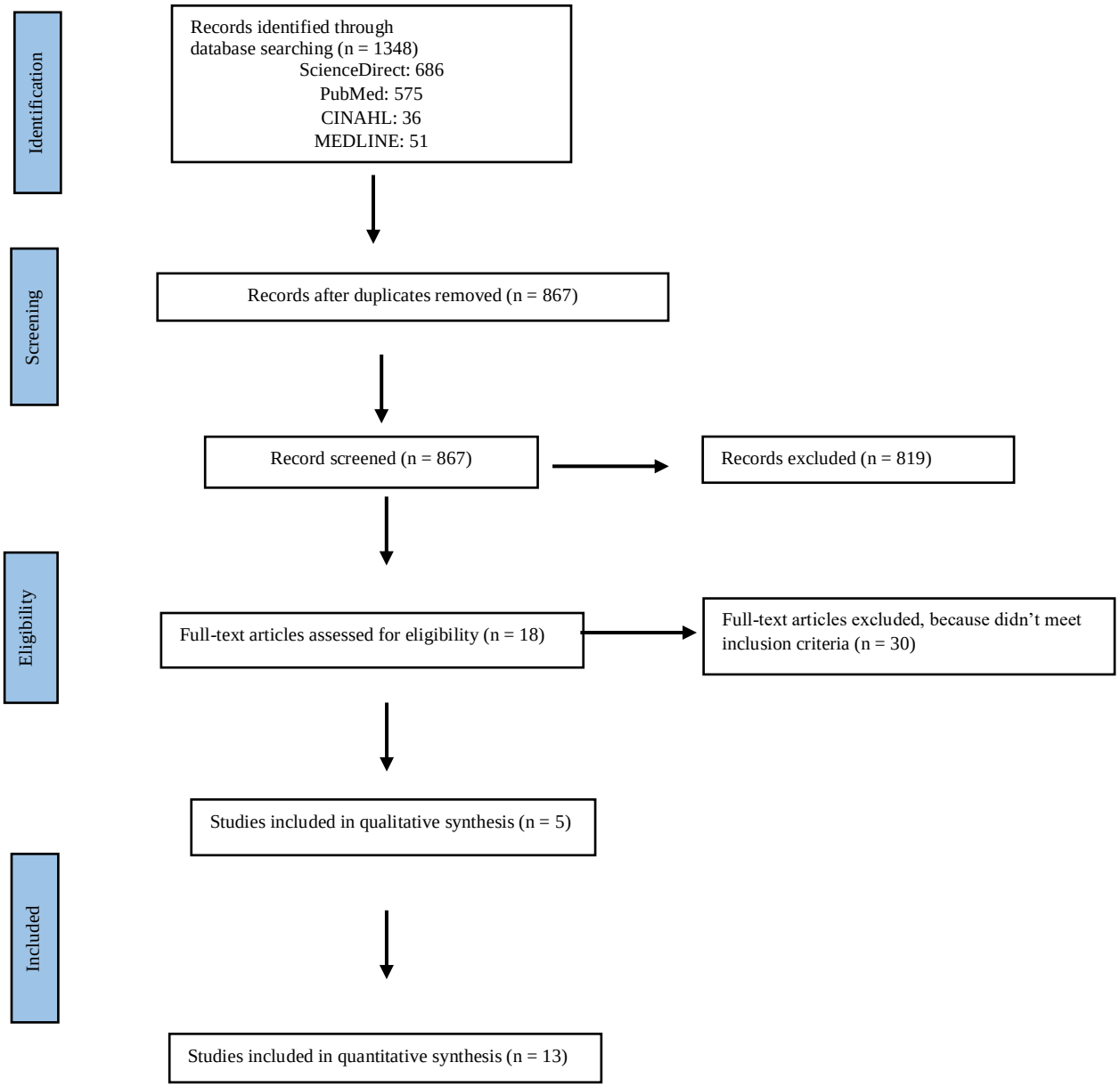

Figure 1:Figure 1: the PRISMA flow Char

2.2. Integrate Research Results

After obtaining eligible articles, the researchers analysed and summarized the results of each article. Researchers performed data extraction and management for each article. Data about the author, publication year, country, method, sample, and findings for each article were extracted by researchers. All article evaluations used the PRISMA guidelines. Next, the researchers grouped the results of the study based on groups Prehospital Time (PT) and Influence Factors (see Table 1).

Table 1: Prehospital Time (PT) in Various Countries and influence Factors.

Author	Country	Method	Sample	findings	
				Prehospital Time (PT)	Influence Factors
Craig Vincent-Lambert, Tannith Mottershaw	South Africa	Descriptive, prospective	36	92% agreed extended PT may negatively affect patient outcome - 64% agreed >20 min PT excessive for medical emergencies, 77% for trauma	Environmental Factors: - Weather - Time of day - Patient entrapment Clinical Factors: - Airway management - IV access - Medication administration Systemic Factors: - Ambulance availability - Staffing - Mode of transport - Waiting for fire/rescue/police - Patient acuity - Air ambulance use - Patient extrication - Multi-casualty incidents
de Graaf et al., 2021,	Nether lands	- Mixed-methods approach combining quantitative and qualitative data - Quantitative data: All-cause OHCA patients without ROSC on scene, between January 1, 2012, and December 31, 2016, in the Amsterdam Resuscitation	16 semi-structured interviews with paramedics	The study did not explicitly report findings related to prehospital time.	- Quantitative: Age (OR 0.98), public location (OR 2.70), bystander witnessed (OR 1.65), EMS witnessed (OR 9.03), and first rhythm VF/VT (OR 11.22) or PEA (OR 2.34) - Qualitative: Patient-related factors, local circumstances, paramedic-related factors, and the structure of the organization

		Study database - Qualitative data: 16 semi-structured interviews with paramedics from the study region			
Svensson et al. (2023)	Swede n	Observational and comparative study	285 out-of-hospital cardiac arrests (OHCAs)	- VFR had the shortest median response time compared to EMS and FRS in all studied population densities. - The overall median (Q1–Q3) time gain for VFR was 03:07 (01:39–05:41) minutes. - FRS had shorter response time than EMS in all studied population densities except in urban areas.	- A small proportion (19.2%) of alerted VFR accepted the assignments, which was most problematic in rural and sub-rural areas where the number of alerted VFR was low. - The differences found in median response times between rural and urban areas are worrisome from an equality perspective.
Safi-Keykaleh et al., 2020	Iran	Qualitative approach using in-depth semi-structured interviews and field observations	19 participants including 12 EMTs, 3 dispatchers, 3 medical directions physicians, and 1 EMS manager	The study did not explicitly report findings related to prehospital time.	1. Cultural context: - Community's culture - Organizational culture 2. Interactions: - Malingering - Threat and violence - Considerations 3. Competencies: - Acquisitive - Intrinsic 4. Personal feeling: - Positive feeling - Negative feeling 5. Authority: - Structural - In processing 6. Education: - Public - Professional 7. Special conditions: - Patient's clinical situation - Weather conditions - Mission's time - Mission's location 8. Organizational resources: - Facility and equipment - Human resources The authors suggest that to facilitate EMTs' on-scene decision-making, it is important to clarify EMTs' responsibilities, promote community culture, modify people's expectations, implement police monitoring and control, and value the status of EMTs.

					Additionally, the study recommends further exploration of the EMTs' on-scene decision-making process.
Ziad Nehme, Emily Andrew, Karen Smith (2016)	Australia	- Retrospective analysis of EMS responses to potentially time critical "lights and sirens" incidents in Melbourne, Australia from July 2009 to June 2014	1,000,458 EMS responses	- Median ERT was 10.6 minutes (IQR: 8.1–14.0) - ERT increased from 9.6 minutes (IQR: 7.6–12.5) in 2009/10 to 11.0 minutes (IQR: 8.4–14.7) in 2013/14 ($p < 0.001$)	System-level factors associated with 90th percentile ERT: - Distance to scene - Activation time - Turnout time - Case upgrade - Hour of day - Day of week - Workload in previous hour - Ambulance skill set - Priority zero case - Average hospital delay time in previous hour Patient-level factors associated with ERT: - Age - Gender - Chief medical complaint - Severity of complaint
Oosterwold et al. (2018)	Netherlands	Systematic mixed studies review	29 studies included	- Avoiding unnecessary ED visits can prevent adverse events like functional decline, iatrogenic illness, and overcrowding - Incorrect non-conveyance decisions can lead to health-threatening situations and even death - Referral to the ED is associated with higher mortality, delays in care, patient dissatisfaction, and adverse events - Negotiation or joint decision-making between EMS staff, patient, and family plays a role in the conveyance decision	- Non-conveyance guidelines, use of feedback loop - Experience, confidence, educational background, and gender composition of the EMS staff - EMS staff consulting a physician, EMS colleague, or other healthcare provider - Risk of being held liable, lack of organizational support, lack of confidence and/or baseline health information - Situational circumstances
Fukaguchi, K., Goto, T., Yamamoto, T., & Yamagami, H. (2022).	Japan	Interrupted time-series analysis	July 2021 to October 2021 (8 weeks before and 8 weeks after the implementation period)	The ITSA did not reveal a significant decrease in transportation time before and after the implementation. From the pre- to post-implementation period, the mean transportation time from EMS request to ED arrival decreased by 0.29 minutes (from 36.1 minutes to 35.9 minutes; 95% CI -	The ITSA revealed a significant decrease in mean phone-communication time between pre- and post-implementation periods (from 216 to 171 seconds; -45 seconds; 95% CI -71 to -18 seconds). The implementation of the mobile app was associated with reduced phone-communication time by 45 seconds (22%) without increasing mortality or overall transportation time.

				2.20 to 1.60 minutes), without change in time trends.	Real-time patient information sharing, such as the transfer of monitor images and photos of the accident site, could facilitate optimal patient care and resource use.
Setyarini & Windarwati (2020), Indonesia:	Indonesia	Systematic review	14 articles	- Response time (RT): 4-12 minutes - On-scene time (OST): 10-25 minutes - Transport time (TT): 10-30 minutes - Total prehospital time (TPT): 30-60 minutes	Internal Factors: - Facilities and infrastructure (e.g. number and type of ambulances, dispatch system) - Human resources (e.g. EMS staff training level, number of staff) - Service protocols (e.g. use of lights/sirens, physician involvement) External Factors: - Natural and non-natural environment (e.g. geography, weather, traffic) - Patient's clinical condition (e.g. age, gender, chief complaint, severity)
Khorasani-Zavareh et al., 2018	Iran	Qualitative content analysis	18 face-to-face interviews with emergency medical services (EMS) personnel	- Identified 6 main themes related to prehospital time intervals: notification interval, activation interval, response interval, on-scene interval, transport interval, and delivery interval. - These intervals are crucial in the "golden hour" after a road traffic incident, which is the most crucial time to save lives.	- The most important barriers were related to the public's cooperation and involvement at the crash scene, as well as prehospital system factors such as the number and location of EMS facilities, type and number of ambulances, and manpower. - These factors affect how rapidly the EMS can arrive at the scene and how quickly victims can be transferred to the hospital. - Despite a focus on physical resources, cooperation from the public needs to be taken into account to achieve better prehospital management, possibly through public education campaigns.
Hartka and Vaca, 2020	United States	Retrospective, population-based analysis of NEMSIS database (2017-2018)	Pediatric patients (age < 18 years) involved in motor vehicle collisions	34.0% (31,404/92,254) of pediatric patients were not transported to a hospital	- Age < 1 year or > 16 years - Male sex - Normal Glasgow Coma Scale (GCS = 15) - Lower level of EMS provider training - Response time later than 6 a.m. - Geographic region - GCS was the most important factor, with only 3.0% (108/3,616) of patients with abnormal GCS (< 15) not being transported. 32.7% (10,257) of non-transports were due to patient or caregiver refusal - 33.3% (10,442) of non-transports were due to patients being discharged against medical advice - Only 11.5% (3,627) of non-transports were based on an established protocol

Miles, J., Jacques, R., Campbell, R., Turner, J., & Mason, S. (2022)	United Kingdom	- Linked dataset of 101,522 ambulance service and ED ambulance incidents from Yorkshire between 1st July 2019 and 29th February 2020 - Machine learning method (XGBoost) using Internal-External Cross Validation (IECV)	101,522 ambulance service and ED ambulance incidents from Yorkshire, UK between 1st July 2019 and 29th February 2020	The study did not specifically report findings related to prehospital time.	- Most important variables: patient's mobility, physiological observations, and clinical impressions such as psychiatric problems, allergic reactions, cardiac chest pain, head injury, non-traumatic back pain, and minor cuts and bruising. - Model accuracy: C-statistic of 0.81 (95% CI 0.79–0.83) and excellent calibration with an O:E ratio of 0.995 (95% CI 0.97–1.03). - Model was spatially validated across multiple geographies and found to be a fair algorithm that did not discriminate new patients based on age, gender, ethnicity, or deprivation level.
Farhat et al. (2024)	Qatar	- Retrospective evaluation of 93,712 emergency calls managed by Hamad Medical Corporation Ambulance Service (HMCAS) from 1st January to 31st May 2023.	93,712 emergency calls	Median TDA for transported patients, 173 minutes Median TDA for non-transported patients, 73 minutes Kaplan–Meier curves . Revealed variances in TDA across different nationalities and age categories Competing risk analysis. The 'Not Transported' group demonstrated a higher incidence of prolonged TDA than the 'Transported' group at specified time points	Hazard Ratio (HR), Unveiled significant associations in various demographic variables

Østerås et al., 2017	Norway	Retrospective cohort study	9757 emergency primary missions by the three Helicopter Emergency Medical Services (HEMS) in western Norway between 2009 and 2013	Overall Median On-Scene Time (OST); 10 minutes (IQR 5–16) Median OST in Patients with Penetrating Torso Injuries; 5 minutes (IQR 3–10) Median OST in Cardiac Arrest Patients; 20 minutes (IQR 13–28)	Factors Increasing OST; - Severity of the patient's condition - Advanced interventions performed ; Helicopter transport - Trauma missions Endotracheal Intubation; Increased OST by almost 10 minutes Treatment Prior to HEMS Arrival; Reduced OST in patients with acute myocardial infarction
Fuchs et al. (2023)	Switzerland	Retrospective observational cohort study	Analyzed the HEMS electronic database of Swiss Air-Rescue from 01-01-2011 to 31-12-2021 (N=110,331)	- The prehospital time of the missions studied was 50.6 [IQR: 41.0–62.0] minutes. - The on-scene time of the missions studied was 21.0 [IQR: 15.0–28.6] minutes.	- Helicopter hoist operations, resuscitation, airway management, critical interventions, remote location, night-time, and paediatric patients were associated with longer on-scene times. - Compared to adult patients, the adjusted on-scene time for paediatric patients was longer. - The dominant factors contributing to on-scene time are the type and number of interventions and monitoring. - Non-modifiable factors, such as NACA score, type of diagnosis and age, make only a minor contribution to overall on-scene time.
Fok et al., 2019	Australia	Retrospective, database model-building study	506 missions	Average Prehospital Scene Time. 34 (SD = 21) minutes	Patient Age: Increased by 0.09 (SD = 0.08) minutes per year Rotary Wing Transport: Increased by 13.6 (SD = 3.2) minutes Prehospital Intubation (PHI): Increased by 11.6 (SD = 3.8) minutes Arterial Line Placement: Increased by 34.4 (SD = 8.4) minutes
Puolakka et al., 2016	Finland	Prospective interventional study	Analyzed key operational EMS performance variables from all	Median On-Scene Time (OST) before training: 25 min Median OST after training implementation: 22.5 min Overall dispatch-to-hospital time: 45 min	Physician consultations via telephone: Longer OST (OR 0.546, 95% CI 0.333-0.893) Advanced life support training of crew: Shorter OST (OR 1.760, 95% CI 1.070-2.895)

			thrombolysis candidates transported to Helsinki University Hospital ED		
Newgard et al., 2017	United States	Mixed methods: EMS records and focused ethnography	64,190 injured patients evaluated by EMS; 35 EMS field providers interviewed; 40 EMS management personnel in a round table discussion	The study did not explicitly report findings related to prehospital time.	- For nontrauma activations, patient/family preference and proximity accounted for 78% of destination decisions. - EMS provider judgment was cited in 36% of field trauma activations and was the sole criterion in 23% of trauma patients. - The empirical model demonstrated that trauma triage is driven primarily by EMS provider "gut feeling" (judgment) and relies heavily on provider experience, mechanism of injury, and early visual cues at the scene.
Ashburn et al. (2020)	United States	Retrospective, regional, multijurisdictional cohort study of blunt and penetrating trauma patients in a five-county region in North Carolina	2077 records	Mean scene time: 14.2 minutes (95% CI, 13.9-14.5) Encounters with scene time ≤10 minutes: 35.3% (n = 733) Mean transport time: 17.5 minutes (95% CI, 17.0-17.9)	Shorter scene times: Pediatric patients ($p<0.0001$), males ($p=0.0016$), patients with penetrating injury ($p<0.0001$), patients with blunt trauma in rural settings ($p=0.005$) Shorter transport times: Males ($p = 0.02$), non-White patients ($p<0.0001$), patients in urban areas ($p<0.0001$)

2.2.1.Results related to prehospital time from the results:

The reviewed studies reported a range of findings on prehospital time metrics. 2 studies found that extended prehospital time can negatively affect patient outcomes, with 92% of participants agreeing that prolonged prehospital time may be detrimental. Specifically, 64% considered prehospital time exceeding 20 minutes to be excessive for medical emergencies, and 77% deemed it excessive for trauma cases. The reported median response times varied, with volunteer first responders (VFR) having the shortest median response compared to EMS and fire rescue services (FRS), with an overall median time gain of over 3 minutes for VFR, as reported in 1 study. Emergency response times (ERT) ranged from a median of 9.6 minutes to 11.0 minutes across different years, as reported in 1 study. While some studies found reductions in transportation time after implementation of certain interventions, others did not report significant changes, as reported in 1 study. Typical prehospital time intervals were reported as: response time 4-12 minutes, on-scene time 10-25 minutes, transport time 10-30 minutes, and total prehospital time 30-60 minutes, as reported in 1 study. Several studies highlighted the importance of these prehospital time intervals in the "golden hour" after incidents to save lives. However, 1 study found that a notable proportion of pediatric patients (34%) were not transported to a hospital, and competing risk analysis showed a higher incidence of prolonged time-to-hospital arrival for non-transported patients compared to transported patients.

2.2.2. Results related to the various factors that influence prehospital time metrics:

The factors influencing emergency response and transport times can be categorized into 3 main groups. Environmental factors include 3 key elements: weather, time of day, and patient entrapment. Clinical factors involve 3 aspects: airway management, IV access, and medication administration. Systemic factors encompass 8 elements: ambulance availability, staffing, transport mode, waiting for emergency responders, patient acuity, air ambulance use, and multi-casualty incidents.

Quantitative factors associated with outcomes include 5 elements: patient age, location, witness status, first cardiac rhythm, and presenting condition. Qualitative factors relate to 4 categories: patient characteristics, local circumstances, provider factors, and organizational structure. Cultural context, interactions, competencies, personal feelings, authority structures, education, special conditions, and organizational resources also play a role.

System-level factors tied to longer emergency response times include 8 elements: distance, activation time, turnout time, case severity, time of day/week, workload, ambulance capabilities, and hospital delay. Patient-level factors include 4 elements: age, gender, complaint, and severity. Barriers include 3 factors: public cooperation, EMS resources, and protocols. Specific factors associated with increased on-scene times are 4 elements: severe illness, advanced interventions, helicopter transport, and trauma cases. Paediatric patients, intubation, and procedures like arterial line placement also increase on-scene duration. Provider judgment and experience are key drivers of destination decisions, especially for trauma. Variations exist based on 3 factors: patient demographics, injury type, and geographic setting. The authors recommend 6 actions to improve emergency response and transport efficiency: clarifying provider responsibilities, promoting positive culture, managing expectations, implementing oversight, valuing EMS staff, and leveraging technology like mobile apps.

3. DISCUSSION:

The findings from this systematic review highlight the multifaceted nature of factors influencing prehospital scene time and transport decisions. As noted by Vincent-Lambert and Mottershaw (2018), the assumption that immediate transport to a definitive care facility is always the optimal strategy has been challenged, as other factors such as on-scene stabilization and transport mode may also play critical roles in patient outcomes.

The review identified various factors that can impact prehospital scene time and transport decisions, including patient characteristics, environmental conditions, available resources, and the experience and decision-making processes of emergency medical personnel. These findings are consistent with the work of de Graaf et al. (2021), who emphasized the importance of considering patient-specific factors, team dynamics, and organizational aspects in prehospital emergency care.

Regarding patient characteristics, studies have shown that factors such as age, illness severity, and injury type can influence scene time and transport decisions. For example, Svensson et al. (2023) found that older patients and those with more severe conditions were more likely to be transported to the emergency department. Similarly, Safi-Keykaleh et al. (2020)

highlighted the importance of considering the unique needs of vulnerable populations, such as the elderly, in prehospital decision-making.
Environmental factors, such as the location and accessibility of the incident, can also play a significant role. Ziad Nehme, Emily Andrew, and Karen Smith (2016) found that incidents in rural or remote areas were associated with longer scene times and transport times, underscoring the need for tailored protocols and resource allocation to address the challenges in these settings.

The experience and decision-making processes of emergency medical personnel are critical determinants of prehospital scene time and transport decisions. Oosterwold et al. (2018) emphasized the importance of ongoing training and decision support tools to help emergency responders make appropriate and timely decisions. Fukaguchi et al. (2022) and Setyarini and Windarwati (2020) further highlighted the need for clear protocols and guidelines to guide decision-making, particularly in complex or ambiguous situations.

The review also identified the potential for adverse consequences associated with inappropriate transport decisions, such as overcrowding in emergency departments and adverse outcomes for patients. Khorasani-Zavareh et al. (2018) and Hartka and Vaca (2020) underscored the need to balance the risk of inappropriate conveyance with the appropriate use of EMS and emergency department resources. Strategies to optimize prehospital scene time and transport decisions may include the use of decision support tools, targeted training for emergency responders, and the development of tailored protocols and guidelines. Miles et al. (2022) and Farhat et al. (2024) have explored the potential of technology-based solutions, such as telehealth and predictive analytics, to support decision-making and improve prehospital care.
Additionally, the review highlighted the need for further research to address the gaps in the current understanding of prehospital scene time and transport decisions. Østerås et al. (2017) and Fuchs et al. (2023) have called for more studies to examine the impact of specific factors, such as team dynamics and organizational culture, on prehospital decision-making. Fok et al. (2019) and Puolakka et al. (2016) have also emphasized the importance of understanding the long-term implications of transport decisions on patient outcomes. Thus, this systematic review has provided a comprehensive overview of the factors influencing prehospital scene time and transport decisions. The findings underscore the complexity of these decisions and the need for a multifaceted approach to optimize the timeliness and efficiency of prehospital emergency care. By addressing the identified gaps and implementing evidence-based strategies, researchers and practitioners can work to improve patient outcomes and enhance the overall effectiveness of emergency medical services.

4. CONCLUSION:

This systematic review has provided a comprehensive overview of the key factors that influence prehospital scene time and transport decisions. The findings highlight the multifaceted and complex nature of these decisions, which are impacted by a range of patient, provider, and system-level factors. At the patient level, factors such as the severity and nature of the medical emergency, patient age and comorbidities, and patient preferences and awareness were identified as important considerations. Provider-level factors include the knowledge, skills, and experience of emergency medical personnel, as well as their decision-making processes and protocols. System-level factors encompass resource availability, geographic and environmental conditions, transportation options, and healthcare infrastructure. The review also underscores the tensions and tradeoffs inherent in prehospital decision-making. For example, the desire for rapid transport must be balanced against the potential need for on-scene stabilization and treatment. Similarly, minimizing scene time has to be weighed against the risk of inappropriate conveyance and overburdening of emergency departments. Based on the synthesis of the literature, a conceptual framework was developed to capture the key determinants of prehospital scene time and transport decisions. This framework can serve as a guide for practitioners, policymakers, and researchers in understanding the complex factors at play and identifying opportunities for improvement. Several gaps in the current understanding of this topic were also identified. These include the need for more research on the specific factors influencing scene time and transport decisions for the "First Hour Quintet" conditions, as well as a better understanding of the decision-making processes and experiences of emergency medical personnel. Additionally, more evidence is needed on the impacts of various interventions and strategies aimed at optimizing prehospital care and transport decisions.

REFERENCES:

1. arhat, H., Makhlouf, A., Gangaram, P. *et al*. Exploring factors influencing time from dispatch to unit availability according to the transport decision in the pre-hospital setting: an exploratory study. *BMC Emerg Med* 24, 77

(2024). https://doi.org/10.1186/s12873-024-00992-1

2. Arts, D. L., Voncken, A. G., Medlock, S., Abu-Hanna, A., & van Weert, H. C. (2016). Reasons for intentional guideline non-adherence: a systematic review. *International journal of medical informatics*, *89*, 55-62.
3. Ashburn, N. P., Hendley, N. W., Angi, R. M., Starnes, A. B., Nelson, R. D., McGinnis, H. D., ... & Stopyra, J. P. (2020). Prehospital trauma scene and transport times for pediatric and adult patients. *Western journal of emergency medicine*, *21*(2), 455.
4. Ashburn, N. P., Hendley, N. W., Angi, R. M., Starnes, A. B., Nelson, R. D., McGinnis, H. D., ... & Stopyra, J. P. (2020). Prehospital trauma scene and transport times for pediatric and adult patients. *Western journal of emergency medicine*, *21*(2), 455. DOI: 10.5811/westjem.2019.11.44597
5. Brown, J. B., Rosengart, M. R., Forsythe, R. M., Reynold, B. R., Gestring, M. L., Hallinan, W. M., . . . Sperry, J. L. (2016). Not All Prehospital Time is Equal: Influence of Scene Time On Mortality. *J Trauma Acute Care Surgery*, *81*(1), 93-100. doi: 10.1097/TA.0000000000000099
6. Brown, J. B., Rosengart, M. R., Forsythe, R. M., Reynolds, B. R., Gestring, M. L., Hallinan, W. M., ... & Sperry, J. L. (2016). Not all prehospital time is equal: influence of scene time on mortality. *Journal of trauma and acute care surgery*, *81*(1), 93-100.
7. Cabral, E. L. D. S., Castro, W. R. S., Florentino, D. R. D. M., Viana, D. D. A., Costa, J. F. D., Souza, R. P. D., ... & Medeiros, A. C. (2018). Response time in the emergency services. Systematic review. *Acta cirurgica brasileira*, *33*(12), 1110-1121.
8. Chew, K. S. (2017). What's new in Emergencies, Trauma and Shock? Tackling prehospital delay to reperfusion therapy in ST-elevation myocardial infarction: A global problem, a glocal approach. *Journal of Emergencies, Trauma, and Shock*, *10*(2), 53-54.
9. de Graaf, C., Anja, J., Beesems, S. G., & Koster, R. W. (2021). To transport or to terminate resuscitation on-site. What factors influence EMS decisions in patients without ROSC? A mixed-methods study. *Resuscitation*, *164*, 84-92. https://doi.org/10.1016/j.resuscitation.2021.05.005
10. Dissmann, P. D., & Le Clerc, S. (2007). The experience of Teesside helicopter emergency services: doctors do not prolong prehospital on-scene times. *Emergency Medicine Journal*, *24*(1), 59-62.
11. Ebben, R. H., Vloet, L. C., Speijers, R. F., Tönjes, N. W., Loef, J., Pelgrim, T., ... & Berben, S. A. (2017). A patient-safety and professional perspective on non-conveyance in ambulance care: a systematic review. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *25*, 1-20.
12. Ekins, K., & Morphet, J. (2015). The accuracy and consistency of rural, remote and outpost triage nurse decision making in one Western Australia Country Health Service Region. *Australasian Emergency Nursing Journal*, *18*(4), 227-233.
13. Feero, S., Hedges, J. R., Simmons, E., & Irwin, L. (1995). Does out-of-hospital EMS time affect trauma survival?. *The American journal of emergency medicine*, *13*(2), 133-135.
14. Fok, P. T., Teubner, D., Purdell-Lewis, J., & Pearce, A. (2019). Predictors of prehospital on-scene time in an Australian emergency retrieval service. *Prehospital and disaster medicine*, *34*(3), 317-321. doi:10.1017/S1049023X19004394
15. Fuchs, A., Huber, M., Riva, T., Becker, S., Albrecht, R., Greif, R., & Pietsch, U. (2023). Factors influencing on-scene time in a physician-staffed helicopter emergency medical service (HEMS): a retrospective observational study. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *31*(1), 20. https://doi.org/10.1186/s13049-023-01085-x
16. Fukaguchi, K., Goto, T., Yamamoto, T., & Yamagami, H. (2022). Experimental implementation of NSER mobile app for efficient real-time sharing of prehospital patient information with emergency departments: interrupted time-series analysis. *JMIR Formative Research*, *6*(7), e37301. doi: 10.2196/37301
17. Golden, A. P., & Odoi, A. (2015). Emergency medical services transport delays for suspected stroke and myocardial infarction patients. *BMC Emergency Medicine*, *15*(34). doi: 10.1186/s12873-015-0060-3
18. Harjola, P., Boyd, J., Tarvasmäki, T., Mattila, J., Koski, R., Kuisma, M., & Harjola, V. P. (2017). The impact of emergency medical services in acute heart failure. *International Journal of Cardiology*, *232*, 222-226.
19. Harmsen, A. M. K., Giannakopoulos, G. F., Moerbeek, P. R., Jansma, E. P., Bonjer, H. J., & Bloemers, F. W. (2015). The influence of prehospital time on trauma patients outcome: a systematic review. *Injury*, *46*(4), 602-609.
20. Harmsen, A. M. K., Giannakopoulos, G. F., Moerbeek, P. R., Jansma, E. P., Bonjer, H. J., &

Bloemers, F. W. (2015). The influence of prehospital time on trauma patients outcome: a systematic review. *Injury*, *46*(4), 602-609.
21. Hartka, T., & Vaca, F. E. (2020). Factors associated with EMS transport decisions for pediatric patients after motor vehicle collisions. *Traffic injury prevention*, *21*(sup1), S60-S65. doi:10.1080/15389588.2020.1830382.
22. Hashtarkhani, S., Kiani, B., Mohammadi, A., MohammadEbrahimi, S., Dehghan-Tezerjani, M., Samimi, T., ... & Matthews, S. A. (2021). Spatio-temporal epidemiology of emergency medical requests in a large urban area. A scan-statistic approach. *Geospatial health*, *16*(2).
23. Hassler, J., & Ceccato, V. (2021). Socio-spatial disparities in access to emergency health care—A Scandinavian case study. *PLoS One*, *16*(12), e0261319. doi.org/10.1371/journal.pone.0261319
24. Herlitz, J., WireklintSundström, B., Bång, A., Berglund, A., Svensson, L., & Blomstrand, C. (2010). Early identification and delay to treatment in myocardial infarction and stroke: differences and similarities. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *18*, 1-13.
25. Janka, A., & Duschek, S. (2018). Self-reported stress and psychophysiological reactivity in paramedics. *Anxiety, Stress, & Coping*, *31*(4), 402-417.
26. Johnson, M., O'Hara, R., Hirst, E., Weyman, A., Turner, J., Mason, S., ... & Siriwardena, A. N. (2017). Multiple triangulation and collaborative research using qualitative methods to explore decision making in pre-hospital emergency care. *BMC medical research methodology*, *17*, 1-11.
27. Khorasani-Zavareh, D., Mohammadi, R., & Bohm, K. (2018). Factors influencing pre-hospital care time intervals in Iran: a qualitative study. *Journal of injury and violence research*, *10*(2), 83. *doi: 10.5249/jivr.v10i2.953*
28. Kironji, A. G., Hodkinson, P., De Ramirez, S. S., Anest, T., Wallis, L., Razzak, J., ... & Hansoti, B. (2018). Identifying barriers for out of hospital emergency care in low and low-middle income countries: a systematic review. *BMC health services research*, *18*, 1-20.
29. Krafft, T., Castrillo-Riesgo, L. G., Edwards, S., Fischer, M., Overton, J., Robertson-Steel, I., & König, A. (2003). European emergency data project (EED Project) EMS data-based health surveillance system. *The European Journal of Public Health*, *13*(suppl_1), 85-90.
30. Krüger, A. J., Lossius, H. M., Mikkelsen, S., Kurola, J., Castrén, M., & Skogvoll, E. (2013). Pre-hospital critical care by anaesthesiologist-staffed pre-hospital services in S candinavia: a prospective population-based study. *Acta Anaesthesiologica Scandinavica*, *57*(9), 1175-1185.
31. McMullan, J. T., & Veser, F. H. (2004). Emergency department volume and acuity as factors in patients leaving without treatment. *Southern medical journal*, *97*(8), 729-734.
32. Miles J, Jacques R, Campbell R, Turner J, Mason S (2022) The Safety INdEx of Prehospital On Scene Triage (SINEPOST) study: The development and validation of a risk prediction model to support ambulance clinical transport decisions on-scene. PLoS ONE 17(11): e0276515. https://doi.org/10.1371/journal.pone.0276515
33. Newgard, C. D., Nelson, M. J., Kampp, M., Saha, S., Zive, D., Schmidt, T., ... & Hedges, J. R. (2011). Out-of-hospital decision making and factors influencing the regional distribution of injured patients in a trauma system. The Journal of Trauma and Acute Care Surgery, 70(6), 1345-1353.
34. Newgard, C. D., Schmicker, R. H., Hedges, J. R., Trickett, J. P., Davis, D. P., Bulger, E. M., ... & Resuscitation Outcomes Consortium Investigators. (2010). Emergency medical services intervals and survival in trauma: assessment of the "golden hour" in a North American prospective cohort. *Annals of emergency medicine*, *55*(3), 235-246.
35. Nilsson, C., Bremer, A., Blomberg, K., & Svantesson, M. (2017). Responsibility and compassion in prehospital support to survivors of suicide victim–Professionals' experiences. *International emergency nursing*, *35*, 37-42.
36. Oosterwold, J., Sagel, D., Berben, S., Roodbol, P., & Broekhuis, M. (2018). Factors influencing the decision to convey or not to convey elderly people to the emergency department after emergency ambulance attendance: a systematic mixed studies review. *BMJ open*, *8*(8), e021732. . doi:10.1136/bmjopen-2018-021732
37. Østerås, Ø., Heltne, J. K., Vikenes, B. C., Assmus, J., & Brattebø, G. (2017). Factors influencing on-scene time in a rural Norwegian helicopter emergency medical service: a retrospective observational study. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *25*, 1-11. DOI 10.1186/s13049-017-0442-5
38. Puolakka, T., Kuisma, M., Länkimäki, S., Puolakka, J., Hallikainen, J., Rantanen, K., &

Lindsberg, P. J. (2016). Cutting the prehospital on-scene time of stroke thrombolysis in Helsinki: a prospective interventional study. *Stroke*, *47*(12), 3038-3040. DOI: 10.1161/STROKEAHA.116.014531

39. Safi-Keykaleh, M., Khorasani-Zavareh, D., & Bohm, K. (2020). Factors affecting Emergency Medical technicians' On-Scene decision-making in emergency situations: a qualitative study. *Frontiers in Emergency Medicine*, *4*(4), e88-e88. DOI: 10.22114/ajem.v0i0.341
40. Sampalis, J. S., Lavoie, A., Williams, J. I., Mulder, D. S., & Kalina, M. (1993). Impact of on-site care, prehospital time, and level of in-hospital care on survival in severely injured patients. *Journal of Trauma and Acute Care Surgery*, *34*(2), 252-261.
41. Setyarini, A., & Windarwati, H. D. (2020). Influence Factors of Emergency Medical Services (EMS) Prehospital Time Interval Variety: A Systematic Review. *Jurnal Ners*, *15*(2), 51-440. http://dx.doi.org/10.20473/jn.v15i2.19786
42. Simonsen, S. A., Andresen, M., Michelsen, L., Viereck, S., Lippert, F. K., & Iversen, H. K. (2014). Evaluation of pre-hospital transport time of stroke patients to thrombolytic treatment. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *22*, 1-5.
43. Svensson, A., Nilsson, B., Lantz, E., Bremer, A., Arestedt, K., & Israelsson, J. (2024). Response times in rural areas for emergency medical services, fire and rescue services and voluntary first responders during out-of-hospital cardiac arrests. Resuscitation Plus, 17, 100548. https://doi.org/10.1016/j.resplu.2023.100548
44. van de Glind, I., Berben, S., Zeegers, F., Poppen, H., Hoogeveen, M., Bolt, I., ... & Vloet, L. (2016). A national research agenda for pre-hospital emergency medical services in the Netherlands: a Delphi-study. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *24*, 1-9.
45. Vincent-Lambert, C., & Mottershaw, T. (2018). Views of emergency care providers about factors that extend on-scene time intervals. *African journal of emergency medicine*, *8*(1), 1-5.
46. Vincent-Lambert, C., & Mottershaw, T. (2018). Views of emergency care providers about factors that extend on-scene time intervals. *African journal of emergency medicine*, *8*(1), 1-5. http://dx.doi.org/10.1016/j.afjem.2017.08.003
47. Wyen, H., Lefering, R., Maegele, M., Brockamp, T., Wafaisade, A., Wutzler, S., ... & TraumaRegister DGU. (2013). The golden hour of shock–how time is running out: prehospital time intervals in Germany—a multivariate analysis of 15, 103 patients from the TraumaRegister DGU®. *Emergency Medicine Journal*, *30*(12), 1048-1055.
48. Ziad Nehme BHlthSc(Hons), Emily Andrew BBSc & Karen Smith BSc, PhD (2016): Factors Influencing the Timeliness of Emergency Medical Service Response to Time Critical Emergencies, Prehospital Emergency Care, DOI: 10.3109/10903127.2016.1164776.