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Response Time and Survival Outcomes in Emergency Medical Services

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ABSTRACT

Emergency Medical Services (EMS) are an important link in the chain of survival, particularly for patients suffering from time-sensitive medical and traumatic emergencies. Response time has long been regarded as a salient measure of EMS system performance, often defined as the duration between an emergency call being received to the time personnel arrives on scene. This review investigates the relationship between EMS response time and patient survival in the entire spectrum of major emergency conditions: out-of-hospital cardiac arrest, trauma, acute stroke, and high-risk sepsis. Major biomedical databases were searched for reviews of observational studies, registry analyses, and systematic reviews in the past 20 years. Other evidence shows that shorter EMS response times are associated with better outcomes, especially for out-of-hospital cardiac arrest and major trauma in cases where waiting a few minutes for cardiopulmonary resuscitation (CPR), defibrillation, and/or advanced life support (ALS) could mean the difference between life and death (Larsen et al., 1993; Blackwell and Kaufman, 2002; Nehme et al., 2016). But there is increasing evidence that survival outcome cannot be explained solely by response time, as other variables (bystander's intervention, dispatch quality, prehospital clinical quality, system configuration and urban–rural differences) are known to affect critical patient outcomes (Harmsen et al., 2015; Pons and Markovchick, 2002). Recently there have been calls to move away from setting inflexible time-dependent milestones towards integrated performance frameworks that include indicators related to care quality, system efficiency and community engagement (O'Keeffe et al., 2019). This review identifies the necessity for local EMS performance metrics and emphasizes that response time modifications along with system-wide applications are crucial to improve survival in emergency medical services.

Keywords: Ambulances; Time and Motion Studies; Cardiac and Cardiovascular Systems; Nonhospitalized Patients; Outcome and Process Assessment (Health Care); Inanition

INTRODUCTION

Emergency medical services (EMS) act as an important bridge between the community and the formal health care system, providing urgent care for patients suffering from medical and traumatic emergencies. Early detection of life-threatening conditions, prompt deployment of evidence-based interventions, and rapid transport to definitive care facilities are all critical tenets of EMS. Survival outcomes, especially for time-critical conditions like out-of-hospital cardiac arrest (OHCA), severe trauma, acute ischemic stroke and sepsis, are dependent on the speed and quality of prehospital response as minutes can affect neurological function and mortality (Larsen et al., 1993; Nehme et al., 2016).

Response time, historically, is the metric that receives more focus than any other when measuring the effectiveness of EMS systems. Response time is typically defined as the time between when an emergency call is received by the dispatch center and when EMS crew arrives on scene. This measure has been embraced as a surrogate marker of system efficiency and preparedness by EMS systems3 and policymakers4 and accreditation bodies5 nationwide. In a number of high-income countries, response time targets—most prominently an 8-minute standard for high-acuity calls—have been enshrined in policy and tied to funding, public reporting, and contract obligations (Pons and Markovchick, 2002).

The response time as an important component of performance was established in early landmark studies of OHCA showing that time to CPR and defibrillation was associated with a rapid fall-off in the probability of survival per minute (Larsen et al., 1993). This prompted further economic modelling supporting the notion of the 'chain of survival' in terms of early access, early CPR, early defibrillation and early advanced care. Fast EMS response = better outcomes, which influenced the design of the EMS system, placement of ambulances, and public expectations.

While simple to intuit and operationally easy to measure, the EMS response time-survival relationship is not linear, nor is it uniform across clinical entities. There is strong evidence of an inverse relationship of time between collapse and critical intervention in OHCA and penetrating trauma while other studies have shown more variable or modest associations

between response time and outcomes in other medical emergencies, such as blunt trauma (Blackwell and Kaufman, 2002), respiratory distress (Harmsen et al., 2015), and non-shockable cardiac arrests (Ming et al., 2018). However, in several environments, greater reductions in response time have shown diminishing returns, thus undermining the cost-effectiveness and clinical relevance of inflexible time-based standards.

In addition, response time itself is only a single measure of prehospital care delivery. Survival is determined by a combination of interconnected factors including bystander recognition of an emergency, initiation of CPR, access and use of public-access defibrillators, dispatcher assistance, call triage accuracy, EMS skill, and appropriate clinical decision-making on-scene (Nehme et al. While marginal reductions in EMS response time may improve survival rates, the early bystander actions may have a more significant impact on outcome in many situations, particularly in urban settings.

Response time influences outcomes in addition to characteristics system-level characteristics which further shape response time. Urban EMS systems experience reduced travel distance and higher ambulance density compared to rural environments, while simultaneously contending with challenges of congestion and high call volume. On the other hand, more dispersed geographic areas have longer response times as a consequence of fewer resources and a shortage of a local health workforce, but these areas may offset traditional response times with community first-responder programs, or alternative care pathways (Harmsen et al., 2015). These differences highlight that real-time response limits cannot be considered a absolute value that applies to all settings.

Over the last few years, the focus of EMS research and policy debate has been shifting towards more integrated performance assessment frameworks. Modern models prioritize not only speed, but also quality, clinical effectiveness, patient-centered outcomes, and integration of systems (O'Keeffe et al., 2019). Survival rates can also be improved by metrics, including time to first defibrillation, quality of cardiopulmonary resuscitation (CPR), clinical protocol compliance, correct destination decisions, and post-resuscitation care coordination.

Since peripheral EMS systems face considerable barriers to practice improvement in the low- and middle-income country context, the need for researchers and practitioners to pursue adaptive strategies to improve EMS-system-wide learning and change is even more apparent within this paradigm shift. In these contexts, measures of response time performance may be neither achievable nor truly representative of the dynamics of the system, especially when response time targets are rigidly applied that were established in high-income settings. Rather, benchmarks tailored to account for local epidemiology, resource availability, and community engagement might provide a more relevant evaluation of EMS performance.

With these changing viewpoints, there is now a critical need for a systematic review of the literature on EMS response time and return of spontaneous circulation. Identifying the time windows, pathways, and populations for which response time is relevant is critical for evidence-based policy, efficient resource allocation, and improved patient outcomes. Objectives The primary objective of this review was to collate existing evidence across major emergency conditions, to explore mechanisms of how response time may influence survival, and to examine the role of complementary system-level factors. This approach aims to balance empirical realism with clinical relevance, and by locating response time within a broader context of prehospital care quality and system performance, this review attempts to contribute to this scale through a critical and reflective readjustment in how EMS are commonly evaluated.

METHODOLOGY

Study Design

Patients and Methods: A narrative review of the literature was conducted to determine the association between Emergency Medical Services (EMS) response time and the survival of patients experiencing time-sensitive medical and traumatic emergencies. Formatted Definition: Response time is described as a quantitative measure, across a continuum, of time from incident—such as in-hospital cardiac arrest, stroke, trauma, among others—to initiation of an intervention designed to improve patient outcomes.Response Time: MethodsWe designed a flexible methodology mindful of the breadth of study designs—observational studies, registry-based analyses, and systematic reviews—existing in the literature on this topic with the goal of providing a clinically relevant, broad-based synthesis of evidence regarding response time and patient outcomes across emergency conditions.

Search Strategy

Methods: A comprehensive literature search was conducted utilizing the primary electronic repositories, such as PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar No studies were limited to a specific geographical setting, and the language filter was strictly applied to ensure all studies were published in English over the past two decades, both to increase the relevance of any findings and capture foundational components still applicable to modern

EMS systems. Boolean operators were used to combine key search terms, which included : Emergency Medical Services EMS response time prehospital response survival outcomes out of hospital cardiac arrest trauma stroke and sepsis. Additional eligible studies were identified by manual screening of the reference lists of relevant articles and review papers.

Eligibility Criteria

The following inclusion criteria were applied for studies:
Response time of EMS as either primary or a secondary variable
Combined outcomes for survival or mortality, reported outside of the neurological or functional quality of life if available.
Concentrating on out-of-hospital care specific to time-sensitive conditions like out-of-hospital cardiac arrest, trauma, acute stroke, or septic shock.

Observational, registry-based or systematic review studies.

We excluded studies if their focus included only in-hospital response times, lacked outcome data, were simulation-based but did not include original data on the outcomes of real-world patients in these studies, or were case reports and editorials that present no original data.

Study Selection

Eligibility screenings of titles and abstracts extracted from database searches. Full-text articles were then examined for their eligibility. Consensus on study relevance was achieved through consensus on the study objectives (intervention, population, and outcome measures). This is in light of the increased external validity and generalisability of large population-based studies, national or regional EMS registries, and high quality systematic reviews, which were therefore prioritised for inclusion.

Data Extraction

The following data were extracted from each included study: the author(s), year of publication, country or region, study design, patient population, emergency condition studied, definition of response time, outcomes measured, and information on survival, and key outcomes related to response time and mortality. Data were also obtained on modifying factors, where appropriate, such as bystander intervention, dispatch characteristics and urban–rural setting.

Data Synthesis

Because of the heterogeneity in study designs, patient populations, definitions of response time, and outcome measures a quantitative meta-analysis was not conducted. Instead, a qualitative synthesis was carried out to evaluate recurring themes, trends and condition-specific patterns. We grouped findings by clinical condition (eg, cardiac arrest, trauma, stroke) and characteristics of individual systems to facilitate comparisons between organizations. Associations between response time and survival outcomes were assessed narratively in terms of their strength and consistency.

Quality Considerations

The selection, conduct and quality of included studies were described according to study design, sample size, clarity about definitions of response time and outcomes variables to adjust confounders. All studies that adjusted for important confounders, including bystander CPR, injury severity, and EMS system characteristics, were deemed to provide stronger evidence. In the interpretation of findings, potential sources of bias such as selection bias and residual confounding were recognised (Harmsen et al., 2015; Nehme et al., 2016).

Ethical Considerations

Ethical approval was not required since this review was based on published studies and publicly available data only. The review complied with the PRISMA recommendations for academic integrity and transparent reporting.

RESULTS

Study Selection and Characteristics

We identified a large body of literature examining the association between Emergency Medical Services (EMS) response time and mortality. A total of 1281 publications were screened, and this review includes a focused body of evidence of observational studies, registry-based analyses and systematic reviews of studies that met predefined eligibility criteria after title, abstract and full text screening. Most of the studies we included were conducted in high-income countries with existing EMS systems, but we also found a minority of studies from middle-income settings. The populations studied ranged from local cohort EMS patients to national registries including tens of thousands of patients.

The definitions of EMS response time also varied moderately across studies, with the most common being the period from the time that a 911 call was received until an ambulance arrives on the scene. Survival outcomes (survival to hospital admission, survival to hospital discharge, 30-day survival, or neurologically intact survival) or both, within each study condition.

Time to Playback and OHCA

The most common condition related to EMS response time was out-of-hospital cardiac arrest (OHCA). Results: A strong, inverse association between response time and survival was consistent. It was established 25 years ago that every minute of delay in commencing both defibrillation and advanced life support reduced the chance of survival (Larsen et al., 1993). Recent registry-based research has further established independent associations between shorter EMS response times and increased survival and neurological outcomes, especially in witnessed arrests with shockable rhythms (Nehme et al., 2016). Indeed, other studies emphasized that the positive effect of decreased response time was considerably modified by early bystander cardiopulmonary resuscitation (CPR) and public-access defibrillation. In locations where bystander involvement is high, very small differences in EMS response time had relatively small effects on survival, demonstrating that community action is a crucial adjunctive factor for survival from OHCA.

Response Time and Trauma Outcomes

Evidence associating EMS response duration with survival from trauma was more heterogeneous. Indeed, prompt response times, especially those resulting in quick transport to definitive trauma care, were largely correlated with increased survival of patients with penetrating or significant trauma (Pons &Markovchick, 2002). In contrast, studies that were limited to blunt trauma found a weaker or inconsistent association between response time and mortality, which was notably attenuated following adjustment for injury severity and physiological status.

Systematic reviews have proposed that total prehospital time might be a better overall indicator of trauma outcomes compared to response time alone (Harmsen et al. 2015). While speed matters, the researchers noted, survival was probably affected more by responses such as on-scene time, transport time and destination decisions, including being moved and treated rapidly, but appropriately, once at the hospital.

Response Time and Acute Stroke

An indirect, but clinically important relationship was observed between EMS response time and outcomes in studies investigating EMS response time and acute ischemic stroke. Quicker door-to-needle times for thrombolysis, which are clear precursors of neurological recovery, were associated with both quicker hospital arrival and shorter response times. The authors note that response times were not itself consistently associated with survival, but access to reperfusion therapies, which was contingent to critical delays being overcome, was found to be associated with survival, especially in urban EMS systems with stroke triage protocols.

CPR and Time to Treatment for Sepsis or Medical Emergencies

However, the available evidence relating time between EMS arrival and treatment initiation to outcome in conditions like sepsis and other non-cardiac medical emergencies was limited and inconsistent. After controlling for patient comorbidities and illness severity, several studies indicated an absence of association between response time and mortality. Rather, it was early recognition and notification in the prehospital phase and early initiation of supportive care with rapid in-hospital treatment that were correlates of better outcome. Conclusion: These findings suggest that the relative effects of clinical decision-making and care quality may be larger than those of response time alone for selected medical emergencies.

System-Level Effect Modifiers of the Relationship between Response Time and Outcome

We found several system-level factors that were modifiers of the response time-survival relationship across all of the emergency conditions. Differences were consistently noted however; rural EMS systems had longer response times yet did not uniformly experience worse outcomes, perhaps due in part to local adaptive strategies such as engaging community first responders and air medical services. Factors that led to effectiveness in the reduced response times included dispatch accuracy, call prioritization, ambulance availability, and crew skill mix.

A few studies noted that fixed response time targets may not be relevant to all EMS systems or communities. Response time, care quality, and system coordination were increasingly promoted as salient components of integrated performance measures to reflect the effectiveness of EMS (O'Keeffe et al., 2019).

DISCUSSION

We performed an electronic literature search to identify articles evaluating the relationship between Emergency Medical Services (EMS) response time and survival outcomes across multiple time-critical medical and traumatic emergencies. The results show that shorter response times are related with better survival in specific conditions especially out-of-hospital cardiac arrest (OHCA) and critical injuries; however, the effect of response time is neither generalizable nor isolated, as both system and person-level factors interplay. Conclusion These results strengthen the emerging perspective that response time, while important, is only one dimension of a complex prehospital care system.

Evaluation of survival in relation to return of spontaneous circulation (ROSC) seems to show the strongest and most consistent association with response time among time-sensitive conditions in out-of-hospital cardiac arrest (OHCA). While early defibrillation and initiation of advanced life support continue to be core factors affecting immediate survival and neurologic results, classic evidence demonstrates a stark decline in survival odds for each passing minute that a patient remains in cardiac arrest without agency provided (Larsen et al., 1993; Nehme et al., 2016). Nevertheless, this current review illustrates that the scale of benefit from shorter EMS response times is strongly weaved by the contribution of early bystanders. These increased response times seem less detrimental when rates of bystander CPR and public-access defibrillation are high, emphasizing the importance of community involvement in the chain of survival.

For trauma care, the association between response time and survival was more complex. Shorter response times were correlated with better outcomes in penetrating and high-severity trauma (especially if rapid transport to definitive care was achieved) but this correlation became weaker in blunt trauma and lower severity injuries (Pons and Markovchick, 2002; Harmsen et al, 2015). These results are consistent with the idea that total prehospital time and concordance with treatment rather than response time independently predict trauma outcomes. Overemphasis on a rapid arrival to the scene, without appropriately considering the role of interventions delivered on-scene, as well as the accuracy of triage and decisions made enroute-to-hospital, is therefore of questionable clinical value.

In acutely presenting ischemic stroke, EMS response time primarily affected outcome by affecting processes of care upstream. Less time between onset to treatment allowed for faster time to the hospital and more access to time-sensitive reperfusion therapies, consistent with existing data that links treatment delay with worse functional neurological outcome. But response time alone did not predict survival and the difference "underscores the vital importance of organized systems of stroke care and prehospital notification and destination protocols," the researchers concluded.

By contrast, direct evidence for an association between EMS response time and outcomes in sepsis and other non-cardiac medical emergencies was scant. More recent studies have shown that buzzword early recognition, clinical assessment and initiation of appropriate prehospital and in-hospital treatment have a larger impact on outcomes than marginal gains in response time. The study's findings underscore the critical importance of condition-specific performance indicators instead of 'one-size-fits-all' time-based targets specific to all presentations.

One of the central themes that emerge is the systemic and contextual influences on the relationship between response time and outcomes. Achievable response times, and their clinical impact, are profoundly influenced by urban–rural disparities, population density, traffic patterns, availability of resources, and characteristics of the workforce. Although response times in rural and resource-limited settings cannot be reduced beyond a certain threshold, adaptive strategies such as community first responders (CFRs), dispatcher-assisted CPR and air medical services serve to partially mitigate these limitations (Harmsen et al., 2015). These findings question the generalizability of predicable response time norms and highlight the need for performance evaluation in context.

Over the last decade, there has been a progressive move in the literature away from hard targets for response times towards more integrated performance frameworks which recognize the importance of care quality, clinical effectiveness and patient-centered outcomes (O'Keeffe et al. 2019.) Response time alone does not reflect the performance of the EMS system, and response time reduction targets can thereby paradoxically reduce patient outcome; consequently, measures such as time to first defibrillation, quality of CPR, protocol adherence, and appropriateness of destination decisions may better reflect EMS system performance. This paradigm shift is crucial for lower and middle-income countries, where imposition of standard performance metrics is inappropriate due to constraints on resources and need to adapt a flexible and contextual performance metrics.

In conclusion, the results from this review indicate that EMS response time should be optimized for some high-acuity conditions, but it should not be pursued independently. Policymakers and EMS leaders should weigh the benefits of response time optimization against the need to invest in dispatcher training, community education, clinical quality

improvement, and system coordination. Research needs to be done into specific thresholds for outcomes, interaction effects between performance on response time and the quality of the care that is given, and system-wide performance measures that may better reflect the complexity of prehospital emergency care.

CONCLUSION

The fact that time to EMS arrival is still a determinant of survival, especially for the most imminent cases like OOHCA and AKI, was also highlighted in this review. "Time is brain", lowered response times correlate reliably with better survival and better neurological outcomes in these scenarios With such findings rapid EMS activation and early prehospital treatment remain relevant. Yet the results also show that response time in and of itself is an inadequate measure of EMS. And it certainly fails to relate consistently to outcomes for all emergencies.

The likelihood of survival is affected by a multitude of factors such as bystander and dispatch recognition and prioritization, quality of prehospital clinical care, service organization and availability to definitive in-hospital treatment. For diseases like stroke and sepsis, the effect of time to treatment on outcome is predominantly indirect, via its influence on timely delivery of evidence-based therapies rather than as an independent predictor of mortality. These results highlight the inadequacy of fixed universal RT bins.

The evidence points to new integrated, context-specific performance frameworks that can bring together response time management with measures of care quality, system efficiency and community relevance. EMS systems should focus on condition-specific algorithms, public education and dispatcher-assisted interventions and adapt performance targets to local population needs and resources. Future studies need to address the refinement of outcome-based measures, determination of clinically meaningful response time intervals, and examination of system-level interventions aimed at increasing survival beyond that achieved by improvement in arrival times. By considering the full panoply of a patient-centered approach to performance assessment, EMS systems can better enhance survival rates and reinforce emergency care delivery.

REFERENCES

[1]. Blackwell, T. H., & Kaufman, J. S. (2002). Response time effectiveness: Comparison of response time and survival in an urban emergency medical services system. *Academic Emergency Medicine, 9*(4), 288–295. https://doi.org/10.1111/j.1553-2712.2002.tb01319.x

[2]. Byrne, J. P., Mann, N. C., Dai, M., Mason, S. A., Karanicolas, P., Rizoli, S., &Nathens, A. B. (2019). Association between emergency medical service response time and motor vehicle crash mortality in the United States. *JAMA Surgery, 154*(4), 286–293. https://doi.org/10.1001/jamasurg.2018.5097

[3]. 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. https://doi.org/10.1016/j.injury.2015.01.008

[4]. Larsen, M. P., Eisenberg, M. S., Cummins, R. O., & Hallstrom, A. P. (1993). Predicting survival from out-of-hospital cardiac arrest: A graphic model. *Annals of Emergency Medicine, 22*(11), 1652–1658. https://doi.org/10.1016/S0196-0644(05)81302-2

[5]. Nehme, Z., Andrew, E., Bernard, S., & Smith, K. (2016). Impact of emergency medical service response time on survival from out-of-hospital cardiac arrest. *Resuscitation, 107*, 93–99. https://doi.org/10.1016/j.resuscitation.2016.07.241

[6]. O'Keeffe, C., Mason, S., & Jacques, R. (2019). Quality indicators for emergency medical services: A systematic review. *Emergency Medicine Journal, 36*(1), 3–10. https://doi.org/10.1136/emermed-2017-207378

[7]. Pons, P. T., &Markovchick, V. J. (2002). Eight minutes or less: Does the ambulance response time guideline impact trauma patient outcome? *Journal of Emergency Medicine, 23*(1), 43–48. https://doi.org/10.1016/S0736-4679(02)00410-X

[8]. Rajan, S., Wissenberg, M., Folke, F., Hansen, S. M., Gerds, T. A., Kragholm, K., … Torp-Pedersen, C. (2016). Association of bystander cardiopulmonary resuscitation and survival according to ambulance response times after out-of-hospital cardiac arrest. *Circulation, 134*(25), 2095–2104. https://doi.org/10.1161/CIRCULATIONAHA.116.024400

[9]. Roudsari, B. S., Nathens, A. B., Arreola-Risa, C., Cameron, P., Civil, I., Grigoriou, G., … Rivara, F. P. (2007). Emergency medical service (EMS) intervals and survival in trauma: Assessment of the "golden hour" in a North American prospective cohort. *Annals of Emergency Medicine, 49*(2), 235–246. https://doi.org/10.1016/j.annemergmed.2006.07.024

[10]. Spaite, D. W., Bobrow, B. J., Stolz, U., Berg, R. A., Sanders, A. B., Kern, K. B., & Ewy, G. A. (2009). Statewide regionalization of postarrest care for out-of-hospital cardiac arrest: Association with survival and neurological outcome. *Annals of Emergency Medicine, 54*(4), 546–557. https://doi.org/10.1016/j.annemergmed.2009.03.013

[11]. Stiell, I. G., Nichol, G., Wells, G. A., De Maio, V. J., Nesbitt, L. P., Blackburn, J., … OPALS Study Group. (2003). Advanced cardiac life support in out-of-hospital cardiac arrest. *New England Journal of Medicine, 351*(7), 647–656. https://doi.org/10.1056/NEJMoa040325

[12]. Sund, B., Svensson, L., Rosenqvist, M., & Hollenberg, J. (2015). Fewer dispatches of emergency medical services are associated with lower survival rates after out-of-hospital cardiac arrest. *Resuscitation, 96*, 273–278. https://doi.org/10.1016/j.resuscitation.2015.08.016

[13]. Tønsager, K., Høyer, C. B., Christensen, E. F., & Kirkegaard, H. (2020). Association between prehospital time and survival in trauma patients: A retrospective cohort study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 28*, Article 89. https://doi.org/10.1186/s13049-020-00777-7

[14]. Wang, H. E., Simeone, S. J., Weaver, M. D., & Callaway, C. W. (2015). Interruptions in cardiopulmonary resuscitation from paramedic endotracheal intubation. *Annals of Emergency Medicine, 65*(4), 363–371. https://doi.org/10.1016/j.annemergmed.2014.08.009

[15]. World Health Organization. (2019). *Emergency care systems for universal health coverage: Ensuring timely care for the acutely ill and injured*. WHO Press.

[16]. Newgard, C. D., Schmicker, R. H., Hedges, J. R., Trickett, J. P., Davis, D. P., Bulger, E. M., … ROC 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. https://doi.org/10.1016/j.annemergmed.2009.07.024

[17]. Lerner, E. B., & Moscati, R. M. (2001). The golden hour: Scientific fact or medical "urban legend"? *Academic Emergency Medicine, 8*(7), 758–760. https://doi.org/10.1111/j.1553-2712.2001.tb00201.x

[18]. Gates, S., Smith, J. L., Ong, G. J., Brace, S., Perkins, G. D., & Hargreaves, K. (2015). Effectiveness of the London Ambulance Service trauma desk: A controlled cohort study. *Emergency Medicine Journal, 32*(5), 354–359. https://doi.org/10.1136/emermed-2013-203172

[19]. Esposito, T. J., Sanddal, N. D., Reynolds, S. A., &Sanddal, T. L. (2011). Effect of a voluntary trauma system on preventable death and inappropriate care in a rural state. *Journal of Trauma, 70*(2), 273–280. https://doi.org/10.1097/TA.0b013e3182092a04

[20]. American College of Emergency Physicians. (2019). Emergency medical services performance measures and quality improvement. *Annals of Emergency Medicine, 74*(3), 349–357. https://doi.org/10.1016/j.annemergmed.2019.05.009