

# Evaluating the impact of the time taken to reach the injured on the outcomes of emergency cases, a study on Red Crescent operations

Salman Hussain Adi Aldayhani<sup>1</sup>, Shabib Mohammed Mutlaq Almutairi<sup>2</sup>, Ali Nidaa Zayed Almutairi<sup>3</sup>, Rashed Ali Rashed Almutairi<sup>4</sup>, Mohammed Abdullah khalifah Alanazi<sup>5</sup>, Naiyf Faiyz Rfaidan Almutairi<sup>6</sup>, Bandar Malfi A Aldhafeeri<sup>7</sup>, Turki Saad M Almutairi<sup>8</sup>, Fahad Abdullah Abdulaziz Alammam<sup>9</sup>, Sultan Ali F Almutairi<sup>10</sup>, Khalid Ali H Alanazi<sup>11</sup>, Abdulrahman turki Shutaywi Alanazi<sup>12</sup>, Mohammad Faleh H Alharbi<sup>13</sup>, Abdullah Hamad Saeed Almuqati<sup>14</sup>

1. *Emergency Medical services, Haill / Turba Center*
2. *Emergency Medical services, Eastern Region / Alrafiah Center*
3. *Emergency Medical services, Eastern Region / Alrafiah Center*
4. *Emergency Medical services, Eastern Region / Alsasar Center*
5. *Emergency Medical services, Eastern Region / abu hadriyah Center*
6. *Emergency Medical services, Eastern Region / samoudah Center*
7. *Emergency Medical services, Eastern Region / Alsairah Center*
8. *Emergency Medical services, Eastern Region / Alnairyah Center*
9. *Emergency Medical services, Eastern Region / Alnairyah Center*
10. *Emergency Medical services, Eastern Region / hafar albatin Center*
11. *Emergency Medical services, Eastern Region / Judah Center*
12. *Emergency Medical services, Eastern Region / hafar albatin Center*
13. *Emergency Medical services, Eastern Region / West Dammam Center*
14. *Emergency Medical services, Eastern Region / Alsairah Center*

## Abstract

Response time in emergency medical services is critical to determining the outcomes of emergencies, especially in life-threatening situations. This study evaluates the impact of the time it takes to reach injured individuals on patient survival rates, recovery outcomes, and the overall efficiency of EMS operations. Focusing on Red Crescent operations, this research examines the various factors that influence response time, including geographic location, traffic conditions, resource availability, and communication systems. Using data from recent Red Crescent operations, the study results reveal associations between response times and patient outcomes, and highlight critical thresholds where delays lead to detrimental effects. The study also explores the challenges EMS personnel face in reducing response times and provides recommendations for improving logistics, resource allocation, and technology integration to enhance rapid response. The findings underscore the need for rapid interventions to improve survival rates and recovery times, underscoring the essential role of EMS efficiency in public health and safety.

Keywords:

---

## Introduction:

Civil defense services are considered an important and necessary service for every citizen. They are a safety valve and a protective shield that protects the lives and properties of citizens and residents from the dangers of fire and rescue accidents and from the dangers of disasters and wars.

Therefore, it is a requirement that the government of this wise country seeks to provide to the citizen wherever he is in the city, village or migration. The General Directorate of Civil Defense has sought, in accordance with the directives of the rulers, to develop five-year plans to meet the citizens' need for civil defense services and to work on expanding the spread of civil defense services to include all regions of the Kingdom [1].

The effective response of emergency medical services in casualty incidents calls for sufficient preparation. Response time is a key element of EMS because the very nature of medical emergencies implies that they must be treated urgently. Response time measures the time frame from the moment an emergency call is made to the moment an equipped vehicle arrives on the scene and can be divided into 3 subsections [2]: call time (from the moment the call is taken by a handler to the moment the alert is raised), gathering time (from the moment the alert is sent out to the moment a medical team is dispatched), and road time (from dispatch to arrival on the scene).

Emergency Medical Services (EMS) agencies are increasingly being held to an ambulance response time (RT) criterion of responding to a medical emergency within 8 min for at least 90% of calls. This recommendation resulted from one study of outcome after nontraumatic cardiac arrest and has never been studied for any other emergency [3].

In emergency situations, time becomes a critical factor that separates life from death. The success of emergency response depends largely on the speed of reaching the injured and providing them with the necessary first aid in a timely manner. The speed of response of emergency teams, such as the Red Crescent teams, is an essential factor in improving the chances of survival and reducing the health complications that the injured may suffer from. In such cases, precious seconds are the real difference between saving and losing a life [4].

This study aims to evaluate the impact of the time taken to reach the injured on the outcomes of emergency cases, by studying the Red Crescent operations and analyzing the effectiveness of the response of the ambulance teams in saving lives and reducing health complications for the injured. The study seeks to understand the factors that affect the speed of response, such as geographical distance, the state of the infrastructure, and the technologies used, in addition to identifying ways to enhance performance through recommendations aimed at improving the efficiency of emergency operations and ensuring the provision of effective health care in a timely manner.

## **Literature review**

The time it takes to reach injured people in emergency cases is a critical factor in saving lives and improving emergency healthcare results [5]. This concept is known as "response time" or "arrival time," and it reflects the time it takes emergency teams from the moment they receive a report until they arrive at the scene and provide initial care to the injured. The effectiveness of emergency response is influenced by several factors related to infrastructure, geography, and technology, as well as the readiness, qualifications, and training of emergency teams [6].

## **Factors affecting response time**

1. Geographical distance and infrastructure: The geographical distance from the nearest ambulance point is one of the most important factors, in addition to the efficiency and congestion of roads and transportation, as remote areas and areas with weak infrastructure suffer from slow response, which negatively affects the results of emergency cases.

2. Availability of resources and equipment: This factor includes the availability of equipped ambulances and the necessary medical equipment in each vehicle, as any shortage may lead to delayed arrival or insufficient services provided.
3. Human efficiency: The experience, skill and training of Red Crescent workers play a fundamental role in rapid and effective response, as well-trained emergency teams can deal with complex situations and make quick decisions that save lives [7].

### **Impact of response time on patient outcomes**

The quality of prehospital care impacts hospital outcomes and patient outcomes. Emergency health services are the first responders for many patients who end up in the hospital. They are trained to use a range of important practical skills that can help patients in the field and reduce response time. Research shows that the speed at which emergency medical teams arrive directly impacts survival rates. Critical injuries such as heart attacks and strokes can deteriorate rapidly if the patient does not receive timely care. A short response time increases the chances of providing the necessary care to patients and preventing deterioration [8]. Patients who suffer cardiac arrest outside medical facilities are at greater risk of death and adverse medical outcomes. Cardiopulmonary resuscitation affects the survival rates of such patients, which suggests that response time may be vital to patient outcomes [9].

Providing an effective and efficient service is the primary goal of EMS agencies (Saudi Red Crescent). Reducing response time may increase medical effectiveness but will reduce efficiency due to the need for additional available resources, as well as the increased cost of providing the service. From a service delivery perspective as well as public relations with patients, patient and customer satisfaction improves with shorter call response times. However, justification for specific time standards for specific medical or traumatic emergencies is lacking [9].

Longer median response times to EMS calls in rural areas compared to urban EMS calls were associated with poorer outcomes [10]. In one study, patients with longer response times within any type of community had poorer outcomes. Some studies have not found a significant association between response time and outcomes [11]. One study examined the validity of the gold standard for EMS calls of 8 minutes or less and found no better outcomes when within that time frame [12].

### **Response time as a function of response accuracy**

Response times are natural and evident kinds of data to investigate processes [13]. Response time is usually considered the independent variable of response accuracy and not vice versa. However, there are some studies that show how the type of incorrect response is an indicator of response time and underlying processes. For example, Novikov et al [14] hypothesized based on studies that errors either stem from a lack of cognitive control (which is considered premature responses) and would lead to short response times (error speed) or from attentional lapses and uncertainty.

## Results

1. **Response Time's Critical Role in Patient Outcomes:** The data confirmed that shorter response times are correlated with improved patient outcomes, particularly for critical cases such as cardiac arrests and strokes. Patients reached within the "gold standard" time frame had higher survival rates and fewer complications, reinforcing the life-saving value of a rapid EMS response.
2. **Influence of Geographical and Infrastructure Factors:** The analysis showed that areas with well-maintained infrastructure and shorter geographical distances to emergency points had notably faster response times, benefiting patient outcomes. Conversely, rural and remote areas faced longer response times due to transportation limitations and greater distances, leading to poorer emergency outcomes.
3. **Technological and Resource Impact:** The availability of real-time navigation systems, adequate medical equipment, and well-prepared ambulance units was shown to significantly improve response times. Facilities with advanced resources responded more quickly and provided better prehospital care, which positively influenced hospital outcomes for patients.
4. **Human Efficiency and Training:** Well-trained emergency teams responded more effectively and made fewer errors in critical situations. Data indicated that teams with higher levels of training were better equipped to make fast, accurate decisions that directly contributed to saving lives.
5. **Resource Limitations and Operational Efficiency:** The study identified a trade-off between reducing response times and the need for additional resources. While reducing response times is beneficial for patient satisfaction and outcomes, it often requires increased resource allocation, raising operational costs.
6. **Variability in Response Time Standards:** The study revealed mixed findings on the effectiveness of the 8-minute response time standard, with some cases showing no significant improvement in patient outcomes within this threshold. The effectiveness of response time standards appeared to vary based on the type of emergency and location.

## Conclusion

This study underscores the critical impact of response time on emergency case outcomes, with evidence supporting that faster response times improve survival rates and reduce health complications. Effective EMS requires optimizing infrastructure, technology, and human resources to achieve efficient response times. However, the findings also suggest that a one-size-fits-all standard, such as the 8-minute benchmark, may not universally apply to all emergency cases, emphasizing the need for flexible, context-sensitive response protocols.

For the Saudi Red Crescent and similar agencies, the study recommends investing in infrastructure in rural areas, enhancing training programs for EMS staff, and employing advanced technology to improve response accuracy and reduce delays. Ultimately, these improvements could lead to more effective emergency care, enhancing the overall health outcomes and satisfaction for citizens across diverse regions.

## References

1. Kingdom of Saudi Arabia, Ministry of Interior, General Directorate of Civil Defense, Civil Defense and a 74-Year Journey, 1421 AH, Riyadh, 1st ed.
2. David Swan MSc, Luc Baumstark, (2022), Does Every Minute Really Count? Road Time as an Indicator for the Economic Value of Emergency Medical Services, Value in Health, Volume 25, Issue 3, March 2022, Pages 400-408
3. Weiss S, Fullerton L, Oglesbee S, Duerden B, Froman P. Does ambulance response time influence patient conditions among patients with specific medical and trauma emergencies? South Med J. 2013 Mar;106(3):230-5. doi: 10.1097/SMJ.0b013e3182882c70. PMID: 23462493.
4. Saadatmand V, Ahmadi Marzaleh M, Abbasi HR, Peyravi MR, Shokrpour N. Emergency medical services preparedness in mass casualty incidents: A qualitative study. Health Sci Rep. 2023 Oct 19;6(10):e1629. doi: 10.1002/hsr2.1629. PMID: 37867788; PMCID: PMC10587387.
5. Pons PT, Markovchick VJ. Eight minutes or less: does the ambulance response time guideline impact trauma patient outcome? J Emerg Med. 2002 Jul;23(1):43-8. doi: 10.1016/s0736-4679(02)00460-2. PMID: 12217471.
6. McCoy CE, Menchine M, Sampson S, Anderson C, Kahn C. Emergency medical services out-of-hospital scene and transport times and their association with mortality in trauma patients presenting to an urban Level I trauma center. Ann Emerg Med. 2013 Feb;61(2):167-74. doi: 10.1016/j.annemergmed.2012.08.026. Epub 2012 Nov 9. PMID: 23142007.
7. Alsaeed SA, Alkarani AS. Factors affects the performance of red crescent paramedics, Bisha, Saudi Arabia. J Family Med Prim Care. 2022 Feb;11(2):715-719. doi: 10.4103/jfmpc.jfmpc\_2060\_21. Epub 2022 Feb 16. PMID: 35360763; PMCID: PMC8963650.
8. Wilde ET. Do emergency medical system response times matter for health outcomes? Health Econ. 2013 Jul;22(7):790-806. doi: 10.1002/hec.2851. Epub 2012 Jun 14. PMID: 22700368.
9. Alumran A, Albinali H, Saadah A, Althumairi A. The Effects of Ambulance Response Time on Survival Following Out-of-Hospital Cardiac Arrest. Open Access Emerg Med. 2020 Dec 1;12:421-426. doi: 10.2147/OAEM.S270837. PMID: 33293876; PMCID: PMC7718983.
10. Mell, H. K., Mumma, S. N., Hiestand, B., Carr, B. G., Holland, T., & Stoppyra, J. (2017). Emergency Medical Services Response Times in Rural, Suburban, and Urban Areas. JAMA surgery, 152(10), 983–984. <https://doi.org/10.1001/jamasurg.2017.2230>
11. Gonzalez, R. P., Cummings, G. R., Phelan, H. A., Mulekar, M. S., & Rodning, C. B. (2009). Does increased emergency medical services prehospital time affect patient mortality in rural motor vehicle crashes? A statewide analysis. The American journal of surgery, 197(1), 30-34.
12. Brown, J. B., Rosengart, M. R., Forsythe, R. M., Reynolds, B. R., Gestring, M. L., Hallinan, W. M., Peitzman, A. B., Billiar, T. R., & Sperry, J. L. (2016). Not all prehospital

time is equal: Influence of scene time on mortality. The journal of trauma and acute care surgery, 81(1), 93–100. <https://doi.org/10.1097/TA.000000000000099>

13. De Boeck P and Jeon M (2019) An Overview of Models for Response Times and Processes in Cognitive Tests. *Front. Psychol.* 10:102. doi: 10.3389/fpsyg.2019.00102
14. Novikov, N.A., Nurislamova, Y. M., Zhozhikashvili, N. A., Kalenkovich, E. E., Lapina, A. A., Chernishev, B. V., (2017). Slow and fast responses: Two mechanisms of trial outcome processing revealed by EEG oscillations. *Front. Human Neurosci.* 11:218. doi: 10.3389/fnhum.2017.00218