# EMS in the USA: Challenges, Disparities, and the Quest for Global Solutions

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**Abstract**

With 1.05 million personnel responding to 42.6 million calls annually, the United States Emergency Medical Services (EMS) plays a vital role in the healthcare industry, serving almost every community in the country. However, the system faces challenges such as long response time, urban-rural outcome variations, and large ambulance bills, which are exacerbated by the COVID-19 pandemic. This study examines EMS systems across the world, considering innovations that could potentially aid the United States in improving its ability to provide emergency care. The included articles are categorized into 4 groups based on their proposed innovation, which include innovations in personnel, systems-level innovations, metrics of successful EMS, and technological innovations. The main innovations from each article are synthesized to construct recommendations for the United States to improve the functioning of its EMS systems. In conclusion, this review suggests incorporating laypeople in the EMS system, establishing special emergency groups, applying technological innovations, and performing an investigation of the cost of EMS.

**Background**

Emergency medical services (EMS) is a vital component of the healthcare industry in the United States, serving almost every community in the country. There are currently 1.05 million EMS personnel nationwide, including 268,420 paramedics and 622,902 emergency medical technicians, working for 19,520 EMS agencies. Annually, these personnel respond to 42.6 million EMS calls, utilizing 87,781 EMS vehicles (National Association of Emergency Medical Technicians, 2022).

Various agencies provide emergency medical services, including public agencies (such as fire departments), private companies, hospital EMS departments, and volunteer groups. The type of agency depends on the region, with some regions experiencing cooperation between different types of agencies. For example, in many places in the United States, the fire department is the first responder after a 911 call is placed. However, if the patient needs to be transported to a hospital, a private ambulance company staffed with EMTs (Emergency Medical Technicians) and paramedics transport the patient. On the other hand, some rural areas in the United States cannot use taxes to support private ambulance companies, and instead, have to depend heavily on local volunteers (National Association of Emergency Medical Technicians, 2022).

There are significant disparities between the EMS outcomes in urban areas and rural areas. Research conducted by physicians in the emergency departments of hospitals in Boston and Columbus uncovered that rural patients, when compared to urban patients, experienced longer response times and lower odds of achieving resumption of sustained cardiac activity (ROSC) during acute coronary events (Peters Ga et al., 2022). Many factors contribute to the differences in EMS outcomes between rural and urban areas, such as the response distance, the rate of mechanical CPR, and the response time.

In addition, extremely high ambulance bills are among the most salient problems for patients, with 71 percent of all ambulance rides involving potential surprise bills (Payton Stredler, 2021). For both ground and air ambulances, out-of-network charges were substantially greater

than in-network prices, resulting in median potential surprise bills of $450 for ground transportation and $21,698 for air transportation (Chhabra Kr et al., 2020). The high bill can be attributed to multiple factors: an unclear cost upfront, lack of insurance reimbursement, and a for-profit ownership structure. Notably, there is limited data on the true cost of ambulances. In response, the Bipartisan Budget Act of 2018 mandated a data collection on the cost of ambulance services (Congress, 2018). Interestingly, EMS is only reimbursed for its transportation services, not for providing healthcare (National Association of Emergency Medical Technicians, 2022). For this reason, while many view EMS as a healthcare provider, their primary function in the eyes of the payer is one of transportation. In other words, if the ambulance does not transport patients to a hospital, they are not reimbursed, even if healthcare is provided on the scene. According to data from state EMS offices, “of the 42.6 million EMS responses that occurred in 2018, only 30.9 million resulted in transports” (National Association of Emergency Medical Technicians, 2022).

Additionally, patients do not get a chance to choose if a public or private EMS agency provides them with their care, which may lead to substantially higher bills for patients. Without knowing the true cost before engaging in EMS, patients are limited both in knowledge and choice, limiting access to competitive market forces and possibly driving up prices (Newberger & Braithwaite, 2023). According to Health Fair, private company’s bills are substantially higher than those of public agencies (Adler et al., 2023). The commercialization of EMS also results in the overuse of expensive transportation services, such as air ambulances (Roman et al., 2020).

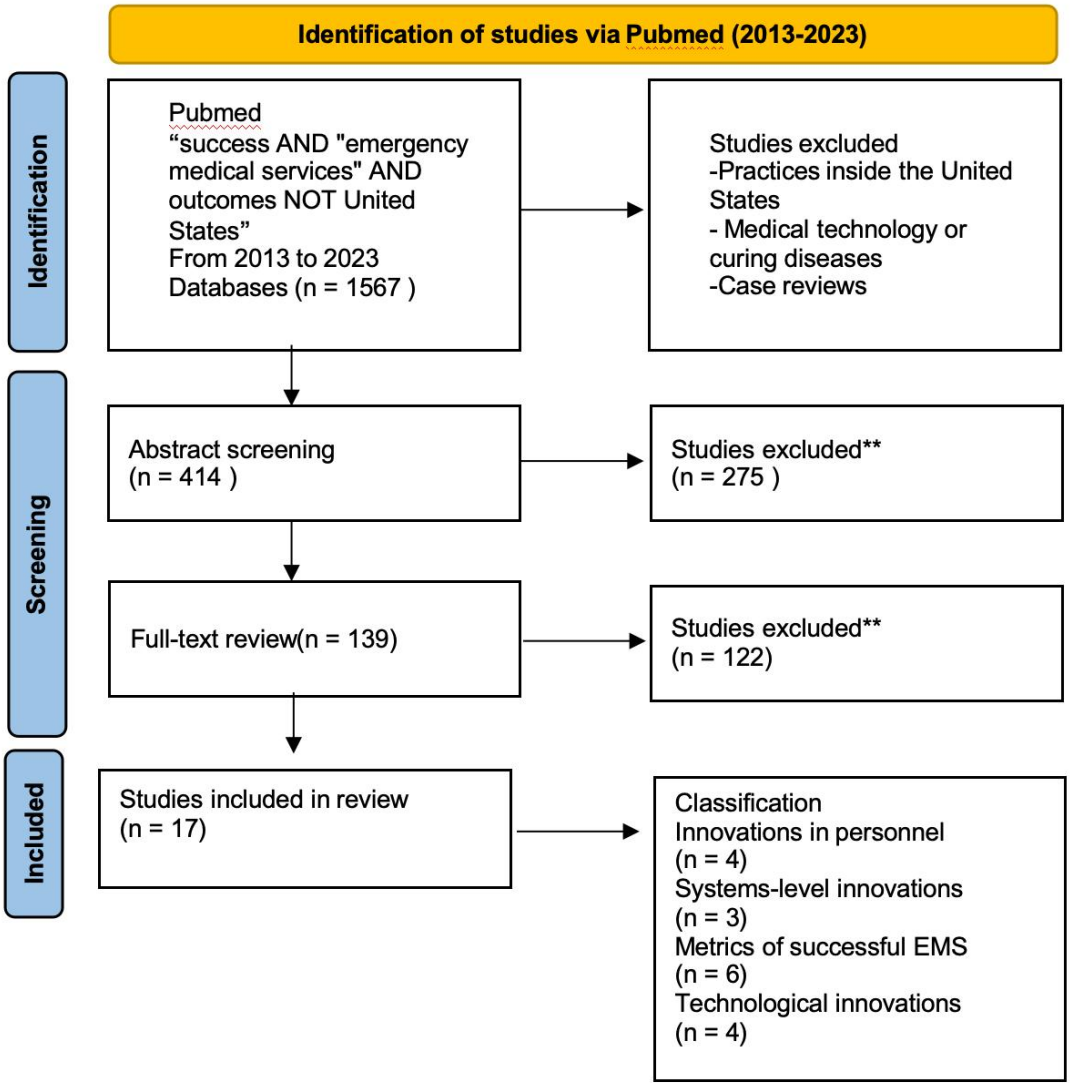
The problems in the US EMS system were exacerbated by the Covid-19 outbreaks. These include a lack of standardized protocols for treating Covid-19 patients, insufficient provisions of PPE either for EMS personnel or patients, and a reduction of personnel due to stress and burnout (Mohammadi et al., 2021). Besides, to prevent cross-infection, ambulances have to be sterilized every time they return to the base, which adds to the response time.

EMS system has a profound role in society as it is the mainstream of pre-hospital healthcare. Unfortunately, many problems exist in the United States EMS system, including but not limited to ambulance allocation, modes of transportation, response efficiency, billing, and so on. Therefore, this study will examine EMS systems across the world, in consideration of innovations that could potentially aid the United States in improving its ability to provide emergency care.

**Method**

In this scoping review, one reviewer analyzed 414 abstracts generated utilizing the phrases: “success” AND “emergency medical services” AND “outcomes” NOT “United States” in Pubmed. Results were filtered to include those between the dates of 2013 to 2023. Articles included were those describing successful EMS practices outside the US, technological or systematic innovation of ways to improve the EMS system, factors associated with a successful EMS, and other articles related to improvements in EMS. Articles excluded were those describing EMS systems inside the United States, research that focuses on medical technology or curing diseases, and case reviews. The reviewers included articles about the EMS system or successful practices outside of the United States while excluding those articles discussing a specific treatment in the pre-hospital emergency.

After viewing the abstracts of the 414 articles generated by the aforementioned screening, 139 articles were included in the full-text review and 17 articles were included in the data section. The reviewer then grouped those articles into 4 groups based on their proposed innovation, which included Innovations in personnel, systems-level innovations, metrics of successful EMS, and technological innovations. The main innovations from each article are synthesized to construct recommendations for the United States to improve the functioning of its EMS systems.



## Innovation in Personnel

Systems-level innovations are made at the organizational or management level. They maximize the use of existing resources and promote collaboration between different components of EMS. These innovations include the reallocation of ambulances, a collaboration initiative, and so on. Through systems-level innovations, the EMS system could achieve its maximum efficiency and bring out the best potential to save lives.

One study in Lebanon established a transfer center at the American University of Beirut Medical Center (AUBMC). By implementing clearer standards of communication, coordination, and care continuity, they increased the number of outgoing transfers by 15% during a four-year observation period (El et al., 2019). In addition, researchers from China proposed the application of a stroke emergency map, which identifies qualified local hospitals and transport protocols for stroke patients. The retrospective observational study shows an increase in the rate of patients receiving rt-PA thrombolysis (from 8.3% to 9.7%) and endovascular thrombectomy (from 0.9% to 1.6%). Therefore, the stroke map provides essential information for EMS workers to transport stroke patients and improve the rate of treatment for stroke patients (Ye et al., 2019). Similarly, A study from Toronto states that the establishment of a PCI initiative enables collaboration between EMS, community hospitals, and hospitals qualified for PCI, which ensures that patients undergo electrocardiography within 10 minutes of arrival at an emergency department and lead to a net reduction in door-to-balloon time from 116 min to 90 min (Young et al., 2014).

## Systems-Level Innovation

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## Metrics for Successful EMS

Studies in this group analyze key components of assessing EMS quality, including factors contributing to a successful EMS. Using multivariable analysis and computational simulation, studies can determine key components contributing to successful EMS. EMS must recognize factors that influence the survival of patients in order to improve in these specific aspects.

One study provided valuable data on the survival rate of OHCA patients between 2006 and 2014 in Toronto. Among 25,826 patients that were treated by EMS for an OHCA, 11,727 (45%) were pronounced dead on the scene, 8359 (32%) died in the emergency department, 3640 (14%) were admitted to hospital but died before day-30, and 2100 (8.1%) were still alive at day-30 (Geri et al., 2020). However, the survival rate is different in different countries. A study done by a group of researchers from Beijing Emergency Medical Center and the Capital Medical University states that only 0.6% of patients survived to discharge, 1.5% of patients survived to admission and 2.4% of the patients had ROSC on the scene (Chen et al., 2021).

There are several studies focused on CPR. A study from Poland found that the rate of ROSC was significantly higher when the CPR was initiated by a bystander, and that men were more likely to receive CPR than women (28% and 54% respectively). They also concluded that the rate of ROSC has no relation to the type of EMT that was sent to the scene (Czapla et al., 2020). However, a study analyzing the data in Beijing stated that although more people received bystander CPR in cardiac arrest from 2012 to 2015 (from 7.1%-11.2%), the survival rate was nearly the same during this period (0.6% survived to discharge) (Chen et al., 2021). A study from Australia focused on the effect of partial resuscitation (resuscitation starts but stops within 10 min) (Czapla et al., 2020). Analyzing 34,849 OCHA cases from the Victorian Ambulance Cardiac Arrest Registry between 2002 and 2012, the researchers found that more than 1/5 of patients received partial resuscitation and the rate of partial resuscitation increased from 8.6% in 2002 to 18.8% in 2012 (Nehme et al., 2015).

Traffic and Transportation is also an important factor that influences the effect of EMS. Another study done in South Korea analyzed how transportation infrastructure influences EMS response availability. Measuring the k-minute area coverage and the k-minute population coverage, researchers concluded that the EMS was greatly influenced by traffic (the average citywide reduction in area and population coverage values when there is traffic are at 34.2% and 33.8%, respectively) (Cho et al., 2017). Another study from the UK analyzed the Prehospital determinants of successful resuscitation after traumatic out-of-hospital cardiac arrest (TCA) and non-traumatic out-of-hospital cardiac arrest (NTCA), concluding that although air ambulances can greatly reduce the time of transportation and are rarely influenced by the traffic, an air ambulance was associated only with survival to admission in TCA but not in discharge (Barnard Ebg et al., 2019).

## Technological Innovation

With the development of technology, more and more advanced technologies are applied to EMS, helping the EMS system become more efficient. Although several technological applications in EMS are still in the testing phase, they show a significant advantage in delivering

equipment and helping patients get early treatment. For instance, a randomized study from Spain evaluated the effect of telemedicine using Google Glass on cardiopulmonary resuscitation (CPR). Seventy two nurses were divided randomly into two groups, one with assistance from senior physicians through Google Glass, and one with no assistance from senior physicians. All of the participating nurses wearing Google Glasses successfully performed defibrillation, compared with 78% of nurses in the control group. The Google Glass group completed CPR 36.39s on average faster than the control group (Pérez et al., 2017).

In addition to CPR, timely rescuing and AED accessibility are other factors influencing the survival rate of cardiac arrest patients. A recent cross-section comparison study from Italy highlighted the positive effect of using drones as assistance in mountain rescue, as the mean time to locate the patient was 14.6 min in the drone-assisted intervention arm and 20.6 min in the control arm (Van Veelen Mj et al., 2023). A pilot study from Sweden examining 14 eligible cases of AEDs delivered by drones in 2020, stated that 64% of drones arrived at the scene before the ambulances and showed a 1'52" advantage compared with ground ambulances in delivering AEDs with a 90% successful rate (Schierbeck et al., 2022). Another study performed in Singapore proposes a model of redistributing ambulances called DES, which can result in a 5% reduction in the calls that cannot be reached within an 8-minute threshold (Lam Ss et al., 2015).

A summery of articles included

| Name of the study | Primary writers | Content | Study design | Group |
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| Impact of city police layperson education and equipment with automatic external defibrillators on patient outcome after out of hospital cardiac arrest | Philipp Stein, Gabriela H. Spahn, Stefan Müller , Andreas Zollinger , Werner Baulig , Martin Brüesch , Burkhardt Seifert , Donat R. Spahn | The article evaluates the effectness of equipting city police with AED in saving cardiac arrest patients | Retrospective observational study | personnel |
| The development of community paramedicine; a restricted review | Brendan Shannon BEmergHealth(Pmed)(Hons), Georgette Eaton MSc, Chelsea Lanos BSc, MSc, Matthew Leyenaar PhD, Mike Nolan MA, | The article evaluates the effect of community paramedic in both saving patients and | restricted review | personnel |

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| | | reducing the EMS system's stress | | |
| Implementation of a medical command and control team in Switzerland | Pierre-Nicolas Carron , Philippe Reigner, Laurent Vallotton, Jean-Gabriel Clouet, Claude Danzeisen, Mathias Zürcher, Bertrand Yersin | The article propose a model for command and control group and states its advantages | Descriptive analysis | personnel |
| Helicopter Critical Care Retrieval in a Developing Country: A Trauma Case Series from Bhutan | Charles Haviland Mize, Egmond Samir Evers, Lhab Dorji, and Ken Zafren | The article reviewed the effect of a helicopter critical care group from Bhutan | Data analysis, multivariable generalized linear models | personnel |
| Interfacility patient transfers in Lebanon-A culture-changing initiative to improve patient safety and outcomes | Mazen El Sayed , Rayan El Sibai , Rana Bachir , Diana Khalil , Maggy Dishjekenian , Lili Haydar , Rosanne Aguehian , Ramzi Mouawad | This study examines transfer characteristics after establishing a transfer center in a tertiary care center in Beirut Lebanon, and identifies predictors of success in patient transfers | Descriptive analysis | Systemetic level innovation |
| Shenzhen stroke emergency map improves access to rt-PA | Shisheng Ye, Shiyu Hu , Zhihao Lei , Zhichao Li , Weiping Li , Yi Sui , Lijie Ren | The study propose a PCI map that could be used to increase | aretrospective observational study | Systemetic level innovation |

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| for patients with acute ischaemic stroke | | the efficiency of transporting stroke patients | | |
| Toronto Heart Attack Collaborative: An Administrative Model That Facilitated a Successful City-Wide Integration Initiative | Justin Young<br>Barry McLellan<br>Marnie Escaf<br>Vladimir Dzavik | This article provides a description of the administrative model that enabled a city-wide integration effort in Toronto | provide a description of the administrative model | Systemetic level innovation |
| Healthcare costs and resource utilization associated with treatment of out-of-hospital cardiac arrest | Guillaume Geri , Damon C Scales , Maria Koh , Harindra C Wijeysundera , Steve Lin , Michael Feldman , Sheldon Cheskes , Paul Dorian , Wanrudee Isaranuwatchai , Laurie J Morrison , Dennis T Ko | The research evaluates the cost of health care during different stages of EMS | Data analysis, multivariable generalized linear models | Metrics for successful EMS |
| Trend in survival after out-of-hospital cardiac arrest and its relationship with bystander cardiopulmonary resuscitation: a six-year prospective observational study in Beijing | Yuling Chen, Peng Yue, Ying Wu, Jia Li, Yanni Lei, Ding Gao, Jiang Liu & Pengda Han<br>BMC Cardiovascular Disorders | The study analyze the database from Beijing EMS and varify factors associated with successful EMS | prospective observational study | Metrics for successful EMS |
| Factors associated with return of spontaneous | Michał Czapla Marzena Zielińska,corresponding author, Anna Kubica-Cielińska, Dorota Diakowska, | Analyzing the EMS data, the study seperates | Analyzing of the medical record | Metrics for successful EMS |

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| circulation after out-of-hospital cardiac arrest in Poland: a one-year retrospective study | Tom Quinn, and Piotr Karniej | several factors associated with a sucessful EMS | | |
| Using a cardiac arrest registry to measure the quality of emergency medical service care: decade of findings from the Victorian Ambulance Cardiac Arrest Registry | Ziad Nehme , Stephen Bernard , Peter Cameron , Janet E Bray , Ian T Meredith, Marijana Lijovic , Karen Smith | The study report the change in quality of the EMS over the past few years | logistic regression and multilevel modeling. | Metrics for successful EMS |
| Characterizing the influence of transportation infrastructure on Emergency Medical Services (EMS) in urban area—A case study of Seoul, South Korea | Jungwoo Cho, Data curation, Formal analysis, Investigation, Resources, Software, Visualization, Writing – original draft,1 Myoungsoon You, Resources, Validation, Writing – review & editing,2 and Yoonjin Yoon, Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing1,* | This study focus on the effect of trafic infrastraction on EMS efficiency and effect how traffic influence EMS | Computer simulation | Metrics for successful EMS |
| Prehospital determinants of successful resuscitation | Ed B G Barnard 1 2, Daniel D Sandbach 1, Tracy L Nicholls 3, Alastair W Wilson 1, Ari Ercole | This article evaluates effect of several EMS | Univariate descriptives and multivariable | Metrics for successful EMS |

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| after traumatic and non-traumatic out-of-hospital cardiac arrest | | practices on rescueing traumatic and non-traumatic out-of - hospital cardiac arrest. | analysis | |
| Randomised clinical simulation designed to evaluate the effect of telemedicine using Google Glass on cardiopulmonary resuscitation (CPR) | Nuria Pérez Alonso 1, Manuel Pardo Rios 1, Laura Juguera Rodriguez 1, Tomas Vera Catalan 2, Francisca Segura Melgarejo 3, Belen Lopez Ayuso 4, Carolina Martí Nez Riquelme 5, Joaquin Lasheras Velasco 4 6 | This experiment evaluates the effect of using Google Glass on CPR | randomised study | technological innovations |
| Drones reduce the treatment-free interval in search and rescue operations with telemedical support - A randomized controlled trial | Michiel Jan van Veelen 1, Giulia Roveri 2, Anna Voegele 2, Tomas Dal Cappello 2, Michela Masè 3, Marika Falla 4, Ivo Beat Regli 5, Abraham Mejia-Aguilar 6, Sebastian Mayrgündter 7, Giacomo Strapazzon 8 | The experiment measure the effectness of using drones in mountain rescuing | A randomized controlled trial | technological innovations |
| Automated external defibrillators delivered by drones to patients with suspected out-of-hospital cardiac arrest | Sofia Schierbeck 1, Jacob Hollenberg 1, Anette Nord 1, Leif Svensson 1, Per Nordberg 1, Mattias Ringh 1, Sune Forsberg 1, Peter Lundgren 2 3 4, Christer Axelsson 2 3, Andreas Claesson | This experiment evaluates the efficiency of using drones to deliver AED | prospective clinical trial | technological innovations |

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| Factors affecting the ambulance response times of trauma incidents in Singapore | Sean Shao Wei Lam a, Francis Ngoc Hoang Long Nguyen a, Yih Yng Ng b, Vanessa Pei-Xuan Lee c, Ting Hway Wong d, Stephanie Man Chung Fook-Chong e, Marcus Eng Hock Ong | The study examines factors associated with the efficiency of delivering EMS and also propose a model that can redistribute ambulances which reduced the respond time | a retrospective study | technological innovations |

**Discussion**

This review examines critical technologies and innovations employed by EMS systems around the world across4 categories, including innovation in personnel, systematic innovation, metrics of successful EMS, and technological innovations. This section considers the effect of those innovative practices and presents potential ways that the United States could apply to achieve those innovations.

The United States could include more lay people in the EMS system, leveraging their large population.rained citizens can shorten the time between an emergency and the administration of first aid. As shown in the data, training other municipal workers, such as the city police force with basic life-saving strategies such as CPR and the use of AED could substantially increase the rate of survival for patients with emergency diseases (Shannon et al., 2022). The United States could also train firefighters, building administrators, taxi drivers, and other lay people who have a high possibility of being present in an emergency. Other studies also show that bystander CPR could improve the survival rate for cardiac arrest patients, either directly or indirectly (Czapla et al., 2020). In this way, when an emergency happens, bystanders can provide immediate help and catch the best opportunity to save the patient. To achieve this goal, governments, and EMS centers could manage free training and send out ads to improve people's first aid awareness and skills. In addition, the rate of females receiving CPR during cardiac arrest is substantially lower than that of males, so the United States could put more effort into guiding people performing CPR on females. Furthermore, the United States could also develop community paramedics. These lay people can use their spare time to be on duty, and serve the community providing medical care to basic and non-emergency patients.

Research has shown that community paramedics can reduce unnecessary EMS calls and save a lot of money for local governments (Shannon et al., 2022). The United States could select people from community fire departments or police departments to form community paramedic troops.

The United States could also establish special emergency groups in each region, such as a critical care group which consists of advanced paramedics or physicians who can perform advanced life support to those people suffering from severe or life-threatening conditions such as trauma or cardiac arrest (Mize Ch et al., 2019). If equipped with helicopters, they could perform rescue operations in remote places and save time compared with ground ambulances (Cho et al., 2017). Since the lack of advanced paramedics and physicians relative to EMTs, the United States could distribute limited numbers of critical care groups in different first-aid centers or central hospitals. Once a major emergency event happens, such as a cardiac arrest or trauma, the nearest critical care group can be activated and get on to the scene using a helicopter. In addition, the United States could establish a command and control group at each EMS region. These groups would consist of people who are in charge of the overall organization in an extensive-casualty emergency and their mission would be to ensure the efficiency of distribution of EMS forces. This group would be the headquarters that organizes the rescuing during a huge emergency incident (Carron Pn et al., 2014). Consisting of one physician and one advanced paramedic, the command and control group could lead the rescuing and provide essential guidance to the frontline first responders. They could also play an important role in communicating with hospitals and other public emergency departments, which would make the whole rescue process more efficient and effective. The United States should consider the density of this type of group in each region, and select personnel to form the special teams. The United States could establish these groups by selecting experienced first responders and physicians from EMS and hospitals to form this special team. Challenges to implementation include engaging qualified candidates in the recruitment process and managing communication between EMS and hospitals.”

Further, The United States should set up a channel for communication between different medical institutions. Each region can set up a PCI map, containing information about the hospital that could perform PCI and some basic operation guide for front line EMTs, and create direct contact between ambulances and PCI balloon rooms. In this way, when the ambulance receives a stroke patient, they can know which institution they should send the patient to and they can inform the PCI hospital so that the hospital can be fully prepared. As soon as the patient arrives at the hospital, necessary examinations can be carried out and the patient can be sent into the balloon room as soon as possible (Young et al., 2014). The United States could also set up a system between EMS and the traffic department, since traffic is one of the determining factors affecting the time constraints of providing first aid. The area that an ambulance could cover in a limited amount of time is reduced substantially when the traffic condition worsens (Cho et al., 2017). In those critical and emergencies, an ambulance could contact the traffic department to help it disperse traffic, such as turning the traffic light from red to green, to help the ambulance arrive at the scene earlier. The United States could also suggest navigation companies use GPS to alert other vehicles to keep the road clear (e.g. the navigation app could pop out windows on the screen when it detects that an ambulance is following behind the vehicle).

The United States could benefit from technological innovation in the EMS system. With the advanced technology both in the United States and outside the United States, EMS systems can make great improvements in reducing the time and increasing the quality of services (Schierbeck et al., 2022). For example, the United States could consider using drones to deliver AEDs. According to the American Heart Association, every minute delay in using an AED decreases the rate of survival for cardiac arrest patients by 10%. Because of uncontrollable traffic, ground ambulances sometimes cannot arrive at the scene on time. Furthermore, the United States can also equip the first responders with Google glasses, which can enable physicians to give remote guidance to the first responders. The physician who is sitting in front of the screen in the control center or hospital could see live video from the scene, using audio and AR projection, the nurse will not only listen to the instructions but also see instructions on the screen. Research has shown that Google glass can reduce the time it needs for the first responders to finish CPR and the time it takes for them to deliver defibrillation (Pérez et al., 2017). Although these innovations are in the testing phase, and inventing or testing costs money and time, these efforts are worth it because the applications of those technological innovations could potentially save more lives. The United States could also invest in cooperation between technological companies and EMS systems so that the company can focus on the technological parts while the EMS could provide useful revision and testing of the product.

The United States should also perform an investigation into the cost of EMS. Over 71% of ambulance rides result in surprising bills, and many EMS services are not reimbursed. This could be attributed to the unclear real cost of providing EMS. Like Toronto, the United States should investigate the cost of EMS in order to provide a more clear and accurate reference for the insurance company to reimburse (Geri et al., 2020).

**Strengths and Weakness**

A strength of this study is its wide scope. The review is supported by 400 abstracts that were screened and synthesized into 4 unique themesBecause the research scope is wide, not all the recommendations can be feasibly adapted to a local EMS system. For example, not all the EMS services in the United States can use helicopters to send out critical care groups and transport patients. Some of the successful EMS practices listed in the data section are from countries that have a different context than the United States, so they have to be localized when applied in and adapted to different regions of the United States.

Another limitation of the work is that a scoping (as opposed to a systematic) framework was utilized to classify articles. The research includes most of the articles about successful EMS practices and researchers related to this. However, in the absence of rigorous data analysis, some of the criteria and collecting processes of the data may be different among different articles.

Additionally, only one reviewer screened articles, allowing for possible bias. Some contrasting results and conclusions are contained in the data section and, because of the limited number of selected articles, this research cannot conclude which one is correct. Further research needs to be done to lead to a more solid and persuasive conclusion.

## Future directions

In the future, more concentrated systematic reviews could be performed on specific or more targeted regions. In light of these innovative EMS practices abroad, the US government could invest in research to evaluate the effectiveness and the efficient allocation of all innovative EMS resources. For example, the researchers could equip an EMS center in the United States with AED drones, and perform a systematic review comparing their efficiency at delivering AED and that of traditional ground ambulance or bystanders. Financial problems also need more attention from future research, which could investigate the feasibility of applying those innovative practices and the change in finance. This will provide reference to the insurance company and the government to reimburse and give funds. Overall, more research could be done investigating the factors associated with successful EMS under the context of the United States. For example, using the data collected by the EMS system, researchers could perform data analysis to explore the factors that influence the results of EMS delivery. Additionally, some research could be done on the policy and appropriation, including investigating the real cost of EMS and how EMS should be reimbursed. In this way, the EMS system can have a more clear direction for making improvements.

## Conclusion

This review analyzed the status quo of the United States EMS system, then used scoping review best practices to consider many successful EMS practices around the globe. It provides recommendations for the United States EMS system and identifies future research directions that can be done in the United States.

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