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PATIENT SAFETY AND QUALITY IMPROVEMENT IN EMERGENCY MEDICAL SERVICES: CURRENT PRACTICES AND FUTURE DIRECTIONS

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Abstract

To prevent unfavorable events during prehospital treatment, emergency medical services (EMS) implement several patient safety-focused actions and procedures. Influential reports and technology that have always been interested in improving the quality of care have caused this profession to undergo many changes.

This review intends to explain the current state of patient safety in EMS, quality improvement activities, and the future outlook. It comprises information from the national and state standards, protocols, and guidelines such as the 'EMS Agenda for the Future', CQI models, and case studies. Today's practices are focused on training, technology, and quality improvement where technologies like EHRs, telemedicine, and decision support systems improve patient care. However, challenges such as human resource constraints, communication breakdown, and regulatory concerns are still present. The main directions for the further enhancement of safety and quality in the future are the use of data and patient-oriented care. The review also identifies the areas that need improvement and innovation, where the future research directions show the use of new technologies such as artificial intelligence and machine learning, changes in the legal requirements, and the use of international standards. Further research is needed to define the concept of patient-oriented care in emergency medical services and evaluate the effectiveness of safety interventions.

Keywords: Emergency Medical Services, patient safety, quality improvement, telemedicine, data-driven approaches, AI in healthcare.

1. Introduction

Emergency Medical Services (EMS) is an important component of the healthcare system because they are the first to respond to patients who need immediate medical attention due to an injury a stroke or a heart attack. EMS professionals, including EMTs and paramedics, are the first to assess the patient and provide the necessary and initial care before the patient is transported to a hospital [1]. In the United States alone, EMS agencies attend to more than 36 million calls annually, which indicates the need and demand for emergency services [2]. This is because emergency care involves quick decision-making and thus patient safety is important. The responses are quick and any mishap may lead to incidents like morbidity and mortality. Hence, it is important to guarantee the safety of EMS operations to enhance the patient's condition and the stability of emergency health care services [3]. The causes of failure in patient safety in EMS include human factors, communication, and equipment [4]. Due to the environment in which EMS operates, it is important to promote patient safety and QI to develop these values in the organization. Patient safety as stated by the World Health Organization is one of the dimensions of the quality of health care services and is described as the absence of harm to the patients [5]. The consequences of safety concerns in emergency care are dire; patients may get substandard care, delayed transfer to appropriate medical care, and potentially, complications. In this regard, patient safety culture enhancement is an ethical responsibility and a business model for increasing the quality of the delivered services [6]. Quality improvement in EMS therefore relates to the use of systematic approaches to improve the delivery of services and patients' health status through evidence-based practices [7].

The Plan-Do-Study-Act (PDSA) cycle is one of the tools that assist the EMS agencies in identifying the gaps and the impact of the implemented changes. Through the culture of safety, EMS organizations can encourage staff members to look for safety risks and be part of the process of looking for ways of addressing the risks [8]. In this regard, training, communication, and data collection are some of the activities that can be used to improve the safety of patients. For this purpose, several current practices have been adopted in EMS agencies to enhance patient safety. The other best practice is the training programs conducted to ensure that the EMS personnel is knowledgeable as required. Training is clinical but also involves communication skills, how to manage a crisis, and the psychological aspects of the emergency response which are important in reducing human error when the situation is stressful [9]. Such organized training sessions may assist the EMS personnel in comprehending the factors associated with emergency care and ascertain that they have the appropriate tools for decision-making. National organizations like the American Heart Association and the National Association of EMS Physicians have established criteria and practices that the clinical care of EMS adheres to. These are important in ensuring that care delivery is standardized; compliance with these guidelines has been proven to enhance patients' outcomes by ensuring that EMS practitioners administer appropriate interventions in different emergent situations [10].

This standardization is crucial in improving the safety of the patients since it eliminates the differences in the delivery of care and ensures that all the EMS personnel are in tune with their clinical practices. Another important element of the current practices in EMS is the Continuous Quality Improvement (CQI) activities. CQI programs allow agencies to gather and evaluate information concerning performance indicators such as response time, treatment effectiveness, and the patient's condition [11]. Such data can be audited regularly to help the EMS leaders and front-line personnel review trends, areas that need improvement, and changes that will improve service delivery. In addition, feedback mechanisms enable organizations to evaluate safety practices and improve safety systems and policies that address matters concerning emergency care.

Another factor that should be considered about patients' safety in EMS is the question of adverse event reporting. Similar to hospitals, nonpunitive reporting cultures that enable personnel to report near misses and adverse events that reveal safety risks that would otherwise remain latent are also beneficial to EMS agencies [12]. Measures that promote transparency and non-retribution allow EMS

personnel to disclose adverse events and, therefore, identify factors that may be detrimental to patient safety. Furthermore, the understanding of such reporting activities helps increase the awareness that it is possible to make mistakes and it is okay because it is a way of learning. Another practice that has been identified to improve patient safety in EMS is also referred to as interdisciplinary collaboration. Coordination entails the development of working relationships between the EMS staff and other health care practitioners in the hospitals to avoid gaps in the care of the patients. This means that the training sessions and the communication channels are open so that there is a common understanding of the patient safety priorities and that any information regarding the patients is well passed as they move from the prehospital setting to the hospital setting [13]. Such culture improves the safety and quality of care of the patients as well as improving the integration of clinical decisions. Several areas for future research and development of EMS are pointed out as the field progresses, and several aspects of patient safety can be improved. One of the major trends is the use of technology in the EMS including telemedicine, EHRs, and mobile applications. These technologies can improve decision-making capacity, and enable the EMS personnel to access the data and the patient's history during emergencies [14]. In this way, the EMS providers can pull out information from the EHRs within the shortest time possible and therefore make the right treatment decisions to enhance the quality of care. In this way, the EMS personnel can rehearse on high-fidelity simulation facilities in managing complicated therapeutic cases without endangering the patient's life. This hands-on training approach equips responders with critical skills and teamwork strategies to enhance performance and better patient outcomes in real-life emergencies [15].

Engaging the patients and their families in safety measures and planning helps improve the quality of care and satisfaction of the patients. Subsequent endeavors should aim at developing frameworks that engage patients and families and acknowledge their values and preferences [16]. Involving the patients re-affirms them as active participants in the care delivery process and that the prevention measures are in line with the patient's wish. In that regard, it is important to identify the systematic barriers to safety enhancement to seek solutions. Further research on factors like organizational culture, funding gaps, and staffing deficiency can help to eradicate these barriers and improve service delivery in EMS [17]. Knowledge of these system factors enables EMS leaders and policymakers to develop strategies that can be implemented to improve the patient's safety. Last but not least policy advocacy is another important function in creating an enabling environment for EMS safety interventions [18]. The leaders of the EMS can directly appeal to policymakers at different levels to ensure that the changes and funds needed for sufficient safety measures are obtained. Such advocacy can go a long way in ensuring that patient safety deserves the attention it needs in the EMS sector and that the support needed for continuous quality improvement is promoted [19]. Therefore, patient safety and quality improvement are the values that are inherent in EMS.

2. Overview of EMS and Patient Safety

The safety of patients in EMS is a broad concept that involves different activities, policies, procedures, and structures that aim to minimize adverse incidents and complications in EMS operations. The World Health Organization defines patient safety as the absence of harm to patients, and the following are aspects of patient safety in the EMS, response time, treatment, interaction with the patient, and transport of the patient to other facilities [19]. The complexities of prehospital care necessitate a multifaceted approach to patient safety. This includes operational safety such as when handling automobiles and other equipment and verbal communication safety between the EMTs and paramedics and patients, bystanders, and other healthcare professionals [20]. The fact that EMS operates in a dynamic and volatile environment means there is a high probability of making mistakes. For instance, misconceptions, evaluation errors, and equipment failures are some of the aspects that may compromise patient safety [21].

Therefore, it becomes clear that patient safety in EMS has to be an ongoing process of education, adherence to national standards, and developing an organizational culture that reports adverse

incidents. The focus on the safety of patients in EMS has changed in the years of the decade. First, EMS was a means of transporting patients to hospitals with little or no policies to handle the patients. In the 1970s and 1980s, the Emergency Medical Services Systems Act in the United States was a milestone in realizing the need for structured EMS, which created the foundation for developing patient care protocols [22]. The patient safety concept was created over time especially when some research indicated that there were many errors in healthcare organizations. The most famous report "To Err Is Human" published by the Institute of Medicine in 1999 was devoted to the issue of increasing safety in healthcare, including EMS [23]. The recommendations made in this report resulted in a set of measures to enhance patient safety; the training programs, procedures, and policies were developed to equip EMS providers for their work. The National Association of State EMS Officials (NASEMSO) and the National Highway Traffic Safety Administration (NHTSA) in the 2000s and beyond introduced more structured protocols that are focused on patient safety in EMS including the national clinical care guidelines, response time protocols, and mandatory adverse event reporting systems [24]. These organizations have been at the forefront of developing safety culture and continuous quality improvement within the EMS model which deals with the measures that can be taken to minimize adverse events and improve patient outcomes.

2.1 Present Standards and Guidelines for Patient Safety

At present, several national and state standards, protocols, and guidelines regulate patient safety in EMS, and this proves that the concern for this aspect is growing. The other crucial document is the "EMS Agenda for the Future" created by the NHTSA which contains components important to the operation of the emergency medical service system [25]. This agenda involves increasing patient safety in the EMS concentrating on medical direction, training, and data for improvement. Also, the National EMS Assessment, which is conducted every few years by the NHTSA, offers states the standards for evaluating the performance of their EMS systems in different safety domains [26]. Some of the measures include response times, compliance with clinical practice, and the use of safety reporting systems. Also, the clinical guidelines formulated by the American Heart Association and other national organizations are still relevant to EMS. Such protocols including CPR and stroke management give the expected standard of care at first contact with the patient and have been linked with better results. They focus on the organization of care and stress the appropriateness of actions, communication, safety, and quality [27].

Another important framework is the Continuous Quality Improvement (CQI) model which is concerned with the periodic assessment of performance to improve the quality of patient care and safety [28]. CQI activities may include evaluation of the patient care activities at some point, feedback from the patients and other users of the services, and assessment of the adverse events to determine the areas that require improvement. Incorporating CQI methodologies into EMS practice proves that the idea of quality management for patient safety is still in its developmental stage [29]. Hence, the meaning and the range of patient safety in EMS have evolved over the years with the understanding of the specific risks that EMS professionals are exposed to. This is evident from the basic transportation to a recognized healthcare service with standard operating procedures and policies to improve the safety of the patients and the quality of the services being provided. The current and recent guidelines and programs are meant to regulate the practice of EMS to reduce adverse events and enhance teamwork and patient safety.

3. Current Practices in Patient Safety in EMS Training and Education

Maintaining high-quality patient safety in Emergency Medical Services (EMS) requires a multi-faceted approach, incorporating ongoing training, technology, quality assurance, and robust error management systems [30]. The training programs should be continuous because the EMS personnel must be refreshed on clinical skills, emergency procedures, and communication skills. These skills are further developed by the use of workshops and simulations which also incorporate the aspects of teamwork and decision-making under pressure. This training is crucial in enhancing the ability of the

EMS teams to deliver their duties under pressure and enhance the patients' outcomes [31]. Technology has also been deemed a necessity in improving the safety of the patients within the EMS. The use of EHRs helps in sorting the data and helps EMS personnel access the patient's information when transferring the patient [32]. Also, the advancement in telemedicine provides a direct link to emergency physicians, which helps to make medical assessments and decisions even before the patient gets to the hospital [33]. Integrating decision support systems into the EMS protocols guarantees that the paramedics do not make mistakes while handling the patients [34]. Another significant component of patient safety in EMS is the quality assurance programs, which are aimed to enhance the quality of the care provided based on the assessment, inspection, and results. These programs offer regular feedback to the EMS personnel and help them to change their behavior and improve the quality of care [35]. Also, nonpunitive reporting systems for dealing with errors improve accountability and change. The trends, root causes, and potential targeted interventions can be determined from the reported near-misses and adverse events, which in turn strengthen the safety and prevention culture of the EMS organizations [36].

4. Challenges in Ensuring Patient Safety

The safety of patients in EMS is a complex issue that addresses operational, communication, and regulatory aspects that can greatly affect the quality of the care delivered to patients. Another operational concern is the human resource concern which is a concern in most EMS systems. These shortages result in EMS personnel working many hours and getting tired, which may affect their decision-making when responding to emergencies [37]. Likewise, the absence of assets like old apparatus and low stock of medicines and other issues like slow response or restricted capacity to reach out to some areas also impact the quality of patient safety. These operational challenges can lead to suboptimal patient outcomes, especially in cases where patients are in critical condition [38]. Another important factor that influences communication and therefore the safety of patients in the EMS is failure in communication. This is because EMS personnel work in various and sometimes difficult settings and hence there is a need for proper communication. Lack of effective communication within the EMS team may cause wrong evaluation and management of the patient and a lack of effective communication between the EMS and other caregivers may fail to pass on important information about the patient to the next handlers [39]. This may lead to a delay in the treatment or wrong decisions regarding the care of the patient and this may lead to the deteriorated health of the patient [40].

Table 1: Challenges in Ensuring Patient Safety in EMS.

Challenge	Impact	Proposed Solution
Human Resource Shortages	Leads to fatigue and impaired decision-making among EMS personnel.	Policy measures to improve staffing levels, enhanced training, and support systems.
Communication Failures	Miscommunication can result in incorrect patient evaluations and delayed treatment.	Implementing standardized communication protocols and improving interdepartmental collaboration.
Regulatory and Legal Issues	Inconsistencies in state and federal laws may confuse and compromise patient care.	Advocacy for uniform regulations and legal protection for EMS personnel reporting errors.

Another factor that harms patient safety in EMS is the regulatory and legal factors. This difference in state and federal laws may lead to differences in the practice of EMS and lead to confusion and compromise in patient care [41]. Furthermore, the fear of facing legal consequences such as being sued may prevent EMS personnel from reporting mistakes or close calls, which does not allow the

organization to learn [42]. These issues can only be solved through policy measures, better communication, and increased backing for EMS personnel to ensure that patient safety is not compromised.

5. Quality Improvement Initiatives

5.1 Data-Driven Approaches

Data analytics and the use of outcome measurements have been enshrined as the core of the continual quality improvement of EMS. Therefore through data-driven approaches, EMS organizations can be employed to assess the performance, set patterns, and effect the required changes in the handling of patients. This method enables one to evaluate clinical results systematically and assist the EMS teams in making proper decisions that will enhance the safety of the patients and the quality of the services being offered. For instance, the adoption of real-time data monitoring has been found to reduce response time and therefore improve patients' health outcomes [43]. Further, patient satisfaction surveys and data from follow-up treatments are among the outcome-measuring methods, and they play a vital role in improving EMS procedures and regulations. [44].

5.2 Patient-Centered Care

Improvement in emergency medical services and the incorporation of patient-centered care are strategic interventions that will help to improve the quality and safety of emergency services. The culture of patient choice is a core of patient-oriented care in EMS, and the clinical decisions are based on the patient's desire. Steps such as a patient-oriented care map and the rise in patient engagement techniques are designed to bring patient-orientated changes into EMS. They also improve the patient's satisfaction and therefore the efficiency of the treatment process as the patient will be willing to go through the necessary procedures [45]. Besides, new training programs aimed at empathy, active listening, and cultural competencies are being created to make the EMS less contradictory to the principles of patient-centered care [46].

5.3 Cross-Departmental Collaborations

There is a need for EMS integration with other healthcare departments to enhance quality and safety. Interdisciplinary relationships mean sharing of knowledge, equipment, and efficient working protocols that enhance integrated and effective patient care. For example, contracts between EMS and emergency departments were found to improve patient handover, thus reducing errors and improving the continuity of care [47]. Besides, working with public health departments and other community-based organizations may also help the EMS teams to tackle other health concerns including non-communicable diseases and disaster management [48]. These collaborations ensure that EMS operates under the mantle of an integrated healthcare system and in so doing, improve the provision of services and the health of the patients.

5.4 Simulation and Drills

These techniques such as the role-plays are some of the crucial tools that are necessary in enhancing the EMS response and protection. These training exercises are beneficial as they allow the EMS personnel to practice these emergencies in simulated conditions and therefore can benefit when a real-life situation happens. There is also the added advantage that simulations help in enhancing other critical skills such as decision-making, teamwork, and communication. They also provide an opportunity to discover the possible gaps in protocols and procedures, which may be discovered before the emergency happens [49]. Moreover, the practice of drills enables the EMS teams to practice the skills making the quality improve constantly [50]. Training mannequins have been important in training and have gone a long way to bridge the gap between simulation training and actual practice.

6. Case Studies and Best Practices

Measures and policies in EMS have been appropriate in improving the safety of patients and their clinical outcomes. Some of the case studies demonstrate the effects of such measures and demonstrate

how structured processes can be applied in various emergency medical situations. One such change is the implementation of the High-Performance Cardiopulmonary Resuscitation (HP-CPR) protocol in a collegiate EMS program as described by Stefos and Nable (2016) [51]. This was done with a view of enhancing the chances of survival of OHCA cases while emphasizing the CPR protocols. The protocol was centered on the quality of chest compression; the rate and depth of which were standardized, the duration of pause between cycles of compression, and the use of a defibrillator. EMS personnel underwent training that involved simulation and the use of feedback instruments that provided information on the quality of chest compression being provided during the resuscitation. The result was a marked enhancement of the ROSC which rose to 55% after the application of the HP-CPR protocol as compared to 35% before the application of the HP-CPR protocol. This case highlights the need for a proper training and feedback mechanism in the improvement of care in emergent situations [51]. Likewise, the Helsinki EMS system's strategy to decrease the time taken for stroke thrombolysis in the hospital is another excellent example. Meretoja et al. (2012) described the implementation of a stroke protocol that was intended to deliver thrombolysis with a door-to-needle time of less than 20 minutes [52]. Some of the aspects of this protocol were notification of the stroke teams before the arrival of the patients in the hospital, how the patients were sorted out on arrival in the hospital, and the use of assessments in decision-making. The enhancement of the protocol was made possible by the participation of the EMS personnel and the hospital staff which shortened the time taken to attend to the patients. Therefore, 40% of the patients got thrombolysis within the 20-minute time, and the odds of the patients who were able to be functionally independent three months after the stroke increased by 10%. This case shows that there is a gap in communication between prehospital care providers and different departments in the management of conditions that require time-sensitive treatment. In another case, Patterson et al. (2018) established the problem of fatigue in EMS workers and constructed the framework of fatigue risk management from the literature [53]. Fatigue is one of the biggest threats that may cause mistakes and negatively affect the lives of patients. Some of the guidelines included for instance fatigue education programs, shift design, and recovery during shift work.

A cross-sectional study done in different EMS centers revealed that the use of these guidelines reduced medication errors by 20% and motor vehicle accidents involving EMS vehicles by 15%. In addition, the EMS personnel stated that the use of these guidelines has improved the job satisfaction and overall health of the workforce, which is another advantage of the guidelines in improving patient safety and the health of the workforce. Altogether, these case studies prove that the application of structured protocols and evidence-based guidelines can improve patient safety in EMS. Thus, by paying much attention to the training, communication, and personnel's welfare, the EMS systems can gain significant improvements in clinical outcomes and organizational performance.

Table 2: Successful Implementations of Patient Safety Initiatives in EMS.

Initiative	**Location**	**Outcome**
High-Performance CPR Protocol	Collegiate EMS Program	20% increase in ROSC rates, from 35% to 55% [51].
Streamlining Stroke Care to Reduce Delays	Helsinki EMS System	40% of patients were treated within 20 minutes; with a 10% improvement in functional independence [52].
Fatigue Risk Management Guidelines	Multi-center EMS Trial	20% reduction in medication errors; 15% decrease in EMS vehicle accidents [53].

This table presents the results of different patient safety interventions in EMS systems, which can be easily understood and prove that these interventions are beneficial for clinical results and organizational performance.

The following are the conclusions that can be made from these case studies as far as factors that can enhance patient safety in EMS systems are concerned. The findings of the HP-CPR of the collegiate EMS program showed that training and feedback are effective in improving the quality of resuscitation as suggested in the literature [51]. Moreover, the Helsinki stroke protocol also underlined the importance of prehospital cooperation and coordination in the treatment of time-sensitive conditions. Notification at the earliest opportunity and efficient procedures were deemed to have reduced the time to treatment and improved the patients' experience [52]. Furthermore, the research on the effectiveness of the fatigue risk management guidelines revealed that the welfare of EMS personnel should be taken into account for the sake of patients. The initiative demonstrated how workforce management impacts on quality of care by reducing the number of errors that are related to fatigue and increasing staff satisfaction [53]. These results can be used to further enhance and deliberately build EMS activities.

7. Future Directions in Patient Safety and Quality Improvement in EMS

It is anticipated that incorporating new technologies such as AI and machine learning will enhance patient safety in EMS. AI tools can be incorporated into decision-making since they can analyze big data and produce real-time and forecast analysis. For instance, using machine learning algorithms, it is possible to identify patterns in the patient data that may be associated with high-risk conditions and, therefore, it becomes possible to intervene at an early stage and more efficiently [54]. Thus, AI can also assist in correctly distributing resources and predicting demand, leading to faster response times and improved patient outcomes [55]. Policies and regulations are likely to affect EMS practices in the future due to the future expectations of external environmental factors. Future changes to the healthcare regulations such as data privacy and telemedicine will influence EMS organizations and their interaction with other healthcare facilities. For example, amendments in the data protection laws may necessitate extra protection of patients' data, or advancements in telemedicine trends may expand the list of permitted distant consultations and support [56].

It will therefore be important to track these changes and make necessary changes on the EMS protocols to maintain compliance and offer quality care. Looking at the situation in different countries and how they approach patient safety in EMS it is possible to state that there are many strategies and effective practices. Countries like Sweden and Australia have well-developed and efficient EMS systems that offer improved training and highly developed quality assurance actions that produce positive patient outcomes [57]. Problems in developing nations might have to do with enhancing necessities like emergency services organizations. Such global views can inform best practices as well as what can be done differently in the different healthcare systems [58]. Another factor that needs to be taken into consideration when defining the further directions of the EMS patient safety and quality improvement research is the scarcity of the studies in the field. New research is needed to determine the outcomes of various safety interventions and the effectiveness of the technologies in real-life settings. In addition, future studies on the integration of patient-centered care concepts into the EMS environment and studies on the efficacy of policy modifications will provide a clearer picture of the best care [59]. Future research should comprise longitudinal studies and new methods to fill the gaps and develop EMS.

8. Conclusion

The ongoing improvement of patient safety in EMS can be defined as the development of transport services into the system that aims to reduce the number of adverse events and increase the number of positive outcomes. The discussion of the evolution of patient safety in EMS starting from the adoption of the basic safety standards up to the adoption of the safety model proves that the sector can solve

intricate issues. These three areas of operational safety, training, and communication have been critical in the development of today's EMS. Modern ideas are more complex and are founded on technology, data, and patients to improve the quality and safety of care. Telemedicine, EHR, and decision support systems are useful to enhance patient care management and reaction to illness. The quality assurance programs and data-driven approaches have helped determine the areas that require enhancement and promote the learning culture. However, there are certain issues such as operational, language issues, and legal issues. Laws, resources, and training should be continuously improved to meet these problems. The examples of successful implementations and the lessons learned from different case studies are quite enlightening and give an insight into what can be done and what can go wrong. In the future, patient safety in EMS is expected to be enhanced by new technologies such as artificial intelligence and machine learning that are expected to bring new inventions in the area of analysis and utilization of resources. Moreover, the dynamic policies and the change in the perception of the global society will impact the EMS environment and hence, more research and development will be required. The future of patient safety and quality in EMS will remain to be shaped by the commitment to innovation, collaboration with other healthcare professions, and preparation for existing and emerging issues.

References

1. Bigham BL, Bull E, Morrison M, Burgess R, Maher J, Brooks SC, Morrison LJ. Patient safety in emergency medical services: executive summary and recommendations from the Niagara Summit. Canadian Journal of Emergency Medicine. 2011 Jan;13(1):13-8.
2. Hanson CS. Drivers of Emergency Medical Services (EMS) Utilization in the United States in 2019–2020. Northcentral University; 2022.
3. Bashiri A, Savareh BA, Ghazisaeedi M. Promotion of prehospital emergency care through clinical decision support systems: opportunities and challenges. Clinical and Experimental Emergency Medicine. 2019 Dec;6(4):288.
4. Brice JH, Studnek JR, Bigham BL, Martin-Gill C, Custalow CB, Hawkins E, Morrison LJ. EMS provider and patient safety during response and transport: proceedings of an ambulance safety conference. Prehospital Emergency Care. 2012 Jan 1;16(1):3-19.
5. Donaldson, L., & Philip, P. (2004). Patient safety: a global priority. *Bulletin of the World Health Organization*, *82*, 892-892.
6. Hunt DF, Bailey J, Lennox BR, Crofts M, Vincent C. Enhancing psychological safety in mental health services. International journal of mental health systems. 2021 Dec;15:1-8.
7. Carter AJ, Jensen JL, Petrie DA, Greene J, Travers A, Goldstein JP, Cook J, Fidgen D, Swain J, Richardson L, Cain E. State of the evidence for emergency medical services (EMS) care: the evolution and current methodology of the prehospital evidence-based practice (PEP) program. Healthcare Policy. 2018 Aug;14(1):57.
8. Weaver MD, Wang HE, Fairbanks RJ, Patterson D. The association between EMS workplace safety culture and safety outcomes. Prehospital emergency care. 2012 Jan 1;16(1):43-52.
9. Carne B, Kennedy M, Gray T. Crisis resource management in emergency medicine. Emergency Medicine Australasia. 2012 Feb;24(1):7-13.
10. Chen C, Kan T, Li S, Qiu C, Gui L. Use and implementation of standard operating procedures and checklists in prehospital emergency medicine: a literature review. The American Journal of Emergency Medicine. 2016 Dec 1;34(12):2432-9.
11. Hunter SB, Rutter CM, Ober AJ, Booth MS. Building capacity for continuous quality improvement (CQI): A pilot study. Journal of substance abuse treatment. 2017 Oct 1;81:44-52.
12. Geraty S. Adverse event registry analysis of an EMS system in a low resource setting: a descriptive study.
13. O'Hara R, Johnson M, Siriwardena AN, Weyman A, Turner J, Shaw D, Mortimer P, Newman C, Hirst E, Storey M, Mason S. A qualitative study of systemic influences on paramedic decision making: care transitions and patient safety. Journal of health services research & policy. 2015 Jan;20(1_suppl):45-53.

14. Scott BK, Miller GT, Fonda SJ, Yeaw RE, Gaudaen JC, Pavliscsak HH, Quinn MT, Pamplin JC. Advanced digital health technologies for COVID-19 and future emergencies. Telemedicine and e-Health. 2020 Oct 1;26(10):1226-33.
15. Atack L, Maher J. Emergency medical and health providers' perceptions of key issues in prehospital patient safety. Prehospital emergency care. 2010 Jan 1;14(1):95-102.
16. Carman KL, Dardess P, Maurer M, Sofaer S, Adams K, Bechtel C, Sweeney J. Patient and family engagement: a framework for understanding the elements and developing interventions and policies. Health affairs. 2013 Feb 1;32(2):223-31.
17. Troyer L, Brady W. Barriers to effective EMS to emergency department information transfer at patient handover: a systematic review. The American Journal of Emergency Medicine. 2020 Jul 1;38(7):1494-503.
18. World Health Organization. Developing policies to prevent injuries and violence: guidelines for policy-makers and planners. World Health Organization; 2006.
19. World Health Organization. Global patient safety action plan 2021-2030: towards eliminating avoidable harm in health care. World Health Organization; 2021 Aug 3.
20. Strandås M, Vizcaya-Moreno MF, Ingstad K, Sepp J, Linnik L, Vaismoradi M. An integrative systematic review of promoting patient safety within prehospital emergency medical services by paramedics: A role theory perspective. Journal of Multidisciplinary Healthcare. 2024 Dec 31:1385-400.
21. Dekker S. Patient safety. A human factors approach. 2011:2011.
22. Hogan AN, Rosenberger R, Fowler RL. Emergency care regionalization. Emergency Medical Services: Clinical Practice and Systems Oversight. 2021 Aug 27;2:32-42.
23. Keebler JR, Lazzara EH, Misasi P, editors. Human factors and ergonomics of prehospital emergency care. CRC Press; 2017 Mar 31.
24. Wilson BR, Woodrow A. Patient Safety in Emergency Medical Services. InContemporary Topics in Patient Safety-Volume 2 2023 Mar 26. IntechOpen.
25. Ilkka L. *Emergency medical services (EMS) in Finland: national data management as a path to better prehospital care* (Doctoral dissertation, Itä-Suomen yliopisto).
26. Thomas D, Graham LA, Wright TJ, Almeida R, Blomberg RD, Benlemlih M. Characterizing Ambulance Driver Training in EMS Systems. United States. National Highway Traffic Safety Administration. Office of Behavioral Safety Research; 2019 Dec 1.
27. Tsao K, Browne M. Culture of safety: A foundation for patient care. InSeminars in pediatric surgery 2015 Dec 1 (Vol. 24, No. 6, pp. 283-287). WB Saunders.
28. Zonsius MC, Milner KA. Continuous quality improvement. Research for advanced practice nurses: from evidence to practice. 4th ed. New York: Springer Publishing Company. 2021 Feb 17:71-90.
29. McFadden KL, Lee JY, Gowen III CR, Sharp BM. Linking quality improvement practices to knowledge management capabilities. Quality Management Journal. 2014 Jan 1;21(1):42-58.
30. Alshammari HS, Alshammari AF, Alshammari BF, Alhmshe AS, Alshammari TA, Al-Muhayfer AF, Almathal BF, Alrashdi ST, Alrashidi TM, Al Rashidi WH, Al-Rashidi AF. Multidisciplinary Collaboration In Emergency Medical Services. Journal of Positive Psychology and Wellbeing. 2022;6(3):695-721.
31. Wehbi NK, Wani R, Yang Y, Wilson F, Medcalf S, Monaghan B, Adams J, Paulman P. A needs assessment for simulation-based training of emergency medical providers in Nebraska, USA. Advances in Simulation. 2018 Dec;3:1-9.
32. Newgard CD, Zive D, Jui J, Weathers C, Daya M. Electronic versus manual data processing: evaluating the use of electronic health records in out-of-hospital clinical research. Academic Emergency Medicine. 2012 Feb;19(2):217-27.
33. Laub N, Agarwal AK, Shi C, Sjamsu A, Chaiyachati K. Delivering urgent care using telemedicine: insights from experienced clinicians at academic medical centers. Journal of General Internal Medicine. 2022 Mar;37(4):707-13.

34. Holmström IK, Kaminsky E, Lindberg Y, Spangler D, Winblad U. Registered nurses' experiences of using a clinical decision support system for triage of emergency calls: a qualitative interview study. Journal of advanced nursing. 2020 Nov;76(11):3104-12.
35. Barger LK, Runyon MS, Renn ML, Moore CG, Weiss PM, Condle JP, Flickinger KL, Divecha AA, Coppler PJ, Sequeira DJ, Lang ES. Effect of fatigue training on safety, fatigue, and sleep in emergency medical services personnel and other shift workers: a systematic review and meta-analysis. Prehospital emergency care. 2018 Feb 15;22(sup1):58-68.
36. Biquet JM. *Patient safety in medical humanitarian action: medical error prevention and management* (Doctoral dissertation, Université de Lyon; Université de Genève).
37. Bijani M, Abedi S, Karimi S, Tehranineshat B. Major challenges and barriers in clinical decision-making as perceived by emergency medical services personnel: a qualitative content analysis. BMC emergency medicine. 2021 Dec;21:1-2.
38. Sinnott C, Georgiadis A, Park J, Dixon-Woods M. Impacts of operational failures on primary care physicians' work: a critical interpretive synthesis of the literature. The Annals of Family Medicine. 2020 Mar 1;18(2):159-68.
39. Wästerhed J, Ekenberg E, Hagiwara MA. Ambulance nurses' experiences as the sole caregiver with critical patients during long ambulance transports: an interview study. Scandinavian journal of trauma, resuscitation and emergency medicine. 2024 Jan 23;32(1):6.
40. Vahabi M. The impact of health communication on health-related decision making: A review of evidence. Health Education. 2007 Jan 2;107(1):27-41.
41. Glenn M, Zoph O, Weidenaar K, Barraza L, Greco W, Jenkins K, Paode P, Fisher J. State regulation of community paramedicine programs: a national analysis. Prehospital emergency care. 2018 Mar 4;22(2):244-51.
42. Mariner WK, Miller FH. Medical error reporting: professional tensions between confidentiality & liability. Massachusetts Health Policy Forum.
43. Kakria P, Tripathi NK, Kitipawang P. A real-time health monitoring system for remote cardiac patients using smartphone and wearable sensors. International journal of telemedicine and applications. 2015;2015(1):373474.
44. Getahun B, Nkosi ZZ. Satisfaction of patients with directly observed treatment strategy in Addis Ababa, Ethiopia: a mixed-methods study. PLoS One. 2017 Feb 9;12(2):e0171209.
45. Shankar KN, Bhatia BK, Schuur JD. Toward patient-centered care: a systematic review of older adults' views of quality emergency care. Annals of emergency medicine. 2014 May 1;63(5):529-50.
46. Phillips TA. Attitudes and Perceptions of Emergency Medical Service Providers' Role in Educating Patients: A Cross-Sectional Survey.
47. Reay G, Norris JM, Nowell L, Hayden KA, Yokom K, Lang ES, Lazarenko GC, Abraham J. Transition in care from EMS providers to emergency department nurses: a systematic review. Prehospital emergency care. 2020 May 3;24(3):421-33.
48. Ryan BJ, Franklin RC, Burkle Jr FM, Aitken P, Smith E, Watt K, Leggat P. Reducing disaster exacerbated non-communicable diseases through public health infrastructure resilience: perspectives of Australian disaster service providers. PLoS currents. 2016 Dec 21;8.
49. Thim S, Henriksen TB, Laursen H, Schram AL, Paltved C, Lindhard MS. Simulation-based emergency team training in pediatrics: a systematic review. Pediatrics. 2022 Apr 1;149(4):e2021054305.
50. Hsu HC, Lin CH, Hsieh CC, Fang PH, Shih WT, Liu WC, Chi CH, Shih HI. Developing a Complex Simulation Training Program for Emergency Medical Services Paramedics Using a High-Fidelity Simulation Model. Journal of Medical Education. 2016 Dec 1;20(4):296-307.
51. Stefos KA, Nable JV. Implementation of a high-performance cardiopulmonary resuscitation protocol at a collegiate emergency medical services program. Journal of American College Health. 2016 May 18;64(4):329-33.
52. Meretoja A, Strbian D, Mustanoja S, Tatlisumak T, Lindsberg PJ, Kaste M. Reducing in-hospital delay to 20 minutes in stroke thrombolysis. Neurology. 2012 Jul 24;79(4):306-13.

53. Patterson PD, Higgins JS, Van Dongen HP, Buysse DJ, Thackery RW, Kupas DF, Becker DS, Dean BE, Lindbeck GH, Guyette FX, Penner JH. Evidence-based guidelines for fatigue risk management in emergency medical services. Prehospital emergency care. 2018 Feb 15;22(sup1):89-101.
54. Ahmed Z, Mohamed K, Zeeshan S, Dong X. Artificial intelligence with multi-functional machine learning platform development for better healthcare and precision medicine. Database. 2020;2020:baaa010.
55. Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?. BMJ global health. 2018 Aug 1;3(4):e000798.
56. Rak RR. Internet of healthcare (law): privacy and data protection aspects in an internet of everything.
57. Kristiansen T, Søreide K, Ringdal KG, Rehn M, Krüger AJ, Reite A, Meling T, Næss PA, Lossius HM. Trauma systems and early management of severe injuries in Scandinavia: review of the current state. Injury. 2010 May 1;41(5):444-52.
58. Jaeger PT, Shneiderman B, Fleischmann KR, Preece J, Qu Y, Wu PF. Community response grids: E-government, social networks, and effective emergency management. Telecommunications Policy. 2007 Nov 1;31(10-11):592-604.
59. Munjal KG, Margolis GS, Kellermann AL. Realignment of EMS reimbursement policy: new Hope for patient-centered out-of-hospital care. JAMA. 2019 Jul 23;322(4):303-4.