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Disaster preparedness in emergency medical service agencies: A systematic review

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Abstract:

The Emergency Medical Services (EMSs) are in the frontline between the health-care systems and people in emergencies and disasters. With the increase in the frequency of natural or man-made disasters around the world, the need for prepared EMS services is increasing. This study aimed to evaluate the current disaster preparedness status of the EMS agencies in the literature and exploring the key preparedness elements and the strategies to improve the EMS disaster preparedness. The electronic database such as PubMed, Web of Science, Scopus, and Google Scholar was searched from 2000 to 2019. The searching keywords included: "EMS," "Disaster," "Preparedness," "Emergency" "Preparedness," "Disaster Preparedness," "Readiness," and the terms related to "disaster types" were used in combination with Boolean operators OR and AND. Out of 1412 articles, 7 articles were included in the review. The most important elements of the EMS disaster preparedness include the size and scope of the incident, surge capacity, planning, communication, training and education, policymaking, financial support, coordination, safety and security, early warning system, disaster response experience, and legal considerations. This systematic review showed that the EMS agencies in the world generally are inadequately prepared for an effective response to major emergencies and disasters. This study provides valuable information to EMS educators, EMS administrators to adopt and perform appropriate activities to improve the EMS disaster preparedness.

Keywords:

Disaster, emergency medical services, preparedness

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Introduction

The EMS systems are in the frontline between the health systems and people in disasters and life-threatening situations. In many countries, EMS is a "gateway" to access specialized care and treatments.[1-3] Moreover, the WHO considers it as a critical part of an effective and efficient health-care system.[4] Disasters take place everywhere in the world and cause many injuries and death people.[5] At the time of writing this article (June 3, 2020), COVID-19 cause death of 384,617 people in the world.[6] Health is one of the main issues in disasters, and improving the health of disaster victims is a major priority for all countries and international organizations and documents such as the United Nations Office for Disaster Risk Reduction (UNDRR)[7] and Sendai Framework for Disaster Risk Riduction.[8] Hence, special consideration for the preparedness of the health systems, especially EMS systems, is essential to ensure the implementation of the UNDRR 2015–2030. EMS systems have advanced over the past 30 years, and they have a brilliant track record in leading and managing numerous disasters.[4,9] Based on the Target Capabilities List of the Homeland Security Department, scene management, triage and

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treatment of casualties, management and distribution of medical supplies and equipment, and shelter are among the roles of the EMS in different emergencies and disasters.[10] With the increasing frequency of various disasters and emergencies around the world, the need for EMS services has also increased substantially, which requires extensive preparedness to improve public health response to disasters.[1] Globally, there is a consensus on the positive effects of disaster preparedness of the EMS systems, and providing the necessary education and training for improving the preparedness of the EMS will play a major role in reducing casualties and mitigating the impact of disasters.[1] Based on the International Strategy for Disaster Reduction (UNISDR 2011), preparedness is "the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions."[7] Given the critical roles of the EMS in the management of disasters, evaluating the current status of the preparedness and exploring the main disaster preparedness elements of the EMS is necessary to improving the preparedness, and achieve effective disaster response. Therefore, this review study was conducted to evaluate the current status of EMS disaster preparedness in the literature and exploring the key preparedness dimensions and the strategies to improve the EMS disaster preparedness.

Materials and Methods

Searching strategies and databases

Search strategy

The present study was a systematic review of publications relating to disaster preparedness of EMS agencies. The study performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[11] and the protocol for this systematic review was published previously[12]. The electronic databases were thoroughly searched to identify relevant studies. The following databases were searched: PubMed, Web of Science Core Collection, Scopus, and Google Scholar. For each database, words and expressions from a controlled vocabulary (MESH and others) and free text searching strategies were used. Only studies that have been published in English from January 1, 2005, to December 31, 2019, were considered for inclusion in this review. Furthermore, to find other potentially relevant articles, the references of the extracted articles were examined. The search was conducted using pre-determined keywords.

Selection of keywords

The keywords and their synonyms included in our search strategy were: "Emergency Medical Service," "Emergency Prehospital Service," "Prehospital Emergency Care," "Ambulance agency," "Disaster," "Emergency," "Mass Casualty Incident," "Weapons of Mass Destruction," "Chemical," "Biological," "Radiological," "Nuclear," and "Explosive Event" (CBRNE), and "Terrorist incident," "Preparedness," "Emergency Preparedness," "Disaster Preparedness," "Readiness,". Using OR and AND, key words were combined and entered in the search box of the databases as follows: (Emergency Medical Service OR Emergency Prehospital Service OR Prehospital Emergency Care OR Ambulance agency) AND (Disaster OR Emergency OR Mass Casualty Incident OR Weapons of Mass Destruction OR CBRNE event OR Terrorist incident) AND and (Preparedness OR Emergency Preparedness OR Disaster Preparedness OR Readiness).

Eligibility criteria

Inclusion and exclusion criteria

In the present study, no restrictions were placed on the design of the selected studies. All initial and secondary studies, whose objectives were to evaluate disaster preparedness of EMS agencies, published in the English language between 2000 and 2019, were considered for review. Dissertations, book chapters, and conference papers were excluded. Furthermore, studies that were not relevant to the aims of the study or did not have abstract and full text or were not published as at the time of the study were excluded.

Selection process

After searching all the databases, the selected articles were inserted into EndNote, and duplicates were removed. After the duplicates were removed, the title and abstract of the selected articles were carefully screened by two independent reviewers for determining the potential eligibility of the studies. Disagreements were resolved by consensus. All of the articles deemed eligible were successfully downloaded and in the same way, the full-texts of the potentially relevant studies were reviewed by independent reviewers for inclusion and synthesis. Any disagreements were again resolved by consensus and reasons for excluding a specific study were documented [Figure 1].

Quality assessment

In the present study, we did not place any restrictions on the type and methodologies of the selected studies; hence, there are no specific tools for quality assessment. Therefore, to evaluate the methodological quality of the selected studies, the STROBE checklist was used tailored to the type of study. In this stage, the selected studies were assessed by two independent reviewers using an appropriate assessment tool for determining the eligibility of the articles for inclusion. Any disagreements were resolved through a consensus method, otherwise, a third reviewer was involved.

Search outcomes

The initial search yielded 1412 titles. After the removal of duplicate studies, 731 articles were considered for title screening. This number was decreased to 43 articles after title/abstract screening. The remaining articles (688) were excluded due to a lack of relevance to the aims of the study. After reading and reviewing the full text of the 43 selected articles, seven studies were considered for the present systematic review. The selection process of the studies is shown in Figure 1.

Results

The findings of this systematic review study include specific details about: (1) research methodology of the selected studies, (2) reported preparedness status and the level of EMS agencies' disaster preparedness, (3) main elements of disaster preparedness of the EMS, and (4) and the strategies to improve preparedness.

Research methodology of the selected studies

Most of the studies included in this review were conducted in the United States[2,13-15] and the three other studies were conducted in Iran,[3] Saudi Arabia,[16] and Finland.[17] Almost all of the studies were cross-sectional (quantitative), and questionnaires or survey checklists were used for data gathering. Only one study used the nominal group interview technique for data collection [Table 1].[2] The sample size of the various studies ranged from 13 to 1932 EMS agencies. Participants of the selected studies included personnel of providence-based, county-based, state-base, and district hospital-based EMS agencies. The majority of the studies used researcher-made tools for evaluating and measuring disaster preparedness of the EMS agencies.[2,11-15,17] One study used the modified version of the emergency medical specialists' (EMS) incident response and readiness assessment (EIRRA) tool.[16] This tool was developed by the United States National Association of State Emergency Medical Services Officials (NASEMSO) for measuring the MCI preparedness. This tool includes seven benchmarks: infrastructure, personnel, public awareness and notification, emergency care system, governance, evaluation, and mass casualty planning. There are 31 indicators in each benchmark. Another study used the "Emergency Medical Services (EMS) Checklist for Ebola preparedness" designed by the Center for Disease Control and Prevention (CDC) for data gathering.[3] The CDC questionnaire includes 54 questions classified into three themes; being prepared to detect, being prepared to protect, and being prepared to respond. Among the instruments in the various studies for data collection, only the Arabic version of the emergency medical specialists (EMS) incident response and readiness assessment (EIRRA) and the CDC "Emergency Medical Services (EMS) Checklist for Ebola preparedness" were standard tools for evaluating the EMS preparedness in emergencies and disasters. There is no valid universal standard tool specifically designed for evaluating the preparedness of EMS systems in disaster situations. A summary of the selected studies used for this review is shown in Table 2.

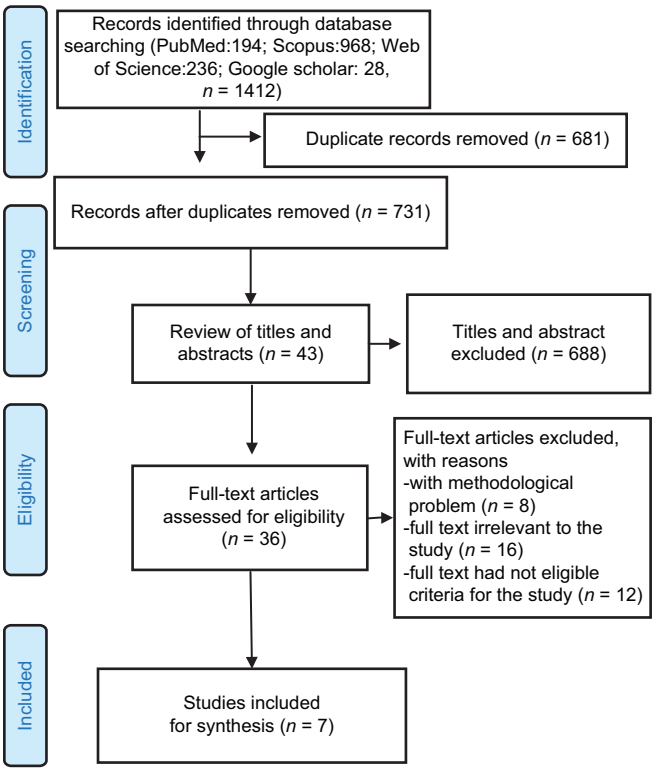

Figure 1: Selection process flow diagram

Table 1: The characteristics related to the selected studies (7 articles)

Study characteristics		Frequency (%)
Date of publication		
2005-2010		4 (57.14)
2011-2016		1 (14.28)
2017-2019		2 (28.57)
Type of study		
Cross-sectional (quantitative)		6 (85.71)
Nominal group (quantitative-qualitative)		1 (14.28)
Country (Study originated country)		
United States	[2,12,13,14]	4 (57.14)
Iran	[3]	1 (14.28)
Finish	[16]	1 (14.28)
Saudi Arabia	[15]	1 (14.28)
Type of incident		
MCI	[15,16]	2 (28.57)
Ebola	[3]	1 (14.28)
Massive epidemic event	[2]	1 (14.28)
MTCWA	[12]	1 (14.28)
Mass-casualty chemical incidents	[13]	1 (14.28)
Emergencies and disasters	[14]	1 (14.28)

MCI=Mass casualty incident, MTCWA=Mass-terrorism chemical weapons attack

The reported level of EMS preparedness for response to emergencies and disasters

The results of this review indicate that, overally, EMS agencies are not adequately prepared for response to disasters in the countries where the selected studies were conducted. However, a study conducted by Jadidi *et al*. indicated that the average preparedness score of the EMS system in Iran for response to Ebola was higher rates (63.73% ± 12.77%).[3] Alotaibi and Khan evaluated the preparedness of EMS in 13 regions of Saudi Arabia for the response to mass casualty incidents (MCI). This study showed that in general, the Saudi Arabian emergency medical systems are not adequately prepared for managing MCIs.[16] Maguire *et al*. explored the preparedness of EMS agencies in one US state for responding to a massive epidemic event. The authors indicated that most of the EMS agencies in this state do not have broad, formal plans for response to large-scale bioterrorism or pandemic events.[2] In another study conducted by Phelps, the preparedness of the EMS for managing victims and responding to threats from a mass-terrorism chemical weapons attack (MTCWA) was assessed. This study reported that only 6 (12%) of the EMS agencies in the region equipped their staff with personal protective equipment (PPE). The authors of this study indicated that the EMS providers were not prepared to safely respond to MTCWAs.[1] In the study of Shirm *et al*., 1932 state EMS agencies in the United States were randomly selected to document the preparedness of EMS agencies for the care of children in mass-casualty events. The study showed that though most (72.9%) of the EMS agencies have a written plan for responding to an MCI, only 248 (13.3%) of EMS agencies had pediatric-specific MCI plans. Furthermore, this study reported that there are considerable deficiencies in the preparedness plans of EMS agencies in the United States for the care of children in MCIs.[14] Jama and Kuisma in Finland conducted a study to survey the preparedness level of EMS systems to respond to chemical MCIs in the prehospital phase. The results of their study indicate that the EMS capacity in Finland for treating casualties in chemical MCIs, especially for cyanide gas exposure, is weak. Nevertheless, there was a good level of preparedness for managing and handling chemical accident patients with bronchodilators, supplemental oxygen, and inhaled corticosteroids.[17] And finally, Furbee *et al*., in the USA, evaluated 768 rural EMS organizations to determine the preparedness of rural EMS agencies for emergencies and disasters. The findings of their study indicate that many rural EMS organizations have limited resources and surge capacities, and are not adequately prepared for the response to events involving 10 or more victims. In addition, there was a low level of preparedness for response to terrorist bombing.[15] [Table 2].

Main preparedness elements of EMS agencies in disasters

After analysis of the selected studies (7 papers), 12 main elements of preparedness, and some activities (subthemes) that can positively affect the outcome of disaster response were identified. The elements include size and scope of the incident, surge capacity (staff, stuff, and infrastructures), planning, communication, training and education, policymaking, financial support, coordination, safety and security, early warning system, disaster response experience, and legal considerations [Table 3].

Strategies to enhance of the EMS agencies preparedness in disasters

Several strategies aimed at enhancing disaster preparedness of EMS agencies have been introduced in the literature. Alotaibi and Khan suggested the supply of sufficient skilled EMS personnel, including medical directors and paramedic graduates. Skilled EMS personnel are trained on how to respond to disasters and they participate in developing guidelines and disaster preparedness planning.[16] Infrastructure improvement, prehospital care system, public awareness/notification, effective evaluation system (evaluation of the performance of emergency responders during disasters and status of pre-hospital medical care), and the development and implementation of disaster preparedness plan were other strategies suggested by Alotaibi and Khan.[16] Close coordination between local EMS agencies and state or national EMS agencies in making EMS policies, guidelines, and procedures for response to disasters is another strategy suggested by Maguire *et al*.[2] Other strategies suggested by Maguire *et al*. include the following: providing safety and support for both responders and their families, the use of alternative modes of prehospital transportation and treatment, including expanding the role of EMS personnel to providing additional treatments and prescribing medications, the integration of local plans of EMS agencies with public health response plans, identifying and training alternate groups of people such as school teachers, artists, business professionals, and other professions without disaster-related responsibilities by the EMS system, the coordination of EMS leaders with hospital and local health officers to make alternate treatment plans and triage methods, and the development of close working relationships with health agencies, emergency management, and selected administrators within their local communities (2007).[2] Jadidi *et al*. indicated that improving staff motivation, stuff, educational courses, management, and IT sectors could potentially increase the level of EMS preparedness (2007),[2] Phelps have also suggested expanding the role of EMS technicians to providing additional treatments and prescribing

Table 2: A summary of selected studies for review

Author	Settings	Samples	Sampling method	Research purpose	Research design	Instrument	Results
Alotaibi *et al*. (2019)	Saudi Arabia	EMS agencies from 13 regions	A convenience sample sampling size not computed	To assess the MCI preparedness of EMS in Saudi Arabia and to identify their strengths and weaknesses when responding to MCIs	A cross-sectional, quantitative study	The modified version of the EIRRA tool was used in this study	The study results indicated that overall, the Saudi Arabia emergency medical system is limited prepared for managing MCIs in 13 regions
Maguire *et al*. (2007)	USA	EMS agencies from nine counties	Purposive sample (convenience sampling)	To determine the preparedness of EMS agencies in one US state to cope with a massive epidemic event	Nominal group	Researcher-made study-specific questionnaire	The findings indicate that most of the EMS agencies do not have broad, formal plans for response to large-scale bioterrorist or pandemic events. So, EMS agencies in this state fundamentally are unprepared for a large-scale bioterrorism or pandemic event
Jadidi *et al*. (2019)	Iran	EMS agencies in 31 provinces	Census method	To evaluate the efficacy and preparedness of EMS in Islamic Republic of Iran to face Ebola	A cross-sectional, quantitative study	"EMS checklist for Ebola preparedness" designed by CDC	The preparedness average score in this study is higher than standards
Phelps *et al*. (2007)	USA	70 after-action reports from 70 city-base EMS	Convenience sampling	To examines the preparedness of the EMS to respond to, treat, and transport victims of a MTCWA	A cross-sectional, quantitative study	Researcher- made questionnaire/ check list	Of the 50 after action reports that mentioned about EMS personal protective equipment, only six (12%) EMS agencies equipped their staff with personal protective equipment Results indicate that EMS responders are not prepared to safely respond to MTCWAs, which may result in a significant loss of life of victims and responders
Shirm *et al*. (2007)	USA	1932 state EMS agencies	Random sampling	To document the preparedness of EMS agencies in the United States for the care of children who are involved in mass-casualty events	A cross-sectional, quantitative study	Researcher- made questionnaire	Most (72.9%) agencies reported having a written plan for response to a mass-casualty event, but only (13.3%) reported having pediatric-specific mass-casualty event plans

Contd...

Table 2: Contd...

Author	Settings	Samples	Sampling method	Research purpose	Research design	Instrument	Results
							There are substantial deficiencies in the preparedness plans of EMS agencies in the United States for the care of children in a mass-casualty event
Jama *et al*. (2016)	Finish	20 hospital districts EMS	Census method	To survey the preparedness level of EMS systems for managing and handling mass-casualty chemical incidents in the prehospital phase	A cross-sectional, quantitative study	Researcher-made questionnaire	EMS capacity in Finland for treating chemically affected patients in the field needs to be improved. Preparedness for administering antidote therapy for cyanide gas exposure was, in general, low. Overall, there was a good level of preparedness for treating chemical accident patients with supplemental oxygen, broncho-dilators, and inhaled corticosteroids
Furbee *et al*. (2006)	USA	768 rural EMS agencies	Census method Sampling	To determine the preparedness of rural EMS agencies for emergencies and disasters	A mailed, written survey	Researcher-made questionnaire	Many rural EMS organizations reported that incidents involving a greater number of victims inspired less confidence in their preparedness. Respondents were less confident in their level of preparedness for a terrorist bombing
							In general, these organizations have limited resources and surge capacities. Their ability to respond adequately to mass-casualty events involving dozens of patients is questionable, and that they do not have the ability to respond effectively to large-scale disasters

MCI=Mass casualty incident, MTCWA=Mass-terrorism chemical weapons attack, EMS=Emergency medical services, EIRRA=EMS incident response and readiness assessment, CDC=Center for disease control and prevention

Table 3: Main elements of emergency medical services disaster preparedness and their activities

EMS preparedness elements	Activities with reference (subthemes)
Size and scope of the incident	Less preparedness confidence for incidents involving a greater number of victims,[1] comical and terroristic events,[1] felt confident in dealing with motor vehicle trauma[1]
Policymaking	Alliance of all-hazard approach in disaster planning,[1] participating of local EMS in establishing policies and procedures by national (state) EMS agency,[1,2] alliance of a single standard for disaster planning[1]
Planning	Developing disaster preparedness plan,[3] developing specific EMS disaster plan,[2] developing disaster preparedness and response SOPs (such as pediatric disaster SOP,[4] developing pediatric and adult triage SOP,[4] protecting EMS providers and their families SOP,[2] developing national and statewide protocols and a disaster plan for major incidence,[2] developing ambulance dispatch management SOP,[2] designing alternative modes of transportation and treatment protocol for EMS providers[2]), developing written disaster response plan,[4] adherence of local response plan to the national response plan,[2] developing disaster-related occupational safety plans,[2] participating all stakeholders in writing of disaster response plan,[1] determining and clearance of preparedness standards[1] trying on well-conceived and implementing completely the disaster plan[1]
Surge capacity	Infrastructure (suppling suitable number and distribution of operation centers and ambulance center base on the population,[3] developing EMS performance system,[3] developing effective prehospital evaluation system[3]), staff (tring to recruitment sufficient and specialist human resource included physicians, paramedic, in the EMS centers,[2,5] availability of providers and ability to attract and retain personnel,[1,2]) suppling the stuff (ambulance,[3] quick detection kit of comical and hazardous materials,[6] alternative vehicle such as mass-casualty transport vehicles,[2] equipment and logistic,[5] personal protective equipment for EMS responder,[6,7] decontamination equipment[6]), suppling of the resources and promoting the surge capacities[1]
Financial support	Allocating adequate fund to EMS[1,7]
Communication	Developing national communications networks.[2,3] Having closer intra and extra-organizational relationship,[2] having risk communication,[3] having intra organizational communication,[2] having closer working relationship with health institutes and elected officials within their local communities[2]
Coordination	Having inter-organizational coordination (such as joint operation room,[3] EMS membership in the supreme disaster committee[3]) and having intera-organizational coordination (such as EMS interaction with the state EMS agency, local and state health department,[2] EMS aware of and integrated with public health response plans,[2]working with hospital and local health officers to create disaster SOP[2])
Training and education	Holding operational exercises (drill),[1,7] implementing theoretical education course,[5] implementing continuous disaster training,[1] exercising disaster plan with DMAT, and CST.[1] Training needs assessment and determining educational priorities (for educational multiple casualty events,[1] chemical accidents,[6] Training alternate groups of people,[2] disaster response plan,[2] CBRN,[7] disaster management[3] and ability to communicate with other responders[1]), holding a training course from local or state health departments[2]
Early warning system	Developing surveillance system[2] rapid identification of hazardous substance[6]
Disaster response Experience	Increased operational exercises and readiness after an incident,[1,3] effect of day-to-day operations on EMS preparedness,[1] effect of more occurrence incidents on increase of preparedness,[1] less preparedness for rare events such as comical and terroristic events[1]
Legal considerations	Legal factors is major hurdle in EMS disaster preparedness[2]
Safety and security	Decontamination,[6], supplying of personal safety,[6] personnel and vehicle decontamination and supplies,[2] vaccination and prophylactic medications,[2] supporting mental health[4]

EMS=Emergency medical services, DMAT=Disaster medical assistance team, CST=Civil support team, SOPs=Standard operating procedures

medications (2007).[13] Supplying sufficient PPE and allocating grants to provide the necessary tools and also for staff training are other EMS preparedness strategies suggested by Phelps.[13] The focus of Shirm *et al*.,[14] in their study was child prehospital health care in disasters. Shirm *et al*., suggested the following strategies: specific written disaster plan for the care of pediatric victims, the involvement of pediatricians in community-level disaster planning and coordination with local schools and child care center officials to discuss emergency planning, the use of pediatric-specific triage protocol for the triage of pediatric victims in disasters, including local reunification plan in the local disaster plan, and including of pediatric victims in the community and regional disaster drills for acquiring pediatric-specific skills in disasters.[14] Improving decontamination preparedness and the capacity of emergency medical services for treating chemically affected patients are two important preparedness strategies suggested by Jama and Kuisma.[17] Moreover, improving the efficiency and effectiveness of day-to-day operations of the EMS, maintaining an all-hazards approach in disaster management measures, improving inter-agency communication skills and capabilities, increasing the participation of local EMS agencies in regional planning, and clarification of the local EMS roles and responsibilities in communication and interaction with other local, state and federal EMS agencies are some suggestions proposed by Furbee *et al*.[15]

Discussion

The main objective of this review was to evaluate the preparedness level of EMS agencies in disasters. The most significant finding of this study is that the EMS agencies in the countries that the studies have originated from there are not adequately prepared for response to the disasters. Despite the critical role of EMS in the care of disaster casualties, very few studies have been conducted on the preparedness of the EMS for the response to the disaster in different countries in the world. Most of the studies reviewed in the present systematic review were conducted in the USA.[2,13-15] Disaster occurrence is unpredictable and hence, the need for further research to improve disaster response is recommended, especially in disaster-stricken countries and countries with high disaster risks. Most of the studies used researcher-made tools.[2,13-15,17] Moreover, specific hazard questionnaires for data collection, however, most of these tools did not have psychometric analysis to confirm their validity. This highlights the necessity of developing standard all-hazard approach tools that have been validated through the appropriate psychometric process and measure comprehensively all aspects and dimensions of EMS agencies' preparedness in disasters.

In the present review, we also explored the main dimensions of EMS preparedness for response to emergencies and disasters. In this regard, we identified 12 main dimensions of preparedness, including Size and scope of the incident, surge capacity, disaster planning, communication, training and education, policymaking, financial support, coordination, safety and security, early warning system, disaster response experience, and legal considerations. Some activities related to these dimensions that can positively affect the outcome of disaster response hare shown in Table 3. The dimensions of preparedness include various aims or final states that preparedness seeks to achieve, and the activities are solid actions that need to be taken to meet those goals.[18] One of the dimensions of preparedness identified in this study is the "Size and scope of the incident." What is clear based on reviewed literature is that with the increase in the size and complexity of the incidents and the number of casualties, the confidence of EMS agencies in response to disasters decreases.[15,17] Furbee *et al*., reported that many rural EMS organization personnel had low confidence in their preparedness for incidents involving a greater number of victims and for terrorist bombing incidents.[15] In addition, based on the findings of Jama and Kuisma, EMS agencies have low confidence in responding successfully to chemical mass-casualty situations.[17] However, EMS agencies feel confident in dealing with motor vehicle trauma.[15] This could be due to the increase in the response capacity. Depending on the size of the incident and the number of casualties, health systems face variable demands for healthcare resources.[19] Moreover, fluctuations in readiness or willingness to respond to different disasters can affect the confidence of EMS agencies. Recent evidence shows that emergency medical service providers may not always be willing to respond to CBRNE terrorism and related incidents.[20,21] Another study reported that the willingness of EMS paramedics to respond to disasters is directly influenced by the type, duration, and visibility of the disaster.[22]

Policy-making is another preparedness dimension that was explored in this study. Using an all-hazard approach is a cost-effective approach in term of time and money[23] in disaster planning, and determination of single standards for it are two main activities that expected by EMS officials in all jurisdictions.[2,15] This is because if policies are developed as part of a disaster preparedness plan in all jurisdictions, disaster relief will be more organized, less chaotic, and more estimated.[24] Based on the results of this study, disaster planning is among the main pillars of EMS disaster preparedness. Disaster planning plays a critical role in an effective response to disasters, and it involves a coordinated process to meet urgent needs with existing resources.[25] In addition, disaster planning is one of the most important elements in the assessment of disaster preparedness of health-care agencies such as hospitals.[26,27] The standard operating procedures (SOPs) is an essential element in emergency and disaster management.[28] The codification and development of SOPs and protocols for EMS disaster management include the following phases: mitigation, preparedness, response, and recovery [Table 3].

An increase in demand for health-care services due to a sudden surge of casualties is one of the most important concerns of health-care systems during disasters[29] and this is the main goal of the "surge capacity" concept in disasters.[30,31] Staff (human resources), structures (facilities and physical space), and specialized and nonspecialized equipment are the three main elements of surge capacity.[32] Therefore, strengthening the capacity of the EMS agencies in areas of human resources, structures, and facilities and equipment are the most important activities in this dimension than can positively affect the preparedness of the EMS [Table 3]. Effective communication and coordination are other elements of preparedness of the EMS identified in this review. Developing national communications networks,[2,16] having closer intra- and extra-organizational relationships,[2] risk communication,[16] having intraorganizational communication[2] and having a closer working relationship with health institutes and elected officials within their local communities[2] are some of the activities suggested by the available literature for improving the

communication of EMS systems in disasters. Palttala *et al*., indicated that communication in disasters is not yet properly integrated into disaster management practice and just the existence of disaster communication plans and other guidelines are not adequate, but rather they need to be developed further.[33]

Education and training of the EMS providers, considered as the heart of EMS systems,[34] are other critical elements of EMS preparedness in disasters. Providing standardized disaster training is one of the main requirements for assessing EMS disaster preparedness.[35] Evidence from previous studies shows a lack of sufficient training courses aimed at improving disaster response outcomes.[21,35] Also, other studies have shown that adequate disaster-related education and training improve disaster preparedness perceptions.[36,37] The assessment of training needs, planning, and implementation of continuous theoretical and practical disaster educational courses, as well as training alternate groups of peoples, were the main strategies suggested by the studies in this review. Disaster response experience, early warning system, financial support, legal considerations, and safety and security were the other elements of EMS disaster preparedness highlighted by the studies in this systematic review. About the effects of previous disaster response experience on disaster preparedness, studies conducted by Alotaibi and Al Thobaity,[38] Baack andAlfred[39] and Nilsson *et al*.[40] demonstrated that previous experience from major disasters increased the perceived level of disaster preparedness among healthcare providers. Providing safety and security are also among the most important issues in preparedness and the willingness of EMS providers to respond to various emergencies and disasters. Rebmann *et al*. reported that administering prophylaxis to EMS personnel and their family and safety were the main factors that affected the willingness of health-care workers' response to the influenza pandemic.[41]

Limitations

One of the limitations of this literature review is related to the study selection phase. In this review, only the studies published in the English language were selected, and potentially relevant studies published in other languages were not selected. Further limitation for this study is the inability to generalize the study results to all EMS agencies in the world due to lack of broad representation of most world nations about EMS disaster preparedness.

Conclusion

The most important finding of this systematic review is that the EMS agencies in the countries that the studies have originated from there are not adequately prepared for response to various emergencies and disasters. In addition, few studies have been conducted on EMS disaster preparedness in the world; therefore, more studies are needed in other countries, especially in disaster-stricken countries and in countries with high disaster risks. The findings of this review indicate that the most tools used in the selected studies is not standard, especially standard tool with a multi-hazard approach for evaluating and assessing the preparedness of EMS agencies in emergencies and disasters. Therefore, designing the tools with a standard methodological approach is required. Planning and implementing activities related to the roles of the main elements of preparedness that were identified in this review can help to improve the preparedness of EMS systems in disasters. Also, the findings of this study provide valuable information to EMS educators, EMS administrators, and researchers which can be utilized in designing standard disaster preparedness assessment tools. Disaster preparedness assessment can support EMS agencies to be adequately prepared for the response to different emergencies and disasters.

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Conflicts of interest

There are no conflicts of interest.

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