REVIEW ARTICLE

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Identification of prehospital emergency challenges in the COVID-19 pandemic: a systematic review

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Abstract: **Objective:** The prehospital emergency system, as the front line of the health system, has played a very prominent role in the management of the COVID-19 pandemic. Given that identifying the challenges of this area in facing various crises, especially COVID-19, can be a road map for preparing and planning for crisis management in the future, the current study was conducted with the aim of identifying the challenges of prehospital emergency in facing the corona pandemic.

Methods: The present systematic review was carried out based on the PRISMA protocol. The search was conducted using the keywords “challenges, obstacles, prehospital emergency and COVID-19” in PubMed, Scopus, and Web of Science databases, and Google Scholar search engine between December 15, 2019 and March 20, 2023. Non-English articles and articles outside the scope of the COVID-19 pandemic were excluded from the study. CASP (critical appraisal skills program), JBI (Joanna Briggs institute) and MMAT (mixed methods appraisal tool) checklists were used to evaluate the quality of the articles.

Results: Based on the searches, 12 articles were finally evaluated. Challenges extracted from the analysis of studies were classified into 3 main categories and 7 subcategories including the main categories of “process, structural, and psychological challenges” and the subcategories of “lack of equipment, inappropriate management of human resources, deficiencies in protocols and instructions, weak staff training, occupational burnout, and weak socio-organizational support”.

Conclusion: The prehospital emergencies of the countries have faced some challenges after the outbreak of COVID-19, which requires the implementation of adaptive strategies and the efforts of the authorities to solve them to prepare for similar crises.

Keywords: COVID-19; Epidemic; Pandemic; Prehospital Emergency; Systematic Review

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1. Introduction

Since the beginning of 2020, the cornavirus disease 2019 (COVID-19) epidemic has emerged as one of the most important threats to public health in the last century with its rapid prevalence, high severity, and high mortality rate (1). Based on the official statistics of the world health organization, until April 12, 2023, more than 762 million confirmed cases of COVID-19 were reported along with more than 6 million deaths (2). With the prevalence of COVID-19 as a crisis and pandemic, the existence of modern medical capabilities, including correct diagnosis, increasing public knowledge, and the knowledge of medical personnel, made the chances of fighting this epidemic many times higher than previous large epidemics; yet, with the rapid increase in the number of infections, the potential of health care units and treatment in every country, even the most advanced one, faded quickly and faced some limitations (3). Consequently, the passage of time and the prevalence of the COVID-19 epidemic showed that many challenges have been created in providing emergency care services in the community, especially in clinical and hospital settings (4). In this way, it challenged the health system of different countries and highlighted the need for the participation of different parts of the health and treatment system to prevent and provide services to control and diminish this disease (1). In the health systems, several organizations have been established to "maintain people’s health", each of which fulfills this task by assuming a part of the re-sponsibility. Considering the role that sometimes seconds and minutes play in saving human lives, the medical emergency management center is one of the most important centers that plays a vital role in the patient’s bedside and transfer to medical centers (5).

Prehospital emergency is actually a community-based care system that responds to the medical needs of injured casualties or patients suffering from emergency and acute diseases outside the health care center, until they are transferred to a medical center (5,6).The prehospital emergency system as the front line of the health system plays a very prominent role in the management of the COVID-19 epidemic (7). Prehospital emergency personnel are one of the most important main groups in this epidemic, who are at the top and first line of care (7). Considering the high workload and increased number of pre-hospital emergency missions due to the prevalence of COVID-19 as a pandemic, many challenges were created for the emergency medical center. Based on various studies, the number of calls and missions of emergency medical centers has increased after the outbreak of COVID-19 (8,9). Following the increased number of missions due to the prevalence of COVID-19, measures taken by emergency medical centers included increased number of personnel, the reduced leave time between shifts, and the increased overtime hours to provide better service (9). Based on qualitative studies conducted in Iran, most of extracted challenges that were reported included “anxiety and stress caused by the fear of infection (10), challenges of the work implementation process, infrastructure, human resources and the necessity of required knowledge and training, personnel safety and personal protective equipment (11). In developed countries, the challenges of providing services by prehospital emergencies reported in various studies are also examined. These include issues such as lack of personal protective equipment, lack of proper leadership and support of managers, lack of collaborative decision-making, lack of appropriate clinical protocols, and lack of coordination between systems (12,13). Due to the newness of the disease and its global spread and the lack of preparation of the pre-hospital emergency system in dealing with this pandemic crisis, the present study was necessary. Given that identifying the challenges of prehospital emergencies along with effective solutions and measures implemented by them in the face of various crises, especially COVID-19, can be a road map for preparing and planning for crisis management in the future, the present study, as a systematic review, identified the challenges of prehospital emergency in the COVID-19 pandemic.

2. Methods

2.1. Study design

This systematic review was described according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) in response to the main research question: "what challenges were there for prehospital emergency in the COVID-19 pandemic?"

2.2. Information sources

The search period in the databases was considered from December 15, 2019 to March 20, 2023, regardless of any limitation. To obtain articles related to the main research question, electronic databases of PubMed, Scopus, Web of Science platform, and also Google Scholar search engine were used.

2.3. Search strategy

The keywords needed to reach the research question were selected based on both free keywords and controlled terms. Relevant keywords were found through the relevant entry terms. In addition, experts were consulted to find appropriate keywords. The keywords of related articles were also checked. The search strategy was determined based on each database in a specific manner and manual search was done by checking the reference of all articles related to the topic (Appendix 1).

2.4. Inclusion criteria

All types of research articles in English that had measured the main question of the research, i.e., "challenges of prehospital emergency in the COVID-19 pandemic", were included in the study at this stage. Besides, if the challenges of hospital and prehospital emergency were examined together in an article, the results of its prehospital phase were included in the findings of the study.

2.5. Exclusion criteria

Articles that examined the challenges of prehospital emergency but were not in the field of COVID-19 pandemic, were excluded from the study. Moreover, “articles published in languages other than English” and “lack of access to the full text of the articles” were considered as exclusion criteria of studies.

2.6. Data extraction

2.6.1. Selection process

Results of the initial search were imported into Endnote X9 software to remove duplicate articles. Then, the studies that were not in line with the main research question in terms of title and abstract were removed. In the next step, articles that were deemed appropriate then progressed to full-text re-view. Two reviewers independently assessed full-text articles against eligibility criteria, with any voting conflicts being re-solved through discussion. Articles accepted after this pro-cess underwent data extraction.

2.6.2. Study risk of bias assessment

Evaluation of the quality of studies and the risk of bias according to the type of studies; is different. The resulting articles were critically appraised using the following checklists: 1. critical appraisal Joanna Briggs institute (JBI) that includes eight items, 2. critical appraisal skills program (CASP) that includes 10 items, and 3. mixed methods appraisal tool (MMAT) that includes 15 items. The critical appraisal aimed to assess the methodology quality (internal validity) and the risk of bias (external validity and generalization of results). To evaluate the quality of qualitative articles and risk of bias, two evaluators re-

Table 1 Characteristics of the studied papers in the systematic review and the results of quality assessment of studies

	Author and year	Title	Objective	Type of research	Country	Design	Quality assessment of studies
1	Yilmaz S (2021) (17)	Coping with difficulties faced in prehospital healthcare amid pandemics	Determine the difficulties faced by prehospital healthcare workers (HCWs) in the transfer of patients to hospital during the COVID-19 and to examine ways to cope	Original research	Turkey	Case study model/ qualitative research	High quality
2	Smereka J (2020) (3)	COVID-19 a challenge for emergency medicine and every health care professional	The challenges of COVID-19 for the medical profession	Letter to editor	Poland	Letter to editor	High quality
3	Mohammadi M (2022) (11)	Challenges of prehospital emergency staff in the COVID-19 pandemic: a phenomenological research	Explore the challenges of prehospital emergency staff in the COVID-19 pandemic	Original research	Iran	Qualitative research	High quality
4	Regmi P (2022)(18)	Ambulance service in Kathmandu, Nepal: service delivery constraints, challenges, and achievements during the COVID-19 pandemic	Investigate the constraints, challenges, and achievements made by ambulances services during the COVID-19 pandemic	Original research	Nepal	Qualitative research	High quality
5	Parvaresh-Masoud M (2021) (19)	Emergency medical technicians' experiences of the challenges of prehospital care delivery during the COVID-19 pandemic: a qualitative study	Explore EMTs' experiences of the challenges of prehospital care delivery during the COVID-19 pandemic	Original research	Iran	Qualitative research	High quality
6	Mohammadi F (2021) (20)	Management of COVID-19-related challenges faced by EMS personnel: a qualitative study	Identify some strategies to manage the COVID-19-related challenges faced by the prehospital emergency care personnel in the south of Iran	Original research	Iran	Qualitative research	High quality
7	Heidari M (2023) (21)	Prehospital emergency service Challenges in the face of the COVID-19 pandemic in Iran	identify the challenges of the prehospital emergency service (PHES) function in the face of COVID-19 pandemic	Original research	Iran	Qualitative research	High quality
8	Hadian M (2022) (22)	Explore prehospital emergency challenges in the face of the COVID-19 pandemic: a quality content analysis in the Iranian context	Explore prehospital emergency challenges in the face of the COVID-19 pandemic	Original research	Iran	Qualitative research	High quality
9	Castro Delgado R (2021) (13)	Management of the COVID-19 pandemic: analysis of the perception of professionals of emergency medical systems in Spain after the first wave	Identify the perceived problems by medical and nursing professionals in the emergency medical services (EMS) in COVID-19 and the measures or solutions adopted to manage those problems	Original research	Spain	Mixed methods	Medium quality
10	Brolan C. (2022) (23)	Lessons from the frontline: the COVID-19 pandemic emergency care experience from a human resource perspective in the Pacific region	Explores emergency care (EC) and other frontline healthcare worker (HCW) experiences responding to the COVID-19 pandemic	Original research	Australia	Qualitative research	High quality
11	Sarchahi Z (2022) (10)	Exploring the challenges of prehospital emergency personnel in COVID-19 pandemic: a qualitative study	Explore the challenges and experiences of prehospital emergency personnel in the context of the COVID-19 pandemic in Iran	Original research	Iran	Qualitative research	High quality
12	David Brown G (2021) (24)	Voices from the frontline: a review of EMS first responders' experience of COVID-19 in Ireland	Explored the experiences of Irish emergency medical services (EMS) during the spread of SARS & COVID-19	Systematic literature review	Ireland	Systematic literature review	Medium quality

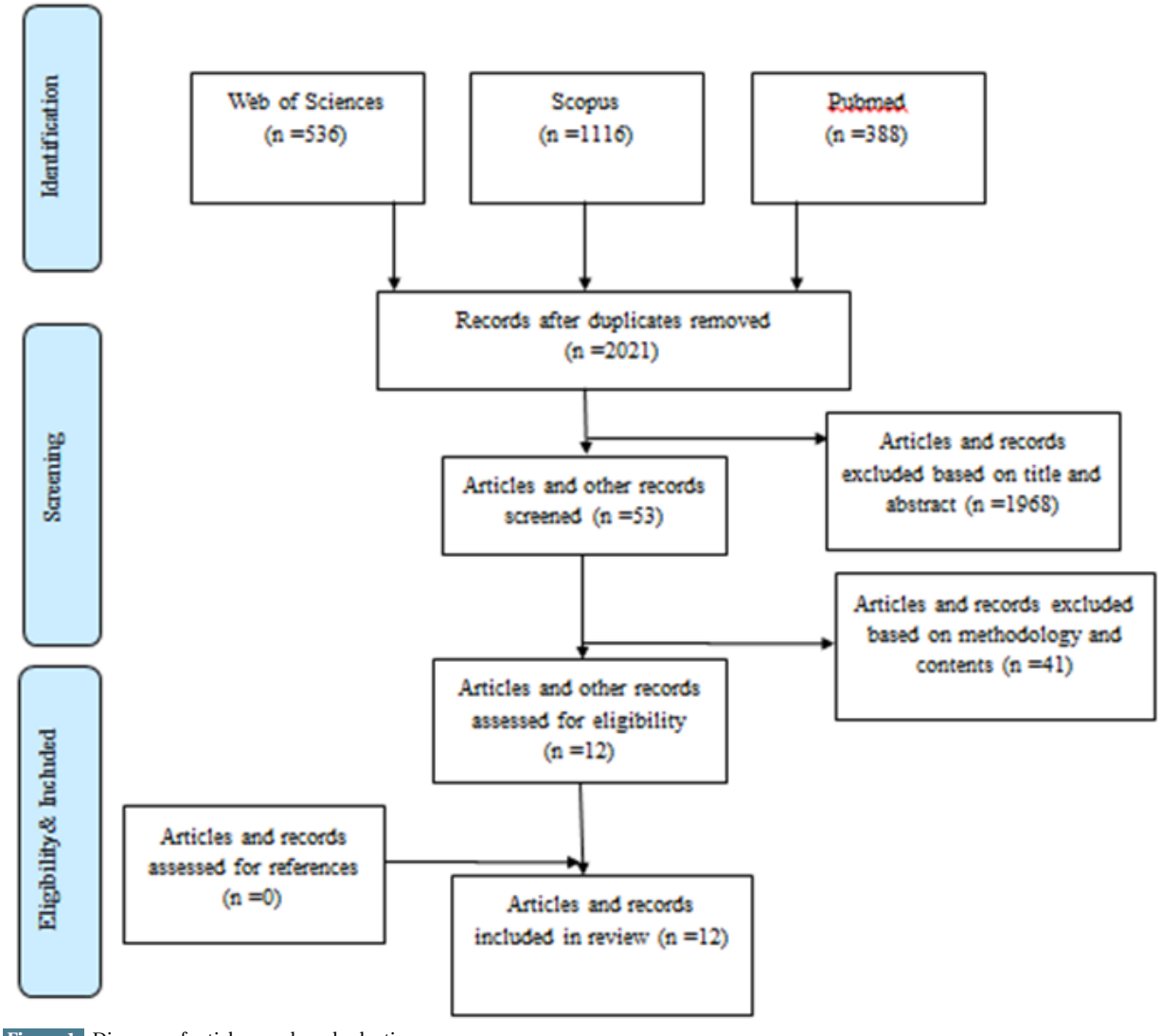

Figure 1 Diagram of article search and selection

Table 2 Extracting categories and subcategories of prehospital emergency challenges in COVID-19 pandemic

Structural challenges	**Lack of equipment**	**The lack of masks and their lack of quality (3,10,17,19-22), unsafe ambulances (3,17), lack of medicine (17)**
	Improper management of human resources	Lack of manpower (17,19,23), personnel infected with COVID-19 (20), long shifts (11,18)
Process challenges	Lack of protocols and guidelines	Lack of comprehensive guidelines for diagnosis care and prevention (11,22), lack of admission protocol between prehospital and hospital emergency (11,13,18)
	Weak personnel training	Method of working with personal protective equipment and observing safety (11), not holding maneuvers or group training (3)
	Weakness in providing care services	Patient transfer problems (11), information systems (17)
Psychosocial challenges	Occupational burnout	Long shift (18), decreased motivation (22), fear of infection (18,19), fear of death (18), fear of transfer to the family (18,19,24), mental confusion (11,17, 22,23), and nervousness (11,22)

viewed them independently based on the CASP checklist. The CASP checklist with three options: yes, no, and I have no opinion. The checklist items included research objectives, method logic, research design, sampling method, data collection, reflectivity, ethical considerations, accuracy in data analysis, clear expression and clarification of the findings, and the value of the research. Based on the scoring method on the CASP website, if 2/3 items do not receive a 'yes' answer, the article did not qualify to be selected. The JBI checklist was also used to evaluate a variety of descrip-

tive/analytical (8 items), cross-sectional (8 items) and systematic review (11 items) studies. This questionnaire contains 8 items, and each item contains four options: yes, unclear, no, and not applicable. The 8 items were clear definition of inclusion criteria, study subjects and the setting described in detail, measuring exposures in a valid and reliable way, using objective and standard criteria to measure conditions, identification of confounding factors, providing strategies to deal with confounding factors, measuring outcomes in a valid and reliable way, and appropriacy of statistical analysis. Based on this, after evaluation, the studies were classified in one of the strong level (more than 75% of the score), medium level (more than 50% of the score), and weak level (less than 50% of the score) (14).

Finally, the third tool, MMAT includes quality criteria of five categories of study designs: (a) qualitative, (b) randomized controlled trial, (c) nonrandomized, (d) quantitative descriptive and (e) mixed methods studies. The MMAT focuses on core relevant methodological criteria and has five criteria per category of study design. The third step consists in rating the criteria of the chosen category (or categories). There are three response options: 'yes' means that the criterion is met, 'no' means that the criterion is not met, and 'can't tell' means that there is not enough information in the paper for you to judge if the criterion is met or not. For mixed methods studies, since there are 15 criteria to rate (instead of 5), the premise is that the overall quality of a combination cannot exceed the quality of its weakest component. Thus, the overall quality score is the lowest score of the study components. The score is 20% when QUAL=1 or QUAN=1 or MM=1; it is 40% when QUAL=2 or QUAN=2 or MM=2; it is 60% when QUAL=3 or QUAN=3 or MM=3; it is 80% when QUAL=4 and QUAN=4 and MM=4, and it is 100% when QUAL=5 or QUAN=5 or MM=5; (QUAL being the score of the qualitative component; QUAN the score of the quantitative component; and MM the score of the mixed methods component) (15).

2.6.3. Data collection process

According to the selected final studies, the title of the study, objectives, names of the authors, year of the study, country, and type of research and method of the study were extracted in a table in Excel software.

2.7. Synthesis methods

After evaluating and selecting the final studies, coding was done by researchers independently using comparative content analysis. In comparative content analysis, the categories were determined first, based on certain conceptual or theoretical models; then, the extracted codes were matched with them and the final categories were determined (14,16) finally, after analyzing the content, the challenges of prehospital emergency in the COVID-19 pandemic were extracted. To increase the validity of the data, the categories and subcategories were extracted through group meetings.

3. Results

To answer the research question: "what challenges were there for prehospital emergency in the COVID-19 pandemic?" a systematic review was carried out and the obtained results were presented in two descriptive and analytical parts. In the descriptive step, 2040 articles were selected from all the mentioned databases. Having removed the duplicate articles, a total of 2021 titles and abstracts of the articles were examined, as a result of which 53 articles with full text were reviewed. Finally, 12 articles were selected for inclusion in the study, and other articles were excluded due to not observing the necessary inclusion criteria. The results are displayed in figure 1.

The review of studies suggested that, out of 12 studies related to the research question, 6 studies (50%) were related to Iran. Besides, 75% of the selected articles were original and most of the articles' methodology was qualitative. Also, based on the results of the evaluation of the quality and bias of the studies, it was found that more than 83% of the studies were of high quality.

Based on the analysis of the articles, there were 3 main categories: structural challenges with the subcategories of lack of equipment and inappropriate management of human resources, the category of process challenges with the subcategories of defects in protocols and instructions, weakness in personnel training, weakness in providing care services, and the category of mental challenges with the subcategories of occupational burnout and weak socio-organizational support (Table 2).

4. Discussion

The present systematic review aimed at examining the challenges of prehospital emergency in facing the corona epidemic. Managers need to be aware of the challenges at times of crisis to be able to design a proper planning system. The identified challenges were classified into 3 main categories and 7 subcategories.

Some of the challenges raised in the studies extracted in this research were in the category of structural challenges and were classified into two subcategories: lack of equipment and inappropriate management of human resources. The required quality and safe equipment, supplies, and drugs must be purchased promptly and provided to organizations to provide quality health services (25).

Nevertheless, one of the most important problems during crises, especially in developing countries, is always the lack of healthcare facilities and their unfavorable distribution in different regions (26). In the present study, the lack of medicine and equipment, especially personal protective equipment (PPE), and wear and tear and unsafe equipment are the main weaknesses identified in the field of equipment shortage. With the start of the COVID-19 pandemic in the world, prehospital emergency services (PHES) personnel, like other members of the health care team, faced challenges related

to the lack of equipment and facilities, especially PPE such as masks and shields, etc. (27,28). The available evidence shows that hospitals also struggled with the lack of personal protective equipment and other equipment during the COVID-19 era (28-31), as it has been experienced in other similar epidemics such as SARS, MERS, Ebola, etc (28-30). Among the reasons for the existence of such challenges, we can mention the increased demand, the lack of a clear process for the proper management of resources during disasters, limited financial resources to provide the required equipment, inappropriate distribution of available resources and equipment, and the lack of preparation in crisis management in epidemics. Pharmaceutical and medical equipment companies may not be interested in producing certain drugs and equipment due to the high cost of production and low possible profit (33). Thus, governments should use appropriate incentives to encourage medical equipment firms and pharmaceutical companies to produce essential equipment and drugs when crises occur. Eventually, health and medical equipment and supplies should be distributed and used according to the needs of the region based on scientific evidence and economic evaluations.

The challenge of lack of equipment has been mentioned in many Iranian studies (10,11,21,22). One of the most important reasons that caused Iran to deal with such a stubborn problem more severely than other countries is the sanctions against Iran, which has imposed a serious challenge on the process of supplying health and medical appliances to centers and personnel (34). For Iran, this situation has been bitterly compared to "swimming with closed hands" (35).

Since the availability of physical resources plays an important role in strengthening organizational resilience against crises, hence, to strengthen the health-treatment resilience of these communities, it is necessary to develop and improve various indicators such as prehospital emergency centers, employees of these centers, doctors, paramedics, and nurses. In this regard, it is a priority to plan for the provision, equipping, and fair distribution of facilities and health-treatment infrastructures in different regions, providing the necessary platforms to attract human resources according to the population covered.

Based on the findings of the present study, improper management of human resources, such as lack of personnel, high workload and long working hours, and the infection of personnel with COVID-19 imposes another challenge to prehospital emergency in the structural domain. By adopting a systemic approach, the relationship between obstacles and challenges becomes clear. Lack of equipment and some process challenges have led to an increase in the number of personnel infected with COVID-19, and with the aggravation of the problem of the lack of manpower, it has resulted in the formation of long personnel shifts. These issues, in turn, will increase the fatigue of the employees and, consequently, increase the error and reduce the safety of the patients. Furthermore, factors such as the lack of manpower and increased personnel infection with COVID-19 will reduce the access of people in the community to prehospital services and, as a result, will intensify the health challenges for the community.

In many countries such as China, Thailand, UK, Iran, etc., the Corona epidemic has also exposed the hospitals to challenges such as increased number of patients and the lack of human resources (29,36-40). Similarly, according to another review report, all employees of healthcare organizations in the world were struggling with the problem of high workload and long shifts during the COVID-19 epidemic and other past epidemics (32) In this situation, improper management of human resources can lead to poor implementation of goals and missions of the health and treatment organization through unfavorable performance in providing services to patients (36). "Flexible allocation of work force" is one of the most important factors affecting the ability of organizations to properly manage services during the COVID-19 pandemic (41). Thus, flexible reassignment of employees to different headquarters and operational departments based on need and access is one way to get rid of the challenge of human resource management and lack of manpower.

The process challenges of prehospital emergencies in the face of the COVID-19 epidemic include the lack of protocols and guidelines, weakness of personnel training, and weakness in providing care services. Similarly, a recent review and meta-synthesis study examined the challenges of all health care workers in the epidemic of COVID-19 and previous epidemics. The themes identified in this review from previous pandemics and epidemics are remarkably consistent with what was found in the present study (32). Among these shortcomings are the lack of comprehensive guidelines for diagnosis, care and prevention, and lack of admission protocol between prehospital and hospital emergency. In a similar way, the lack of predicting the connection between pre-hospital care and hospital care was a challenge faced by France during the COVID-19 epidemic (42). As the contradiction in the exist-ing guidelines has caused the confusion of personnel in the practice of care protocols of corona patients in USA and Iran (34,43). In similar circumstances, such as the time of the in-fluenza outbreak in the United Kingdom, one of the key ob-stacles for the medical staff to fulfill their duties and obliga-tions was the lack of information about the risks and what is expected of them during a crisis (44). Weakness in protocols and guidelines based on scientific and up-to-date evidence will reduce the quality of services provided. In this regard, the capacity of research centers, research institutes and sci-entific associations can be used to conduct applied research in the relevant field.

Weakness in personnel training, including method of working with personal protective equipment and safety, lack of maneuvers, etc., were some of the challenges raised in the present study. The lack of adequate training of personnel to deal with epidemic conditions in many countries shocked

managers by the widespread prevalence of the disease and caused them not be prepared to deal with the related conditions and challenges (21). This challenge has also been reported for hospital personnel of Sweden, Iran, etc. (36,45). For instance, training in Brazilian hospitals was limited to occupational health and safety procedures (such as engineering and administrative controls) (46). In China, the lack of training on the correct use of personal protective equipment put health care personnel at the risk of transmission of COVID-19 in hazardous work environments (47). Additionally, the lack of professional ethics in the performance of employees revealed the need for training in this field (48). A hospital in France also raises the challenge of informing all health care workers (HCW) of the new guidelines and tackles this challenge by holding regular information sessions using the hospital's intranet (42). Weakness in training processes, in addition to increasing the risk of personnel becoming infected due to poor knowledge, will also reduce the quality of services provided to patients. Thus, it is recommended that managers pay serious attention to the training of technical skills needed by paramedic emergency personnel to face all kinds of health crises and periodically hold maneuvers for practical training and reviewing what they have learned, for the preparation and resilience of the EMS system in possible future health crises. Moreover, more cooperation between the ministries of health of countries, the world health organization and international scientific societies in the field of health is recommended for the transfer of knowledge related to COVID-19 and the up-to-date training of medical staff. This cooperation can be done through scientific meetings, research collaborations with national and international organizations and strengthening the curricula of medical universities based on it.

Despite all the efforts made in the field of providing health services, prehospital emergency rooms faced the challenges of weakness in providing care services, including transfer problems and information systems. In such conditions, the use of quality management techniques and the use of private sector capacity can lead to the improvement of health care and service standards. This is because the private sector is usually more cost-effective than the public sector and has a good ability to provide high-quality services to a large population (18). Prehospital emergency medical service (EMS) is an information-sensitive area due to the emergency nature of its services. This is because the information system in EMS leads to the integration of the system and better provision of emergency care (49). However, the current study confirms the results of the Mastaneh Mouseli study that most EMS information systems have challenges in providing this information (50). Studies indicated the existence of this challenge in Iran, even before the prevalence of corona. Challenges such as weakness in providing information system, manual registration of information, registration in isolation and non-sharing of information for EMS have been mentioned (50); in the corona situation, these challenges showed themselves more and created problems in providing services. Therefore, using electronic systems and simultaneously providing information and sending information to EMS databases, and providing hardware and software equipment for this purpose are among the solutions in this regard. One of the problems created by corona for the treatment staff in hospitals and prehospital emergencies is the psychological challenges that have been mentioned in many studies (36,41,51-53). Occupational burnout and weakness in socio-organizational support were among these challenges that were identified in the present study. The destructive effects of COVID-19 on physical and mental health, including fear and anxiety caused by the fear of infection, have been mentioned in studies in China, Saudi Arabia, and Iran (28,54,55). Based on the results of a study on healthcare workers in 14 Asian and African countries, moderate to severe psychological distress was prevalent in 67% of HCWs. The lowest rate was reported in the United Arab Emirates (1%) and the highest in Indonesia (16%) (56). Yet, prehospital personnel are more exposed to stressors due to the pressure of direct patient care, dangerous working conditions, and higher workload compared to other jobs, especially during the corona epidemic (57). According to the results of studies during the COVID-19 epidemic, the level of perceived stress in about a third of the pre-hospital personnel in Turkey was moderate or high (58) and in Saudi Arabia, 60% of them had a severe mental disorder (59). The findings of a study on pre-hospital workers in 5 countries including Turkey, India, Singapore, Iran, and South Korea, showed that access to personal protective equipment and working hours during the COVID-19 epidemic caused differences in the anxiety levels of pre-hospital workers (60). Therefore, it can be said that process and structural challenges in the prehospital system, especially the lack of equipment and weakness in human resource management in a systemic approach, will aggravate the burnout of personnel. This issue has jeopardized the physical and mental health of the personnel, which will have a negative effect on the performance and morale of the employees.

Another challenge addressed in the study was the weakness of organizational support, including inappropriate allocation of available resources and lack of efficient payment. The challenge of insufficient resources during epidemic has put the medical staff of many countries such as Thailand, UK, USA, and Iran at risk (29,36,37,39,61). In similar circumstances, such as during the outbreak of influenza in the UK, one of the dissatisfactions of the medical staff was their feeling that the managers did not consider their needs seriously (44). This challenge causes psychological pressure and complex ethical issues in personnel. Therefore, in addition to the need to increase the allocated budget in health crises, senior management team needs to formulate a plan to effectively use available resources and prevent resource wastage. This is because the optimal allocation of resources is necessary to continue providing services and increase the resilience of the health system.

People's lack of desire for vaccines, lack of support from relatives and their negative reaction were some of the challenges in the field of social support. In recent similar epidemics, this challenge was also raised, so that a review study on the challenges of pre-hospital emergency in the face of diseases such as SARS, MERS, Ebola, influenza, etc. showed that despite the efforts made to encourage vaccination, the vaccination rate is still below the optimal level (62). In addition to the need for organizational support, the supportive behavior and companionship of community members for their self-sacrifice and activity in corona conditions can be very effective in motivating and improving the mental health of this group.

Certainly, the COVID-19 pandemic will not be the last health crisis; so, health systems, in addition to providing quality services, must respond to epidemiological shocks and health crises and become resilient against these shocks. Resilience of the health system means the ability, capability, and capacity to predict, prevent, absorb, adapt and change the health system when faced with shock and crisis and continuous provision of health services during shock and crisis management (63). Thus, it is necessary to prepare for health crises by providing the necessary infrastructure, planning human resources management, equipment, information system, personnel training for critical conditions, and conducting simulated exercises.

Finally, this study not only provided practical knowledge of the existing challenges related to prehospital emergency practice in the COVID-19 pandemic, but also provided an overview of the resilience of prehospital emergency in countries against health crises. By identifying the challenges of pre-hospital emergency, this approach can pave the way for the next steps towards capacity building and increasing resilience, adaptation interventions and their evaluation, and adaptation to adverse health effects caused by health crises.

5. Limitations

Among the limitations of this research, we can mention the lack of domestic and foreign research in the field of similar epidemics, which could be useful in comparing and contrasting the consistency of the results of the current research with other researches.

6. Conclusion

Prehospital emergencies in countries are facing challenges that limit their resilience to epidemics such as COVID-19. Thus, to promote resilience and adaptability against the adverse effects of health crises such as COVID-19, it is necessary to implement adaptive strategies to solve these challenges in similar crises. Attention to the health and well-being of EMS personnel through psychological and psychosocial support services, appropriate allocation of resources such as PPE, and the use of experienced personnel to provide care to patients with COVID-19 is essential. Such efforts can provide safe care, facilitate the adaptation of EMS personnel to the situation at hand, and optimize their performance.

7. Declarations

7.1. Acknowledgement

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7.2. Authors' contribution

AE: Conceptualization, investigation, methodology, project administration, writing the original draft, review and editing; RA: Conceptualization, methodology, formal analysis validation, writing the original draft, review and editing; NB: Methodology, formal analysis, validation, writing the original draft, review and editing; TSH: Writing the original draft, review and editing.

7.3. Conflict of interest

The authors report there are no competing interests to declare.

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Appendix 1 Search strategy in databases

Database	Search strategy
PubMed	(((Barrier*[Title/Abstract] OR challenge*[Title/Abstract] OR problem*[Title/Abstract]) AND (Prehospital[Title/Abstract] OR "Pre-hospital"[Title/Abstract] OR "Pre hospital"[Title/Abstract] OR "Emergency Medical Services"[Title/Abstract] OR "Prehospital Emergency Care"[Title/Abstract] OR EMS[Title/Abstract] OR "Emergency Service"[Title/Abstract] OR "Emergency Services"[Title/Abstract] OR "Emergency Medical Services"[MeSH Terms] OR" Emergency care" [Title/Abstract])) AND ("Coronavirus"[Title/Abstract] OR Covid[Title/Abstract] OR "COVID-19"[Title/Abstract] OR "SARS-CoV-2"[Title/Abstract] OR pandemic*[Title/Abstract] OR "nCov"[Title/Abstract] OR "novel coronavirus*"[Title/Abstract] OR pandemic*[Title/Abstract])
Scopus	TITLE-ABS-KEY (Barrier*[Title/Abstract] OR challenge*[Title/Abstract] OR problem*[Title/Abstract]) AND TITLE-ABS-KEY (Prehospital[Title/Abstract] OR "Pre-hospital"[Title/Abstract] OR "Pre hospital"[Title/Abstract] OR "Emergency Medical Services"[Title/Abstract] OR "Prehospital Emergency Care"[Title/Abstract] OR EMS[Title/Abstract] OR "Emergency Service"[Title/Abstract] OR "Emergency Services"[Title/Abstract] OR" Emergency care" [Title/Abstract]) AND TITLE-ABS-KEY ("Coronavirus"[Title/Abstract] OR Covid[Title/Abstract] OR "COVID-19"[Title/Abstract] OR "SARS-CoV-2"[Title/Abstract] OR pandemic*[Title/Abstract] OR "nCov"[Title/Abstract] OR "novel coronavirus*"[Title/Abstract] OR pandemic*[Title/Abstract])))
	TS ((("Barrier*" OR "challenge*" OR "problem*") AND TS ("Prehospital Emergency" OR "Pre-hospital Emergency" OR "Prehospital Emergency" OR "Emergency Medical Services" OR "Prehospital Emergency Care")) AND TS ("Coronavirus" OR "COVID 19" OR "COVID-19" OR "SARS-CoV-2" OR "nCov" OR" novel coronavirus* "OR " pandemic*)))