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Preparedness challenges of the Iranian health system for dust and sand storms: A qualitative study

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Abstract:

BACKGROUND: The dust and sand storms (DSS) in Iran increased in recent years, which have caused adverse health effects. Regarding the effects of DSS on the health indicators, the health system plays a key role based on the mission and the services which it provides. The present study was conducted, in Iran, to fill the existing knowledge gap and to understand the preparedness challenges of the health system in response to the DSS.

MATERIALS AND METHODS: Twenty-one semi-structured interviews, in 2016–2017, were undertaken. This study carried out using purposeful sampling with key informants in the Khuzestan Province, national policymakers in Tehran, as well as people affected by this phenomenon. A qualitative approach, using the conventional content analysis, was employed to analyze the collected data.

RESULTS: Four main categories that appear to explain the preparedness challenges of the health system for DSS include the risk assessment, knowledge management, organizational elements, as well as monitoring and evaluation.

CONCLUSIONS: It is imperative that policymakers of the country pay special attention to the hazard risk understanding and managing the various aspects of the beliefs and attitudes associated with DSS. The development of early warning system, regular drills and exercises, as well as public and specialized health promotion training related to this phenomenon are suggested.

Keywords:

Air pollution, climate change, health promotion, public health, qualitative research, readiness

Introduction

In recent years, the occurrence of dust and sand storms (DSS) has increased, and Iran is one of the countries that deal with this phenomenon.^[1,2] As stated by the World Health Organization (WHO) report, among the 24 polluted cities in the world with the highest average annual PM10 levels (particulate matter $\leq 10 \mu\text{m}$), 24% are Iranian cities.^[1] According to another report from the same organization, the cities of Zabol, Bushehr, and Ahvaz were

found to be the most polluted regions.^[3] The results of studies in different parts of the world also indicate that this phenomenon causes cardiorespiratory disorders, meningitis, fungal diseases, conjunctivitis, skin problems, mortality and injuries from traffic incidents, progressive coughing, reproductive disorders, and headache.^[1,4] Regarding the effects of DSS on the health of people, the health system plays a key role based on the mission and the services, which it provides.^[5,6]

The studies of DSS focused mainly on health indicators^[7-15] and the recognition of the nature of the phenomenon, including

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main sources, frequency of occurrence, frequency variation, and duration of the occurrence, as well as contents of PM.^[1] Considering that various factors such as knowing the negative effects and threats, having an emergency operation plan (EOP), training, early warning system (EWS), information exchange, drill, and exercise, effective monitoring and evaluation affect improving the preparedness level and effective response to the consequences of various types of disasters,^[5,6,16-19] but a comprehensive qualitative research (QR) has not been performed to determine the preparedness challenges of the health system for the DSS. QRs have a profound role in understanding the experiences of the participants from a particular phenomenon, knowledge about the areas that have not been investigated so far, the discovery of variables related to the phenomenon, and the existence of a comprehensive approach to the phenomena of the study.^[20] Therefore, considering that the health system is a multifactor system that is sensitive to the cultural conditions of the countries, this study was conducted in Iran to understand the challenges influencing the preparedness of this system in response to the DSS.

Materials and Methods

This study was organized using Conventional Content Analysis (CCA). This approach is useful when the investigator's aim is to obtain participants experiences.^[21] Using CCA, the data were collected directly and without the prior hypothesis. Then, codes, subcategories, and categories were extracted by an inductive process.^[22]

Setting

Interviews at three levels in Iran, with key informant persons, were conducted included national and provincial policymakers, provincial executives, and people affected by DSS [Table 1].

Participants

In this study, purposeful sampling was used to select participants. Due to the nature of multi-sectoral DSS preparedness (DSSP), experienced and/or knowledgeable individuals in responsible organizations were invited to participate in the study. Participants were selected from three levels of national and provincial senior policymakers, provincial executives, and citizens that affected by dust. They presented their views on DSSP during interviews. The first participant was a qualified professional in health in disasters and emergencies (HDE) at the national level. After conducting this interview and identifying the initial categories, other participants were selected to clarify the emerging concepts.

To ensure the sufficiency of the number of participants, the data saturation criterion was used.^[23] As a result,

in interviews, each known concept was discussed until concepts became saturated and new information was not produced. Despite initial coordination, from among the 23 participants, three of them did not agree to the interview because of their busyness. Eventually, 20 qualified participants were enrolled in the study [Table 1]. These participants had a working experience of about 1–10 years. Citizen participants had been living in the research environment for many years. Interviews were conducted at the workplace of the participants. In the case of citizens, interviews were also conducted in public places such as the park and the hospital.

Data collection

Data were collected through semi-structured interviews. This type of interview is appropriate for QR due to its flexibility and depth.^[24] Interviews started with general questions and went into details. The questions centered on the challenges of the Iranian healthcare system preparedness for DSS. All interviews were conducted in Persian. Initially, during 8 months (June 2016 to January 2017), 16 interviews and then five further interviews were conducted over the period (from September 2017 to November 2017) to saturate the data. Face-to-face interviews lasted between 14 and 77 min and telephone interviews between 10 and 48 min. In cases where there seemed to be ambiguities, a second interview was also conducted.

Data analysis

All interviews were recorded digitally and transcribed verbatim. For data analysis, Graneheim and Lundman approach was used.^[22] To identify the ideas, the process of collecting and analyzing data took place simultaneously, and thereafter, the next interview was carried out [Table 2].

Analysis of data was conducted under the strict DKZ supervision and in collaboration with other research team members. To understand the concepts in depth and avoid superficial and mechanical coding, coding and categorization of concepts were implemented manually by paper and pencil and following by categories and sub-categories.

To achieve trustworthiness, were used four strategies that recommended by Schwandt *et al.* [Table 3].^[25]

Results

At the beginning of the analysis, 1775 codes were obtained and finally achieved 804 codes after removing duplicated and merging similar cases. In the next step, 52 primary subcategories and 23 categories were formed. At last, the preparedness challenges were extracted based on the

Table 1: The information of the participants in the qualitative study of the preparedness challenges of the Iranian health system for the dust and sand storms

Variable	Variable description	n	n (%)
Experience level	National [§] and provincial ^l policymakers	9	45
	The professional in HDE and associate professor of the Medical University, EMS managers, MoHME managers, provincial red crescent organization manager, provincial DMO manager, NDWMC, Department of Environment		
	Provincial executive key informants	7	35
Gender	The deputy director of treatment in hospital, the lung specialist and associate professor of the Medical University, the headquarter of information and guidance, matron of university hospital, nursing staff of ED, emergency medical assistant, horticultural science specialist		
	People living in Khuzestan province	4	20
	Male	12	60
Age	Female	8	40
	30-40	4	20
Type of interview*	40-50	10	50
	50-60	3	15
	60-70	3	15
Face to face	Face to face	17	81
	Telephone	4	19

[§]In Tehran, the capital of Iran, interviews with policymakers were conducted; ^lIn Khuzestan province, in the southwest of Iran, interviews with key informants were conducted; *With one of the participants, a face - to - face interview was performed once and again on the phone. EMS=Emergency Management System, MoHME=Ministry of Health and Medical Education, DMO=Disaster Management Organization, NDWMC=National Drought Warning and Monitoring Centre, ED=Emergency department

Table 2: Data analysis in the qualitative study of the preparedness challenges of the Iranian health system for the dust and sand storms

Step of data analysis	Description
First step	All interviews were read carefully, reviewed several times. The main researcher noted his general understanding at the end of each interview after reading the full text of the interview
Second step	Meaning units were identified
Third step	The condensed meaning units were extracted and coded
Fourth step	The categories and subcategories were formed by constant comparison of the codes in terms of similarities and differences between concepts. After conducting the first interview, a set of codes, categories and subcategories were created and confirmed by the research team

viewpoints of the participants in the four categories and the 12 subcategories including the risk assessment (with three subcategories of risk understanding; analysis of current preparedness status; belief and opinion), knowledge management (with two subcategories of education and training; research), organizational elements (with five subcategories of guidelines, protocols, and programs; policymaking and planning; institutional structure and responsibility; collaboration, coordination, and communication; resources), monitoring and evaluation (with two subcategories of prediction and early warning; drill and exercise). In Table 4, these categories, subcategories, and codes are shown.

Risk assessment
Risk understanding

The participants stated that the risk of dust particles and

their health effects, in particular, its chronic consequences and psychosocial dimensions, is not understood well by the managers. There is no proper estimation of the severity of the phenomenon, the identification of high-risk areas, the classification of the origin of the dust, and the composition of the dust particles in the country.

...The authorities in the country must understand that the evacuation of the (bordering province) Khuzestan province, because of the consequences of the DSS, is threatening our security (P7).

Analysis of current preparedness status

According to the participants, there is currently not enough preparedness to deal with the DSS in the health system and related organizations. The healthcare teams and the society have empirically, spontaneously, and of course, forcedly, learned how to reduce the effects of the phenomenon, how to reduce the vulnerability, and how to use self-care methods.

...Every time the dust occurred, we obtained new experiences to get prepared and found ways to reduce its effects (P2).

Belief and opinion

From the perspective of some people in society, the dust phenomenon is horrible and disgusting. Some people do not trust the government and the healthcare system, blaming the government for exacerbating the DSS. The lack of a common perspective on the causes of respiratory diseases, during dusty days, is another existing challenge.

...We still have a compensation and response-based attitude in our disaster management system... (P18).

Table 3: Strategies to achieve trustworthiness in the qualitative study of the preparedness challenges of the Iranian health system for the dust and sand storms

<i>n</i>	Trustworthiness criteria	Description
1	Credibility	Was guaranteed through member check, peer check, constant comparison, and triangulation The transcribed text and a summary of the first four interviews were shared with the participants by email or in-person to be checked During the interview, KA also asked the participants about any possible misunderstandings to give reflective commentary For the peer check, coding of one of the first and richest implemented interviews was compared to the codes extracted by five PhD students (independent of the research process) under the supervision of the DKZ. Also, sections of all interviews were transcribed and the codes and the initial and final categories were controlled by an HDE specialist and who was familiar with QR (ZG) In addition to the interview, data generation was conducted through observation and search for contradictory evidence and negative analysis (negative case analysis) Also, during the data analysis, investigator triangulation in the research team led to the consideration of different views. Constant Comparison was carried out through repeated returns to the data during the analysis phase, which contributed to the formation of categories and subcategories. The main researcher, with a PhD degree in HDE, has experience in EMS. The principal investigator engaged at all stages of data collection and analysis
2	Confirmability	Has also been promoted through non-bias in over various issues in the research process employing bracketing, writing memos, and neutrality of data
3	Transferability	Was provided with a detailed description of the entire study process
4	Dependency	Providing detailed information to other researchers, guaranteed it. So that they could replicate and develop the present study

EMS=Emergency management system, QR=Qualitative research, DKZ=Davoud Khorasani-Zavareh, KA=Kiyoumars Allahbakhshi, ZG=Zohreh Ghomian, HDE=Health in Disasters and Emergencies

Knowledge management

Education and training

According to the participants, the preparedness knowledge of healthcare system related to DSS is limited, and there are scarce academic training programs. In the health sector, there is a general lack of knowledge about the subject of DSS and the cause of the increased burden of respiratory problems. There is currently no effective media education, and training is inappropriate and inadequate. Further, the training of vulnerable groups is not a priority.

... Therefore, I do not actually know an integrated training program to be taught by the healthcare system for DSS (P2).

Research

Participants stated that in terms of DSS, there is a lack of health-related research that can be referred to by researchers and policymakers. Most of the previous research is not applicable and does not help to increase the population's adaptation to the phenomenon. University researchers confront with the lack of funding and data related to PMs and the history of respiratory referrals, especially in the early years of dust occurrences.

... The healthcare system should take into account that the DSS may have had bad effects over the long term, but it has not been researched so much... (P8).

Organizational elements

Guidelines, protocols, and programs

Participants noted that in the country's healthcare system, there were no codified agenda for the preparedness or a

national treatment protocol for the phenomenon. In all of the affected provinces, the healthcare system lacks a comprehensive operational response plan. It does not play an active role in designing the health annex of environment-related projects and the creation of structures compatible with the DSS.

... In conclusion, I have to say that there is no action plan for the dust particles, except we wait until it goes away... (P7).

Policymaking and planning

According to the participants, the dust phenomenon is not of proper priority in the country and the surrounding region. The healthcare system has no prior management plans for patients associated with this risk. The issue of DSS has not been addressed in the EOP. On the other hand, health diplomacy does not work well in the country.

... You see, in policymaking, we didn't take it (DSS) serious as an incident that threatens people. We cannot do anything; it's from Iraq, from Saudi Arabia (P7).

Institutional structure and responsibility

Participants emphasized that there was no definite responsible organization at the national level for the comprehensive management of DSS. The adverse results of the improper actions of some organizations in combating the dust phenomenon have been imposed on the healthcare system. The existence of transnational sources and the noncompliance of these countries with the obligations of eradicating the phenomenon have

Table 4: Classification of the preparedness challenges of the Iranian health system for dust and sand storm

Category	Subcategory	Code
Risk assessment	Risk understanding	The weakness of manager's risk perception Inadequate understanding of the value of water resources The low - level perception of the phenomenon in people
	Analysis of current preparedness status	Lack of adequate health readiness Earn current preparedness through experience Doing response-based measures
	Belief and opinion	The attitude of being the disgusting phenomenon Believe in failing against the DSS The need for compulsory compliance with the phenomenon
Knowledge management	Education and training	Weaknesses in medical personnel training Poor education on DSS in school level Poor quality of public education
	Research	Lack of health-related research on DSS Inadequate reliable researches Lack of research funds
Organizational elements	Guidelines, protocols and programs	Lack of national written preparedness program Lack of national response plan Lack of building codes tailored to DSS
	Policymaking and planning	Inattention to climatic conditions in strategic planning Lack of priority on DSS in the health system Disregarding ethnicity by policymakers
	Institutional structure and responsibility	Lack of transparency for the responsibility of involved organizations Unconscionable disclaimer of organizational obligations Lack of rational supervision on the DSS coping strategies
	Collaboration, coordination, and communication	The weakness of regional cooperation Intra and inter-agency interaction challenges Lack of strong international relations
	Resources	The health care personnel shortages Lack of financial resources to cope with the phenomenon Inadequate implementation of approved credit Keeping the secret of DSS information Inadequate space of the ED The equipment shortages
Monitoring and evaluation	Prediction and early warning	Poor predicting the occurrence of DSS The weakness of prediction for patient's visits The weakness of the online inter-organizational warning network
	Drill and exercise	Inadequately designed exercises Different nature of the drill of the DSS Lack of exercise at the family level

DSS=Dust and sand storms, ED=Emergency Department

led managers unconsciously do not perform their responsibility and accountability properly.

... We do not have a specific authority responsible for the DSS., the national DMO is responsible for the hazard, but it has no knowledge, no specialized staff, even an Emergency Operation Centre (P1).

Collaboration, coordination, and communication

According to the participants, in spite of the fact that the management of the DSS has a multi-sectoral nature, however, at the level of the responsible organizations and the health sector, there has been no strong inter- and sometimes

intra-organizational coordination and communication. The lack of national cooperation agreements, the lack of collective participation and regional environmental coordination, and the lack of strong international communications are among the most challenges.

... Our problem is a regional one. It's very clear that without a systematic regional collaboration, no problem will be solved (P5).

Resources

Another issue that the participants concerned about was providing resources at the preparedness stage included

human capital, financial assets, information, physical spaces, as well as drug and medical equipment. In the health system, there is a shortage of specialists for asthma and allergy, paramedics, and trained disaster managers. Imposed sanctions and reduced oil revenues led to a shortage of financial support in the healthcare system.

... At the time of the (dust) challenge, officials say that they will assign budgets... but it's never the case; we have no budgets... (P4).

On the other hand, in the early years of the DSS, there was no accurate information of the respiratory patients. The number of advanced centers for patients with respiratory diseases is small. Further, hospitals face with a shortage of beds for respiratory patients, personal protective equipment (PPE), respiratory drugs, and lack of advanced satellite communication equipment.

... Whenever (a dust disaster) occurs, there is a shortage (of drug and PPE). Drugstores do not have N95 or FFP2 masks (P9).

Monitoring and evaluation Prediction and early warning

Participants pointed to the lack of prediction of the occurrence of the DSS, insufficient information for the warning, lack of advanced models and technologies, as well as no infrastructural investment in this area. There are currently no national, especially indigenous, warning indexes, or inter-organizational online warning information networks. Most citizens do not trust weather conditions forecasts.

... We should consider which countries we compare ourselves with in terms of precision of the DSS prediction... How much did we invest in developing the radar station networks? (P18).

Drill and exercise

According to the participants, the nature of the drills for the DSS is different from the other hazards. In the health sector, the drills for the DSS were not of priority and planning did not take place for practicing probable scenarios, emergency evacuation of the hospital departments, admitting respiratory patients, and increasing the preparedness among the vulnerable groups. In recent years, the health system only carried out top table exercises. At the family level, there has been no plan for exercises of DSS.

... The DSS drills are not like the earthquake or fire exercises. It has a different nature... most of our drills are real. For example, we (provincial DMO) performed a drill with real dust, but not that much concentrated. We declare a warning situation. We planned for the closure of schools. We discussed the reduction of work hours (P6).

Discussion

The lack of advanced meteorological models, lack of proper investment, and lack of inter-organizational sharing of data are among the most important reasons for weak prediction of the occurrence of DSS by EWS authorities. Based on the study in three cities in East Asia, despite the frequency of DSS in Taipei and its proximity to the deserted areas, due to the earlier DSS warnings, the mortality was less than the other two cities among the susceptible and vulnerable groups.^[26] Our findings suggest the need to use very short-term predictive methods such as Nowcasting for storm events.^[27] Therefore, despite all the positive measures taken by the government, Iran needs to focus on and prioritize EWS advanced technologies, which is in line with another previous study in the case of hospital preparedness.^[28]

The lack of an adequate risk understanding of the DSS and its consequences, among (national and provincial) managers and policymakers as well as people, was another important finding that prevented proper preparedness measures. According to the previous studies, factors that influence society's perceptions of risk-taking include the impact on a greater number of people at a certain time and place, the level of understanding of people about the impact of risk on them, the novelty of risk, and the capable of being explained through scientific evidence.^[29,30] On the other hand, reduced risk perception may be due to the neglect of the risk management approach in the country.^[31] As part of the Sendai Framework for Disaster Risk Reduction 2015–2030, the first priority is that disaster risk management policies should focus on comprehensive disaster risk understanding.^[32] Given the fact that Iran has observed different patterns of precipitation scenarios over the years, suggested that the dust phenomenon is considered a high priority for the government. Comprehensive understanding of the causes and outcomes of this phenomenon and an appropriate estimation of the severity of risk are important steps in the preparation of the responsible organizations and the people for this phenomenon. Moreover, as emphasized by the WHO, a system approach on this phenomenon is curtailed; that in other event also was pronounced.^[33]

Another important finding of the study is the role of people and authorities' beliefs and opinions about how to improve preparedness for the DSS. As discussed, a deterministic viewpoint and beliefs such as being dominated by this risk can limit control measures and preparedness of the community.^[34] Another attitude in the study is the cause of the onset of bronchial asthma and respiratory allergies, many of them who refer to health centers. The current hypotheses that are more controversial are related to the factors such as pollens and fungal spores (mainly *Conocarpus* plant) and

exacerbation of disease during rain and lightning, as well as aerosols with various dimensions and compounds in the air. Studies have shown that when the risk is explainable through scientific evidence, people are less scared of the risk and prepare themselves better because their understanding has increased.^[29]

Failure to allocate enough financial resources at the preparedness stage was another important finding of the study. In addition to the inappropriate management of available resources, imposed economic sanctions and reduced oil revenues in recent years are other noteworthy reasons.^[35,36] The healthcare sector has also been affected by sanctions, especially in the field of medicine preparation and medical equipment in hospitals.^[37] In general, with limited resources, the health system should focus on target populations and high-risk populations in the complex conditions of the emergence of DSS. In terms of the sanctions, domestic policymakers and sanctioning countries should also pay close attention to the harmful effects of such measures on health and ethical issues and human rights. They should separate the health category from the sanctions.

The findings of the present study emphasize the weaknesses of health education (public and specialized) in relation to the DSS. The main reasons of which were lack of a structured training program, lack of academic education, not exploiting the capacity of community preparedness (such as schools and religious groups) to increase awareness and shortage of effective media education. One of the key priorities of the Hyogo Framework for Action is to take governments' attention to the use of knowledge, creativity, and education to produce a culture of safety and resilience at all levels.^[38] Blashki *et al.* pointed out that before disasters, training and management of susceptible groups such as children, the elderly, and respiratory patients should be prioritized.^[39] Therefore, measures such as general and specialized training to improve the preparedness of the various groups of society, holding of scientific workshops, and inclusion of the DSS-related lessons in the educational curriculum of all learning levels of schools and universities, especially the provinces involved, are recommended.

According to the findings of the present study, in the health sector and other involved organizations as well as in the general population, there has been no attention to the preparation for DSS through drill and exercise, as well as evacuation and sheltering. The newness of this risk in the country, inadequate knowledge of the phenomenon, managers' tendency to conduct traditional drills such as those related to the earthquake and flood, lack of proper planning, lack of resources, and inadequate public information are among the most important reasons for

the inattention. Given the importance of drill and exercise in the preparedness cycle,^[40] Klima *et al.* found that managers should pay more attention to operation-based exercises, because such drills, unlike discussion-based exercises, can assess the applicability of the hospital EOP.^[41] Niska and Shimizu found in their study that more than 11% of the US hospitals did not conduct any drills in 2011 to assess their preparedness level.^[42] Therefore, it is suggested that health managers focus on organizing regular drills with an approach to all hazards, including the DSS. In these drills, the response plans and training should be made on educating people how to expose less to the dust particles, using masks and inhaling drugs for acute asthma treatment.

Strengths and weaknesses

This was one of the few studies that use qualitative approach to get the experiences of key informants about the preparedness challenges of the health system for the DSS. Like other QRs, the number of participants was small in this study, but these individuals had sufficient experience and knowledge and all data were saturated, which can overcome the limitation of this study.^[43] In future studies, preparedness problems proposed by authors can be explored in similar countries and assessed in terms of fitness. In this research, some experts did not participate due to busyness or lack of availability; however, the research team tried to saturate concepts by other well-experienced participants. Due to time limits, all the affected provinces were not studied; however, key persons at the national level were fully aware of the challenges facing the country and put forward some solutions.

Conclusions

In Iran, with different patterns of precipitation scenarios, policymakers need to pay particular attention to risk understanding and risk management approaches. Then, it is necessary to carry out more research to manage the people's beliefs and opinions towards different aspects of the DSS. With the deployment of modern dust-health EWS, the health sector can provide accurate and immediate information at the social level, particularly for vulnerable groups. It is also recommended to provide public education at schools, families, religious institutions, social groups, and media to promote people readiness. Ultimately, the health system can evaluate EOPs through the planning and implementation of full-scale simulation drills and exercises.

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Ethical consideration

Informed consent was taken either in written by the signature of the interviewee's consent form, or oral acceptance from all participants. They were informed that all collected data were anonymity, confidentiality and they have the right to withdraw from the research at any time. The study was approved by the Ethics Committee in Biomedical Research of Shahid Beheshti University of Medical Sciences, Tehran, Iran, with the ethical code of IR. SBMU. RETECH.1396.1149

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Conflicts of interest

There are no conflicts of interest.

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