Designing a Surveillance System to Monitor the Adverse Health Effect of Environmental Disasters: A Case Study of Drying Lake Urmia-Iran

Hojatolah Gharaee[1] (ID), Rebecca Susan Dewey[2], Ramin Rezapour[3],
Naser Derakhshani[4], and Saber Azami-aghdash[5] (ID)

Abstract

Background: Through designing a surveillance system, steps to policy making and designing measures needed to reduce the potential risks of environmental disasters on human health could be taken. Therefore, this study aimed to develop a model for Environmental Disasters Diseases Surveillance System (EDDS) to monitor Adverse Health Effects (AHEs) of Environmental Disasters (AHEEDs).

Methods: As the first step, the literature review was conducted to identify the AHEEDs. Then, using the results of the first step and analyzing the existing documents, the AHEEDs were identified, and, based on the experts' opinions, high-priority effects were included in the EDDS. Then, using semi-structured interviews, 20 experts' views on the appropriate model of EDDS were investigated. To design the initial model, a panel of experts was formed with six participants. Finally, the Delphi technique was used for expert opinion and model finalization.

Results: As a result of the literature review and document analysis, 41 hazards/diseases were identified. Finally, ten diseases were suggested to enter the EDDS. In the experts' view, it is better that communicable diseases be reported actively and urgently and Non-Communicable Diseases (NCD) actively and non-urgently. From the participants' point of view, the most significant achievements of the EDDS can be organizational and managerial, health promotion, and economic achievements.

Conclusion: Developing a dedicated EDDS for AHEEDs can be very helpful for better management of these effects. To this end, the model proposed in this study can serve as a guide for national and local policymakers to implement surveillance systems for AHEEDs.

Keywords

surveillance system, adverse health effects, environmental disasters, Urmia Lake

[1] Department of Health Management and Economics, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran
[2] Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, UK
[3] Iranian Center of Excellence in Health Management, School of Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran
[4] Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran
[5] Tabriz Health Services Management Research Center, Health Management and Safety Promotion Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran

Corresponding Author:
Saber Azami-aghdash, Tabriz Health Services Management Research Center, Health Management and Safety Promotion Research Institute, Tabriz University of Medical Sciences, University Street, Panahi Alley, No. 14,
Tabriz, Iran.
Email: s.azami.a90@gmail.com

Introduction

The nature, theory, and conception of disasters are much debated and the subject of much academic deliberation. According to the Oxford English Dictionary, disaster is a "ruinous or distressing nature; a sudden or great misfortune, mishap, or misadventure; a calamity." Perhaps this is something of an over-simplification of a complex concept. Health impacts are a major reason for the mainstreaming of concern over environmental disasters.[1] There are different kinds of disasters, including natural or human-caused (technological, environmental, intentional/terrorism), rapid or slow onset, and short or long duration. In contrast to natural disasters, characterized by readily recognized physical injury with relatively predictable recovery periods, environmental disasters are characterized by slowly evolving and long-term adverse health consequences.

Different types of disasters have different health consequences.[2] Drying lakes are one of the types of environmental disasters that have their own Adverse Health Effects (AHEs). Today, there are many global experiences of drying lakes, most notably Aral Lake in Central Asia, Salton Lake in California, Owens Lake in California, and the Great Salt Lake in Utah, USA.[3] One of the worst experiences of drying lakes is the drying of "Lake Urmia." Lake Urmia is the name of a lake in northwestern Iran. Lake Urmia is Iran's largest inland lake and the second largest saltwater lake in the world.[4] The lake began to dry out in the mid-2000s, and today it is at risk of drying completely. Many environmental experts and government officials believe that the drying up of Lake Urmia has irreparable consequences not only for Iran but also for the regional countries.[5] Respiratory diseases, increased cancers, hypertension, prevalence of eye diseases, skin diseases, psychological hazards, and abortion are just a tiny part of the AHEs of drying lakes on public health.[6–10] To address the above risks, those should be prevented at every stage of the disease that is possible and controlled at the earliest possible time.[11]

Given that disease control and reduction is one of the critical goals of global development, through developing health indicators and daily observation of changes in these indicators, the health status of each country is assessed, and accordingly, short-term and long-term health plans are set for officials. The most crucial factor in changing these indicators is the disease surveillance system, which is the collection, analysis, and dissemination of information and the Implementation and evaluation of health plans based on this information.[12] In fact, the surveillance system is used as a key strategy for disease prevention. Also, to interpret the health status and health problems of the community and to decide how to improve it, allocate resources, and evaluate the effectiveness of implemented programs, appropriate information is needed that is accessible through the surveillance system.[12]

Since the end of the last century, many countries have established a system under the name of the diseases surveillance system, which its task was to investigate and collect data with the aim of discovering the incidence of epidemics as soon as possible. Iran also established a diseases surveillance system in 2000.[13] This monitoring system was initially established to monitor infectious diseases, but later it was developed and covered more diseases such as Malt fever, rabies, cancer, etc.[12]

Iran's surveillance system consists of two parts for communicable and non-communicable diseases (NCD). The Disease Management Center, affiliated with the Ministry of Health, is in charge of the national surveillance system. The provincial disease management centers are responsible for the duties of the national center in each province. The national center for disease management provides the list of diseases subject to urgent (daily report by phone or internet) and non-urgent reporting and announces them to the service providers. Updating the mentioned list according to local and national conditions is also the responsibility of this institution. If primary health care providers, hospitals, private clinics, and diagnostic centers find the suspected cases should report them to the provincial disease management center based on instructions. After examining and confirming the cases, the provincial disease management center reports them to the national disease management center within the determined time frame. Confirming the incidence of epidemics and planning and managing interventions in order to control the epidemics are also among the duties of the national and provincial disease management centers.[14]

Despite recent years' studies on the effect of environmental disasters on community health, the need to design an Environmental Disasters Diseases Surveillance System (EDDS) for the AHEs of such crises is felt. Using obtained information from surveillance system, the policies, plans, and measures could be designed to prevent and reduce risks. Therefore, the aim of this study was to develop an EDDS to monitor Adverse Health Effects of Environmental Disasters (AHEEDs) (Case Study of Lake Urmia–Iran).

Methods

This study is a mixed method study (quantitative and qualitative) designed and conducted in 2021.

Identification of Adverse Health Effects of Environmental Disasters (Drying of Lakes)

A literature review was conducted in the first step to identify the AHEs of drying lakes worldwide. The literature review has been conducted based on the book "Systematic Review for Support of Evidence-Based Medicine".[15] The required information was collected from PubMed, Scopus databases, and Google scholar search engines. No time limit was set for the search, and the published articles were searched until the end of 2021. To increase the confidence of identifying and reviewing all existing literatures, some authentic journals were searched manually, the reference list of included articles was also searched, and the databases of the European Association for Gray Literature Exploitation (EAGLE) and the Health Care Management Information Consortium (HMIC) were also searched for Gray literature.

The most important inclusion criteria included articles that consider the health effects of drying lakes. Due to the different nature and scope of the problems and because not compatible with the results of the drying of the lakes, the articles or other kinds of literature that consider the AHEs of drying of other water sources such as rivers, wetlands and ponds, were excluded. Articles and literature other than English and Persian were also excluded. Finally, articles that only examined the exposure to risk factors of lakes drying and did not assess the association of risk factors with health were excluded.

The data extraction form was designed manually using Microsoft Word. Initially, using this form, the data of three papers were extracted experimentally, and the deficiencies and problems in the original form were eliminated. The extracted data were manually analyzed and reported using the content analysis method.

Prioritizing Adverse Health Effects of Environmental Disasters (Drying of Lake Urmia)

At this stage, using the results of the literature review and analyzing the existing documents, the AHEs were identified. Then AHEs were prioritized using the experts' perspective, and high-priority effects were entered into the surveillance system. Four criteria proposed by the World Health Organization (WHO) to select risk factors for inclusion in surveillance activities were used to prioritize the identified AHEs:

- The significance of the risk factor for public health in terms of the nature and severity of the morbidity, disability, and mortality of the NCDs associated with these risk factors;
- The cost of collecting valid data on a repeated basis;
- The availability and strength of the evidence that intervening on the factor will reduce NCDs in the community; and
- The ability to measure the risk factor burden uniformly in different settings to ensure comparability and to measure changes over time.[11]

Table 1. Priority Matrix of Adverse Health Effects of Drying of Lake Urmia.

	The criteria and rating of risks				
Risks	Significance Score 1 to 5	Cost Score 1 to 5	Evidence Score 1 to 5	The ability to measure the risk factor burden Score 1 to 5	Total score
1					
2					
3					
4					
5					
6					
7					

Based on the above criteria and priority matrix, the risks were prioritized (Table 1). Based on the number of diseases identified and with the agreement of the research team, a score of 1 to 5 was assigned for each criterion. Therefore, the mean score of each AHEs varied from 4 to 20. Risks that scored above 15, marked in green mean high priority, between 11 and 15, marked in yellow mean medium priority, and from 4 to 10.9, marked in red mean low priority. High and medium-priority risks were entered into the surveillance system.

Experts' View on the Appropriate Model for Environmental Disasters Diseases Surveillance System (EDDS) (Drying of Lake Urmia)

A qualitative method was used to evaluate the viewpoints of experts on the appropriate model of **EDDS** for AHEEDs. Among the different approaches to qualitative studies, the Grounded Theory approach was chosen because of the belief that in phenomena and life experiences, there are substances that can be understood and studied.[16,17]

The study participants were experts and officials from various vice chancellors of universities of medical sciences, including vice chancellor for resource management affairs, vice chancellor for Health (PHC affairs) and vice chancellor for treatment, experts and health professionals from health services provider centers, various schools of universities of medical sciences, research centers, and other interested organizations. Inclusion criteria included having at least five years of job experience and scientific activities related to the subject and having the desire and ability to participate in the study. Purposeful sampling was used to select participants.

Semi-structured interviews were used to collect data. The duration of each interview varied from 46 to 80 min. Sampling continues until the saturation is reached, that is until the researchers feel that new information is no longer available.[18] This phase was achieved with 15 participants in the present study, but the researchers continued sampling up to 20 individuals to ensure excellent reliability. With The interviewees' consent, their statements were recorded, and the interviewers also took notes during the interview. Immediately after each interview, recorded interviews were listened to several times by researchers and were transcribed word by word.

Content-Analysis was used to analyze the data, a method for identifying, analyzing, and reporting patterns within the text, and is widely used in qualitative data analysis.[18] Data were coded by two researchers. The steps for analyzing and coding the data were as follows: familiarity with the text, identifying and extracting primary codes (identifying and extracting more data related to primary codes), identifying themes (inserting extracted primary codes into related themes), Reviewing and completing identified themes, naming and defining themes, ensuring the reliability of the extracted codes and themes (agreeing between the two coders through discussion and resolving disputes).

EDDS Model Design and Validation

At this stage, according to the results of the previous steps (literature review, prioritization matrix, and investigation of the experts' perspective), the draft of the model's components was reviewed by a panel of experts composed of six experts. In the expert panel, each component of the model was discussed and based on the consensus of experts, and the initial model was developed.

After determining the principal dimensions and structure of the initial model, the Delphi method was used to determine the model's validity. A summary of the objectives and the initial model developed in the earlier stages was prepared as a Delphi questionnaire and sent to 17 experts. Using this questionnaire, each stakeholder rated each policy option from two aspects of importance (whether this option is essential and should be considered) and implementability (whether the health system can implement it). The Delphi questionnaire consisted of a 9-point Likert scale, in which options with a median higher than seven were accepted, options with a median of 4–7 were entered in the second phase, and options with a median less than four were excluded.

The Delphi Study and Expert Panel participants included Tabriz, Tehran, Iran, Hamedan, Shahid Beheshti, and Urmia Universities of Medical Sciences.

Inclusion criteria for participants in this phase of the study included:

- At least BSc or MD degree for professionals from the health administrative section;
- At least five years of job experience in managing or delivering primary health care services;
- At least a PhD degree for academic professionals;
- Desire and ability to participate in the study.

Ethical approval

The study had been approved by the Ethics Committee of the authors' institute. Ethical Number: IR.TBZMED.REC.1397.775. The authors fully respect ethical issues (including the informed consent of the participants, plagiarism, duplication, etc). The confidentiality principles are respected in the information of individuals. The individuals were assured that the study results would be used only for the study and not in any other cases, and each
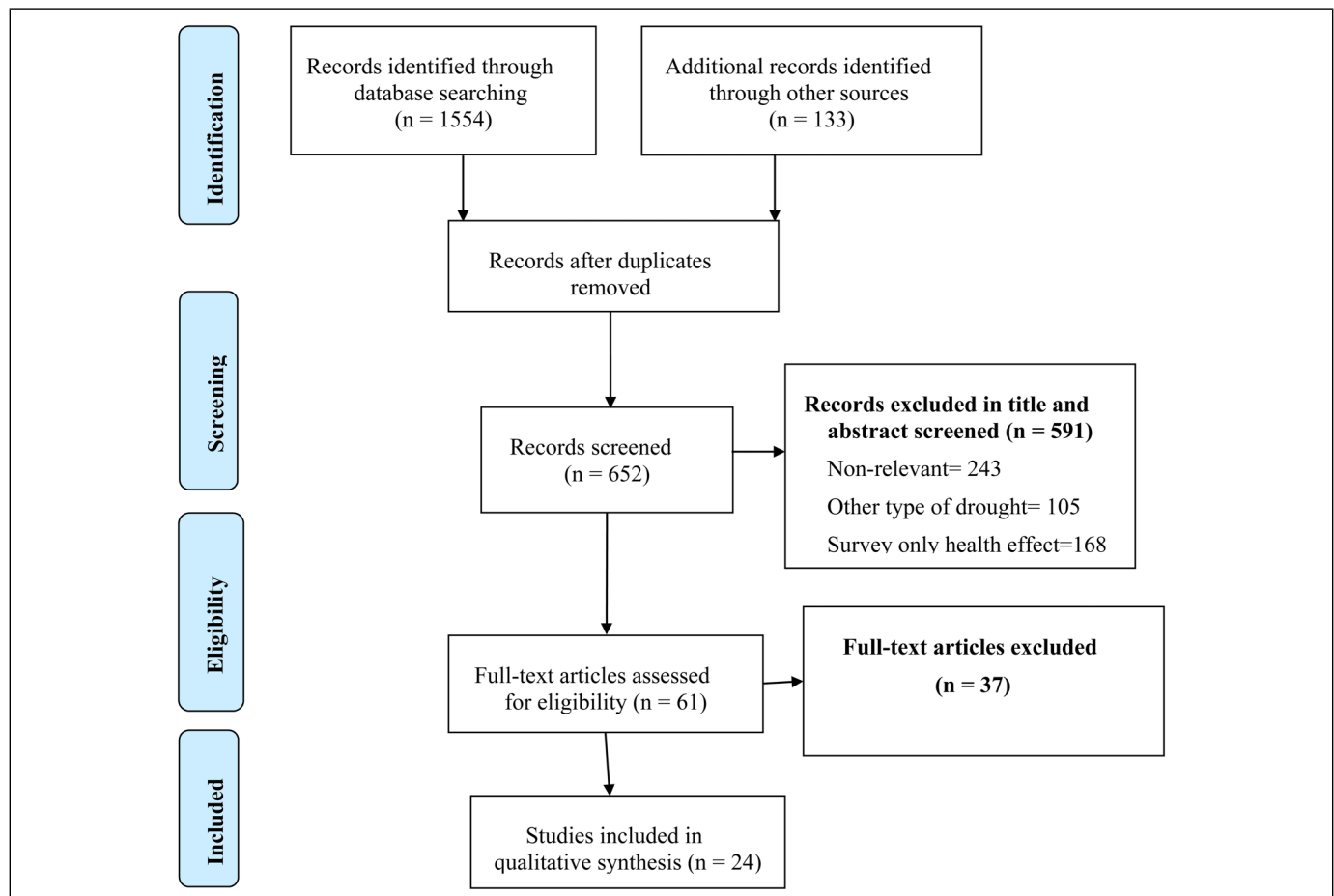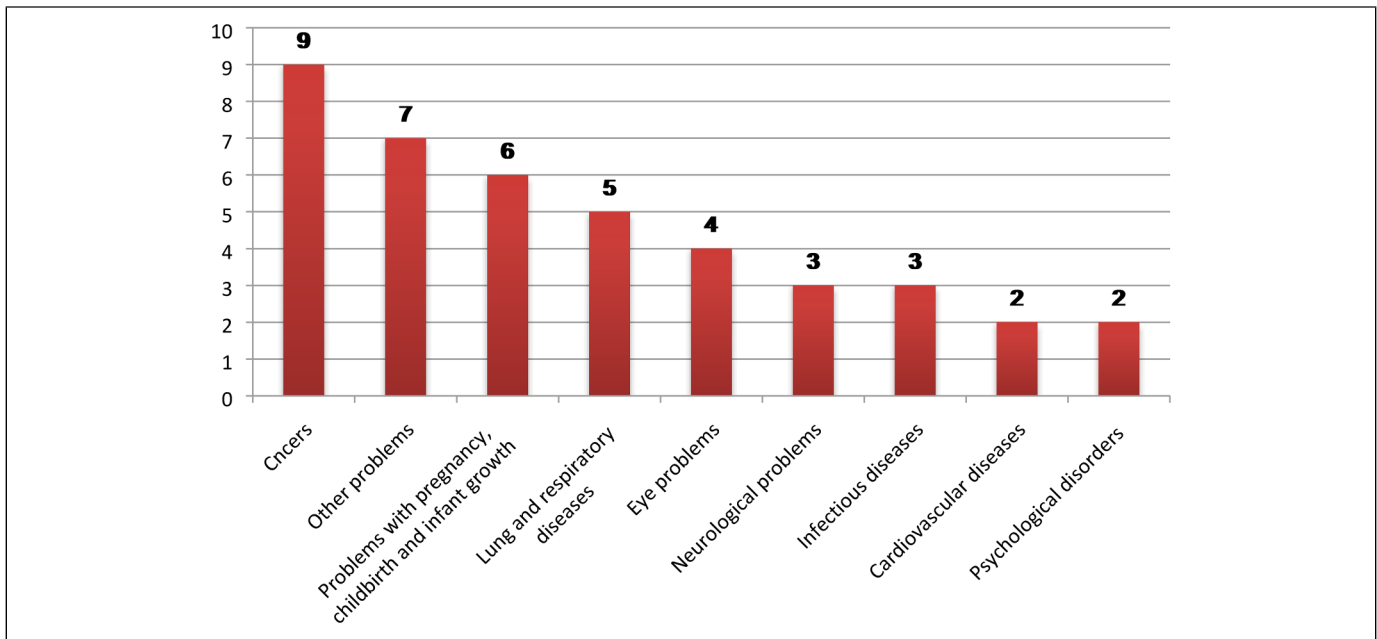

Figure 1. Selection of sources of evidence.

Figure 2. Adverse health effects caused by drying of lakes.

person was allowed to leave the study at any phase of the study without any loss.

Results

Identification of Adverse Health Effects of Environmental Disasters (Drying of Lakes)

As a result of the literature review and analyzing the existing documents, 435 AHEs caused by the drying of lakes were identified (Figure 1).

After eliminating duplicates and merging similar cases, 41 risks were finalized in 9 groups (Figure 2) (Table 2).

Prioritizing Adverse Health Effects of Environmental Disasters (Drying of Lake Urmia)

Identified diseases in previous phases were divided into two groups of communicable and NCD (Figure 3).

The diseases listed in Figure 3 were entered into the prioritization matrix and sent to 15 experts, 14 of whom filled and returned the matrix. Of the 18 types of diseases that entered the prioritization matrix, mental disorders, respiratory diseases, Eye problems, Hypertension, Cardiovascular diseases, Cancers, Allergic reactions, Goiter, Malnutrition, Anemia, Vector-borne diseases, Soil-borne diseases, Liver diseases, Systemic diseases, Water and foodborne diseases, Neurological problems, Epigenetic effects, and Airborne Diseases respectively, achieved the highest to lowest scores. Also, the risks were categorized into six high-priority, four medium-priority, and eight low-priority sections, and finally, ten types of risks were suggested to log into the surveillance system (Table 3).

Experts' View About the Appropriate Model for Surveillance System of Environmental Disasters' Adverse Health Effects (Drying of Lake Urmia)

How to Diagnose, Assess and Report Risks and Symptoms in the View of Experts. There are different views on diagnosing, assessing, and reporting the risks and symptoms (being active or passive, urgent or non-urgent). The type of risk, distance to the disaster area, the time between exposure until the prevalence of the AHEs, and health system facilities as the influential factors in diagnosing, assessing, and reporting are some factors that participants consider.

Participant No.4: "It depends on our capabilities. If possible, I would recommend active care personally, but in some places, active care is necessary and must be active … For example, in food and waterborne diseases, the surveillance system must be active …".

Participants believed that the health system requires planning with a range of urgent, mid-and long-term measures. Urgent measures include monitoring, evaluation, and reporting of acute symptoms of AHEs, mid-term measures including annual health effects monitoring with the participation of the people themselves, and long-term measures including self-reporting and registering of symptoms of AHEs.

As most problems occur in the long run, it is imperative to design an effective surveillance system with long-term efficiency and high sensitivity. Participants believed that the surveillance system could be active or passive and urgent or non-urgent depending on the type of disease. Participants believe that communicable infectious diseases should be active and urgent, and non-communicable can be active and non-urgent.

Participant No.10: "In my opinion, it is the kind of health effects that determines whether the reporting system must be

Table 2. Adverse Health Effects Caused by Drying of Lakes (n = 41).

ROW	diseases group	diseases
1	Lung and respiratory diseases	Asthma
2		Chronic Obstructive Pulmonary Disease (COPD)
3		Pulmonary Tuberculosis
4		Chronic bronchitis
5		Pulmonary infections
6	Cancers	Leukemia
7		Lung cancer
8		Breast Cancer
9		Skin Cancer
10		Gastrointestinal cancer
11		Throat cancer
12		Oral cancer
13		Thyroid cancer
14		Kidney and liver cancer
15	Infectious diseases	Diarrhea
16		Typhoid
17		Malta fever
18	Cardiovascular diseases	Hypertension
19		Myocardial infarction
20	Problems with pregnancy, childbirth and infant growth	Abortion
21		Childbirth problems
22		Menstrual cycle disorders
23		Infant death
24		Mental retardation
25		Teratogenicity
26	Neurological problems	Headache/Migraine
27		Immune system problems
28		Stroke
29	Psychological disorders	Depression
30		Anxiety/Stress
31	Eye problems	Macular Degeneration
32		Cataracts
33		Photo keratitis
34		Sty
35	Other problems	Malnutrition
36		Kidney and urinary tract diseases
37		Arthritis
38		Oral Health Problems
39		Skin and Hair Diseases
40		Genetic disorders
41		Endocrine disorders

active, passive, or urgent or non-urgent … Obviously, infectious communicable diseases must be active and urgent, and non-communicable can be passive and non-urgent …".

On the other hand, some participants believe that the surveillance system for environmental disasters (drying up Lakes) should be syndromic (symptom-based assessment) and focus on the symptoms of AHEs.

Participant No.7: "… I suggest that the surveillance system focus on the symptoms of AHEs of drying up of environmental disasters. That is, instead of seeking to diagnose and report asthma, it should seek a set of symptoms …".

Participants believe that health system staff should be trained to be highly sensitive and accurate when consulting patients with suspected symptoms. It should be apparent to the patient which symptoms should be treated or referred to upper levels. First, the staff should record and review the information needed, then referred to a practitioner or specialist for diagnosis. Based on the doctor's discretion, labs and diagnostic centers can also be used to diagnose the health problem. Finally, after confirmation, the disease should be reported.

Participant No.2: "The Ministry of Health should conduct the necessary investigations to determine what health problems and risks may arise in this area … The health system staff should be trained that if these diseases with these symptoms were found here, what should be done? …".

Essential Information for Collecting, Reviewing, and Reporting. Participants believe that one of the influential factors contributing to the Implementation of a surveillance system is accurate planning of the information needed and how it should be collected and reported.

Participants also believed that experiences from the current surveillance system provide outstanding opportunities and a basis for implementing the AHEEDs (Urmia Lake). There are some backgrounds to some risks, but others do not and should be designed for these crises specifically.

It also appears that implementing the surveillance system will require the health system to provide the opportunity to record relevant information in the electronic system. One solution, according to participants, is to add to the current electronic system a series of additional information related to the effects of environmental disasters.

Demographic information such as age, gender, job, income, symptoms and AHEs background, living area (distance to the danger area), the level of knowledge, awareness, and attitude and practice of the individual on the subject, health information, and disease backgrounds, hereditary and genetic background, type of drinking water source, background to underlying diseases (such as diabetes, hypertension, cardiovascular disease, organ transplants, etc), etc can be tracked and recorded. Also, for accurate planning, it is necessary to provide general information, including indicators of morbidity, mortality, prevalence, incidence, and trends of some diseases such as hypertension, pulmonary disease, respiratory problems, asthma, bronchitis, cancers, and information on providing health services, especially in the adjacent areas. Also, the concentration of various pollutants, environmental changes such as vegetation, vectors, and endemic and epidemic diseases of the area, should be measured, recorded, and reported.

The above information and their short and long-term trends should be compared statistically with previous years and other parts of the country or other regions.

Officials Responsible for the Surveillance System at Different Levels of the Health System in the City, Province, and Country and the Skills They Need. A community-based surveillance system can
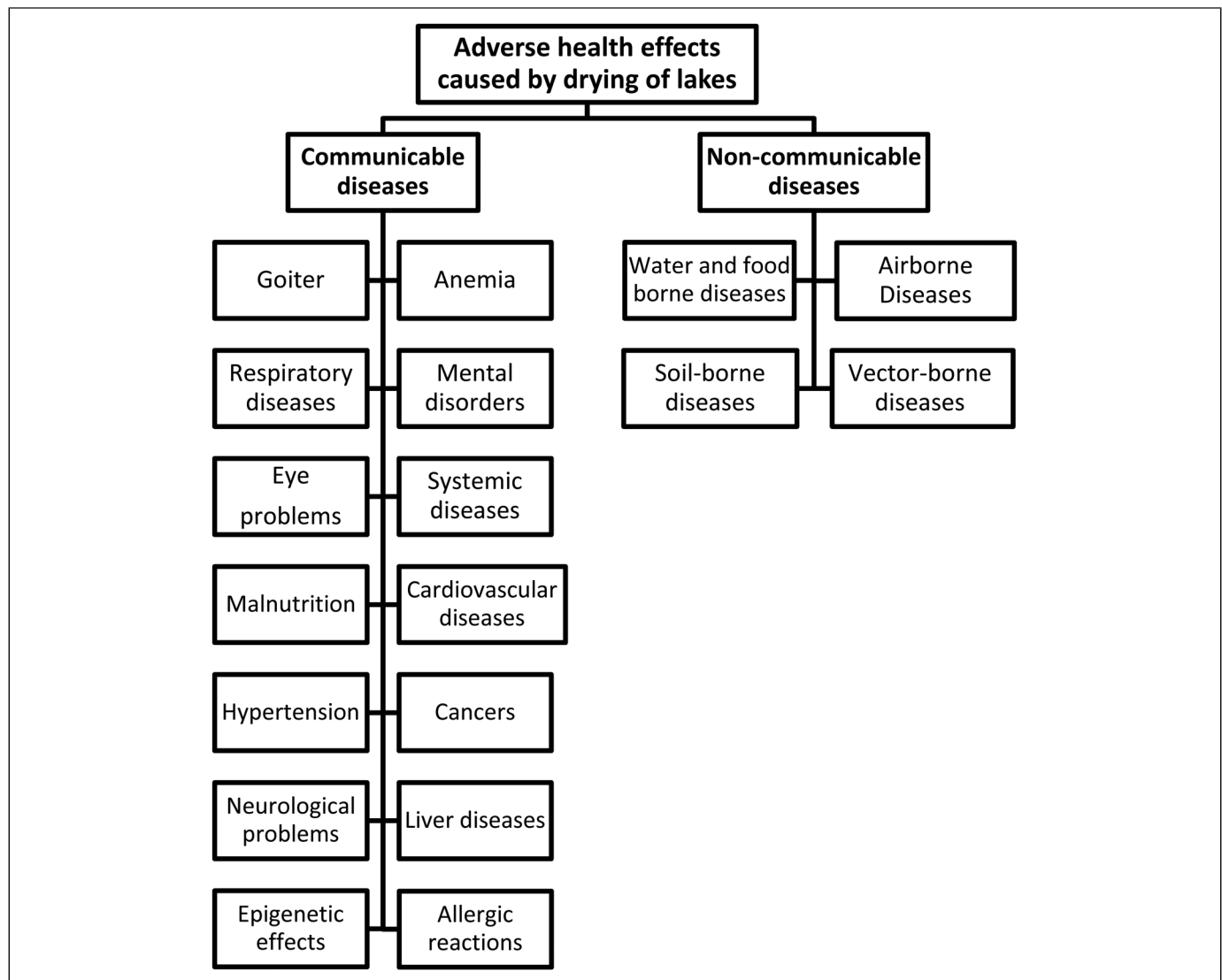
Figure 3. Variety of diseases that can potentially cause by drying of lakes.

be designed to train people who are more sensitive to report when they see specific symptoms.

Participant No.5: "… In our country, for example, caring for acute flaccid paralysis is community-based. Influencers are trained to report as soon as they see certain symptoms …".

Participants believed that due to the lack of human resources, it was not possible to examine the symptoms house to house and individually. One of the most effective things they believe is monitoring the centers where people go to get services, such as pharmacies, laboratories, diagnostic centers, and so on. Information should be collected from all centers where patient information is available, reporting should be extensive and then assessed by an expert body or team.

Participants believe authorities at all levels should be involved in the implementation of the surveillance system. Specialized units of the Ministry of Health and the University of Medical Sciences that are directly related to each AHEs, should also contribute to the management and Implementation of the system.

Possible Achievements and Implications of Designing and Implementing the Surveillance System. Participants believe that designing and implementing the surveillance system for the AHEEDs will have meaningful results and achievements, which can be categorized into three managerial and organizational, health status, and economic areas (Figure 4).

EDDS Model Design and Validation

The initial framework consisted of 25 options in 4 sections, including diseases/risks required for registration, procedures for diagnosis, evaluation and reporting of diseases/risks, information that need to be collected, reviewed, and reported, and general information entered in phase I of Delphi. In the first step, after analyzing the experts' scores, one option was excluded because of the low score, nine options went to the second stage, and 15 were accepted. In the second Delphi phase, ten experts responded to the forms, and due to the high agreement of the first and second phases, the Delphi was

Table 3. Prioritization Matrix of Adverse Health Effects of Drying of Lake Urmia.

		The criteria and rating of risks				
		Significance	Cost	Evidence	The ability to measure the risk factor burden	Total score (out of 20)
Row	Risks	Score 1 to 5	Score 1 to 5	Score 1 to 5	Score 1 to 5	
1	Anemia	2.1	2.8	1.9	4.5	11.3
2	Goiter	2	3.4	2.1	4.7	12.2
3	mental disorders	4.2	4.8	4.3	3.9	17.2
4	respiratory diseases	4.8	3.2	4.9	3.8	16.7
5	Systemic diseases	2.9	2.2	1.7	2.1	8.9
6	Eye problems	4.4	3.1	4.7	4.2	16.4
7	Cardiovascular diseases	4.8	2.9	3.4	4.4	15.5
8	Malnutrition	3.1	3.3	1.6	4.1	12.1
9	Cancers	4.9	2.5	4.1	3.9	15.4
10	Hypertension	3.9	4.8	2.6	4.4	15.7
11	Liver diseases	2.4	2.3	1.2	3.4	9.3
12	Neurological problems	1.8	2.2	1.4	3.1	8.5
13	Allergic reactions	3.5	2.7	4.2	2.7	13.1
14	Epigenetic effects	3.2	1.4	1.6	1.5	7.7
15	Soil-borne diseases	1.3	2.2	1.8	4.2	9.5
16	Water and food borne diseases	2.2	3.1	1.1	2.5	8.9
17	Vector-borne diseases	2.3	3.1	1.5	3	9.9
18	Airborne Diseases	1.6	2.5	1.4	2.1	7.6

Note: Risks that scored above 15, marked in green mean high priority, between 11 and 15, marked in yellow mean medium priority, and from 4 to 10.9, marked in red mean low priority.

ended in this phase eventually; 23 options were accepted, and two options were excluded. Based on the results of the study, the surveillance system for environmental disasters following Figure 5 was presented in 23 options, and four sections include diseases/risks required for registration, procedures for diagnosis, evaluation, and reporting of diseases/risks, the information needed to be collected, reviewed and reported, and general information.

Discussion

The aim of this study was to design and validate an appropriate model for the surveillance system to monitor AHEEDs focusing on the drying of Lake Urmia as an example.

Based on the results of the literature review and the views of experts, the research team divided the AHEs caused by the drying of lakes into two groups of communicable and NCD. In a review study conducted by Sadeghi Bazargani et al (2019), of 22 reviewed articles, 17 papers indicated that the drying of lakes had adverse effects on human health. In this study, the effects of lake drying on human health were classified into seven areas (respiratory problems, reproductive system problems, kidney, and urinary tract diseases, cancers, anemia, diarrhea, and others).[19]

The results showed that due to cost and budget constraints, not all AHEEDs can be taken care of, so it is better to enter

the higher priority cases into the surveillance system. According to the Priority Matrix, the ten main risks are eligible to enter the surveillance system. According to the WHO Guidelines for the development of non-communicable disease surveillance system, the decision on how many AHEs could enter the care system depends on available resources, such as workforce and equipment, in the country or region affected by the crisis.[11]

According to the results, the problems caused by the environmental crisis occur in the long run and are not perceptible, so a surveillance system for environmental crisis is necessary for ongoing risk assessment so that people in need of care and treatment be identified timely.

How to Diagnose, Assess and Report Risks and Symptoms

The results indicated that there were different views on how to diagnose, evaluate, and report the symptoms and diseases (whether active or passive, urgent or non-urgent), but the overwhelming majority share that infectious communicable diseases must be active and urgent, and non-communicable can be active and non-urgent.

All practitioners and staff at all health system levels must have the necessary training and skills. Guidelines should be
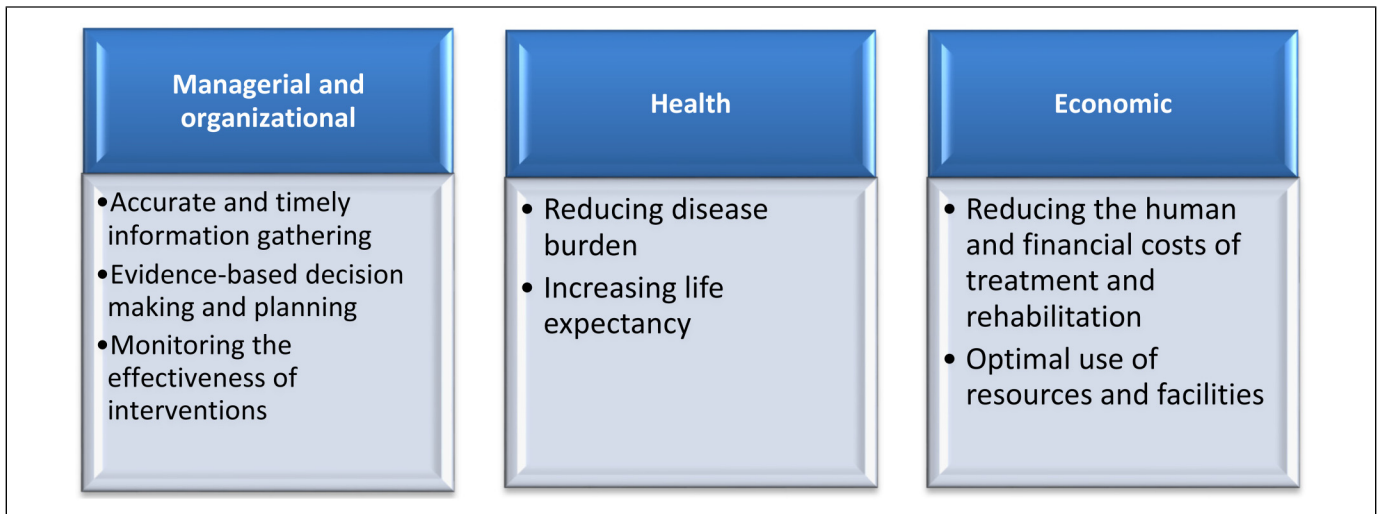
Figure 4. Results and achievements of design and implementation of surveillance system for adverse health effects caused by environmental disasters.

developed to identify the symptoms needed for assessing and reporting. PHC and medical health centers, diagnostic and even rehabilitation centers at all levels should be involved in risk registration and reporting.

Essential Information for Collecting, Reviewing, and Reporting

Based on the findings of the study, the Implementation of the current surveillance system for communicable diseases has provided valuable experiences for the health system, which can be very helpful in the design and Implementation of the surveillance system for AHEEDs, and it should be clear by exchanges between specialists in different fields what information should be collected for each disease.

The results showed that assessing most of the risks included in the surveillance system can be syndromic. This means that the symptoms of various AHEs in the community must be reviewed, recorded, and reported. Such as cough or eye irritation in people with respiratory or eye problems. Symptoms and risk factor exposure data can be used to provide information to predict disease and health conditions. They can also provide information on health indicators for a particular area.[11]

On the other hand, one of the requirements of the surveillance system is the existence of an electronic system in which information is recorded and reported based on a network. It is also possible to add some features to the current information system for communicable diseases to enable the registration of AHEEDs.

A wide range of information is essential for registering and reporting the health effects of environmental disasters, including demographic information, occupational information, geographical location, health information, and disease records. In addition to the above information on individuals in the community, the trend of AHEs, in the short-term and long-term, should be compared statistically with previous years and with other areas and other countries and regions.

Another option is to design a reporting system so people can easily register their suspicious health symptoms online. Even if a large portion of this information is unrealistic, recording it will enhance the system's sensitivity to identify the items that need follow-up. The WHO recommends that in a surveillance system, risk factors should be assessed at three levels: Self-reporting by individuals with symptoms (step one); Objective information through physical examination (step two); and Objective information through laboratory analysis (step three).[11] The approach of this method is to focus on collecting core data at each level that is the primary determinant of disease burden.

Officials Responsible for the Surveillance System at Different Levels of Health Provision in the City, Province, and Country and the Skills They Need

The results indicate that the surveillance system for AHEEDs should be community-based, meaning that they get help from people and influencers in reporting suspicious cases. Also, if the surveillance system is syndromic, reporting suspicious cases does not require professional expertize and can be accessed by almost everyone in the community, but experts should perform information screening. Therefore, reporting should be community-based, and experienced experts should conduct screening.

One of the critical factors in the effectiveness of the disease surveillance system is people's participation in all stages, from designing to implementing the system. People's knowledge of the diseases targeted by the disease surveillance system and their symptoms and people's perception of the importance of identifying and reporting these diseases in preventing and
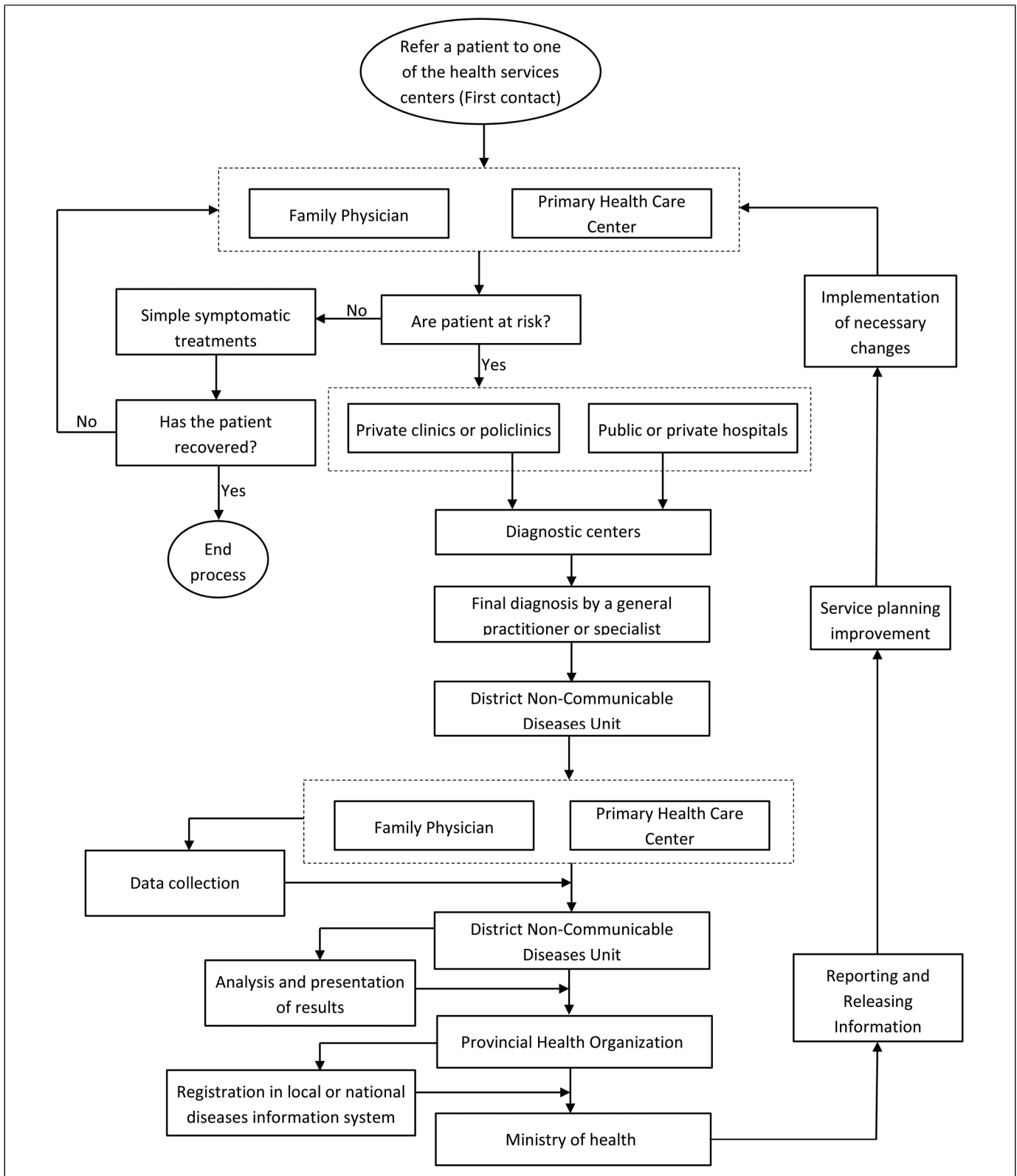
Figure 5. Steps of surveillance system for monitoring the adverse health effects of environmental disasters.

controlling the effects of drying up of the lake can provide the basis for more people's participation and the effectiveness of the system.

Since there is already a surveillance system for communicable diseases, those working on the current structure should be assisted in managing and organizing the surveillance system

for AHEEDs. Implementation of this system requires the full cooperation and commitment of the Ministry of Health units. All organizations, institutions, and stakeholders involved in recording, reporting, diagnosing, treating, and disseminating information about communicable diseases should participate in the surveillance system of AHEEDs. Effective monitoring requires uniformity, simplicity, and standardization of definitions and classification of cases.[20] In a study by Ebadi Fard Azar et al (2008), the infectious disease surveillance system of three countries, the USA, Iran, and Australia, were compared, and a model was presented to reform the Iranian surveillance system. The study states that new technologies must be used to manage the surveillance system information so that information can be reached quickly at any time and place, there should be standard and uniform guidelines for identifying and classifying disease cases, all levels of the health system participate in the surveillance system, the necessary mechanisms for the participation of all public and private sectors should be provided, geographic Information Systems (GIS) should be used to determine how diseases are distributed in different regions of the country and also a national body should be designed for surveillance system management.[20] The results of a study conducted by Dehcheshmeh et al (2015) show that to develop an efficient and effective surveillance system for communicable diseases, it is necessary to consider: policy and planning, resource development, organization, collaboration, and participation of all sectors, the process of monitoring and evaluation of the surveillance system.[21]

Conclusion

Given the increasing environmental disasters in recent years and the potential impacts of these disasters on human health, a surveillance system for monitoring and managing AHEEDs can effectively prevent and reduce the severity of risks. To this end, the model of the surveillance system proposed in this study, based on the study of the drying of Lake Urmia and its AHEs, can serve as a guide for policymakers and national and local officials. Despite the researchers' efforts to present a practical and close-to-reality model, it is recommended that relevant authorities take into account each area's operational aspects and local conditions when using the present model.

Study Limitations

In part of the present study, existing documents were used to extract information. Given that this information was not collected for research purposes, some were less appropriate for the study.

One of the significant limitations of the present study was the limited number of experts on the subject under study, which may affect information saturation.

People's perceptions, as the audience of the disease surveillance system, are fundamental and should be considered in the design and implementation of the model. Another limitation of the study is not using people's opinions in the design of the disease care model.

All participants were also from Iran and were more aware of the situation in Iran, which may limit the generalizability of the findings to other countries.

ORCID iDs

Hojatolah Gharaee https://orcid.org/0000-0002-9354-4175
Saber Azami-aghdash https://orcid.org/0000-0003-1244-359X

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Author Biographies

Hojatolah Gharaee, Ph.D., is an Assistant Professor in the Department of Health Management and Economics at School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran.

Rebecca Susan Dewey, Ph.D., is a research fellow in neuroimaging at the Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, collaborating closely with the NIHR Nottingham Hearing Biomedical Research Unit, University of Nottingham, Nottingham, United Kingdom.

Ramin Rezapour, is a researcher in Iranian Center of Excellence in Health Management at School of Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran.

Naser Derakhshani, Ph.D., is a researcher in Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran.

Saber Azami-aghdash, Ph.D., is an Assistant Professor in the Department of Health Management and policy at School of management and medical informatics, Tabriz University of Medical Sciences. He is also senior researcher in Tabriz Health Services Management Research Center at Health Management and Safety Promotion Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran.