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## Risk Assessment of Arbaeen Mass Gathering in the Covid-19 Pandemic

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### ARTICLE INFO

#### Keywords:

Risk assessment  
Arbaeen  
Covid-19  
Mass gathering

### ABSTRACT

**Introduction:** Arbaeen is a religious ceremony held annually with the participation of a large number of pilgrims. During the pandemic of Covid-19, a mass gathering of Arbaeen pilgrims can strengthen the transmission of this disease and put more pressure on the health care system of countries. The aim of the study is to evaluate the risk of Arbaeen ceremony in the Covid-19 pandemic in 2021.

**Materials and methods:** A mixed method was performed to perform the study using qualitative and quantitative methods. A national risk assessment tool was used that consisted of hazard identification and assessment, scenario development, exposure assessment, vulnerability assessment and risk estimation. The national risk assessment tool was completed through a focused group discussion and the opinions of 20 representatives of the health system and the level of risks were estimated. Data were collected, analyzed, and integrated by the research team.

**Results:** Based on the results of risk matrix analysis, factors such as the increase in the number of new cases of COVID-19, the probability of exposure to a new variant of COVID-19, the probability of arrival of a new variant of COVID-19 to the country, the probability of increasing referrals to healthcare facilities (score 16), the probability of getting respiratory diseases, and the environmental contamination (score 12) occupied the red area of the matrix and were found to have the highest risk (unbearable risk), that needs immediate action.

**Conclusion:** Preparing for a mass gathering such as Arbaeen is very important in order to reduce the risk of communicable disease, and the first step in improving preparedness is risk assessment and its continuity in the various stages of the ceremony. Therefore, policy makers and planners of such events should conduct risk assessments with the participation of local and national public health authorities regularly.

### 1. Introduction

The World Health Organization (WHO) defines mass gatherings as the gathering of a certain number of people in a specific place, for a specific purpose in a specific period, so that communities need more effort and double planning and action to provide services and responses [1]. Arbaeen is a religious ceremony held annually in Iraq with the participation of 17–20 million people from many countries of the world [2], and the gathering place is in Iraq for about two weeks. Pilgrims from different countries such as Iran, India, Pakistan, Afghanistan, the Republic of Azerbaijan, Turkey, Lebanon, Kuwait, Bahrain, Saudi Arabia, etc. are present in this ceremony, and they walk to the city of Karbala, south of Baghdad, to gather at the end of the 40-days following Ashura, for the commemoration of the martyrdom of the third Shia Muslim Imam, Hossein ibn Ali's. The mourning ceremony of Arbaeen is the world's largest public mass gathering.

In Arbaeen, due to the large population of pilgrims' journey and Variability of the time of the ceremony, public health managers must be prepared to manage the excess pressures on the country's health system [3]. On the other hand, ensuring the safety and health of the participants in this event is one of the most important parameters in successful mass gatherings management [4]. In this type of ceremony, which participants attend from different nations, regions, and cultures, the exposure, occurrence, and spread of infectious diseases is very important and varies depending on the type and location of mass gathering [5]. People attending the Arbaeen event may be threatened by communicable diseases such as water & food borne diseases, injuries, terrorism, and bioterrorism, in addition, non-communicable diseases and accidents are worrying [6].

Covid-19 pandemic which has started in December 2019, spreads rapidly through respiratory droplets in closed environments [7], therefore holding the mass gathering can strengthen the transfer of Covid-19 and

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puts more pressure on the health care system of countries [1]. On the other hand, participants in the Arbaeen ceremony may not believe in the health risks of this religious ceremony. Therefore, the mass gathering of Arbaeen and its related effects is considered a serious threat to health, and ignoring this issue can have unfortunate health consequences [8,9], and it is necessary to take preparedness measures to manage and control infectious diseases such as Covid-19. Since understanding the risks associated with mass gatherings is the first step in policy-making and planning for public health managers, it is necessary to consider the potential risks before the ceremony according to the type of ceremony, the number of participants, time, and place, hence the risk reduction is possible through effective planning [10].

Risk assessment is a systematic process for collecting, evaluating, and documenting information to determine the level of risk that provides a basis for managing and mitigating the negative consequences of acute public health hazards. Based on the risk assessment, preventive intervention can be planned and ensured the required infrastructure is in place to control potential problems [11]. This study was designed to risk assessment in the Arbaeen ceremony of 2021, with the emphasis on COVID-19 and determine priority risks and interventions in the Iranian health system.

## 2. Materials and methods

In this study, a mixed-method was used to perform the study using qualitative and quantitative methods. Risk assessment in its simplest form is risk prediction and estimation, which is itself a function of three components: hazard, exposure, vulnerability (World Bank, 2014 - Fig. 1). In this study, a national tool developed in 2014 was used to assess the risk [12].

In this method the stages of risk assessment include 1. Hazard identification and assessment and scenario development, 2- exposure assessment, 3- vulnerability assessment and 4- risk estimation.

### 2.1. Hazard identification and assessment, scenario development

In our study, the hazard is holding Arbaeen ceremony during the Covid-19 pandemic, to determine the vulnerability and exposure, national documents and reports from the beginning of the epidemic in the country through the system of emergency operations centers in the Ministry of Health, patient registration system in the Ministry of Health (MCMC<sup>1</sup>), daily reports from the Epidemiology Committee of Ministry of Health, and the approvals of Coronavirus national committee were studied. Available data included the number of cases, deaths, recovered ones, the ratio of death to the total number of patients, and demographic characteristics. To predict the amount of exposure, we needed a foresight scenarios. Three scenarios were predicted for holding the ceremony: a scenario with a limited population (less than 500 thousand people), a scenario with a medium population (Between 500 thousand and one million people), and a scenario with the participation of more than one million pilgrims.

### 2.2. Exposure assessment

The purpose of this stage is to determine the population, assets and activities exposed to exposure, the nature of this exposure and the factors that lead to exposure of these cases to risks, the factors that cause damage due to this exposure, and to estimate the potential effects of the risk. Given the current situation of the country, the probable scenario to implement the Arbaeen walk program was predicted as holding a ceremony in a very limited and completely controlled way (less than 500 thousand people).



Fig. 1. The relationship between risk and its components.

### 2.3. Vulnerability assessment

Various methods can be utilized to assess hazards and vulnerability. The use of Focus Group Discussion (FGDs) is a good way to identify risk in rapid risk assessment [12]. Therefore, in this study, two rounds of multidisciplinary FGDs from June to July 2021 were used to assess risk in COVID-19. Participants included 20 key individuals who were representatives of different departments of the Ministry of Health, the Deputy of Treatment, the Deputy of Health, the Food and Drug Administration, the Emergency Medical Service organization, and the universities of medical sciences in the border provinces. The characteristics of FGDs participants are in Table 1.

In the first round, the current situation of Covid-19 in our country and other countries was shared with the participants. The model and risk assessment process were also explained to them. Participants were then divided into two groups FGDs of 10 multidisciplinary experts and each group held a focused discussion under the chairmanship of the working group secretary, and using the method of brainstorming, vulnerabilities of the health system and its risks in each group were determined. Moderators completed and registered the risk assessment tables designed to collect qualitative data. The results of each group were collected, analyzed, and integrated with the research team, and the final vulnerabilities and risks were identified (Table 2).

### 2.4. Risk estimation

In the next round of FGDs, the risk was scored based on the severity and probability of occurrence. Participants in each group of FGDs scored between 1 (minor) to 4 (severe) for the severity of each risk, and between 1 (rare) and 4 (very likely) for each risk, and then these scores were multiplied to achieved overall risk priority number. A risk score of 12–16 was an unbearable risk, and 8–9 was a significant risk. Unbearable and significant risks are a priority in planning. National emergency management plans and emergency interventions to reduce risks in FGDs were discussed and recorded. The results of both groups were collected, integrated, and at last, the final report was prepared (Table 3).

## 3. Results

In the first stage of risk assessment (vulnerability and exposure determination), participants identified the effects of Arbaeen mass gathering in

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**Table 1**  
Demographic characteristics of the FGDs ( $n = 20$ ).

Demographic Characteristics	N
Gender	
Male	14
Female	6
Age (year)	
30–39	10
40–49	9
50 or older	1
Level of Educational	
Master of science	3
General Practitioner (GP)	9
Ph.D. (Health in Disasters and Emergencies)	3
Medical specialist	5
Work Experience (years)	
5–10	2
11–15	8
16–20	10
Workplace	
Universities of Medical Sciences	6
Deputy of Health	5
Emergency Organization	5
Deputy of Treatment	1
Food and Drug Organization	2
Health Reference Laboratory	1

epidemics such as COVID-19 on five suspected areas (people, property, services, livelihood, and the environment) (Table 2). In the second stage, the risk matrix (scoring risks based on probability and severity) was extracted. According to the risk matrix (Table 3), “increasing the number of COVID-19 cases”, “the probability of exposure to new variants of COVID-19”, “the probability of arrival of new variants of COVID-19 to the country”, “the probability of increasing referrals to healthcare facilities” (score 16), “the probability of getting respiratory diseases”, and “the environmental contamination” (score 12) occupied the red zone of the matrix and identified as having the highest risk (intolerable risk) that require immediate actions. Other risks and scores were shown in Table 3. In the next step, a comprehensive national emergency management plan was developed according to the capacities and vulnerabilities of the health system. These interventions were developed separately for immediate, significant, and delayed intervention.

#### 4. Discussion

The present study was conducted to develop a comprehensive risk management program in the coincidence situation of Covid-19 and Arbaeen mass gathering based on risk assessment. The results of this study showed that “the increase in the number of new cases of COVID-19”, “the probability of exposure to a new variant of COVID-19”, “the probability of arrival of a new variant of COVID-19 to the country”, “the probability of increasing referrals to healthcare facilities”, “the probability of getting respiratory diseases”, and “the environment contamination” gained the highest scores in the risk matrix and require immediate interventions. Another study conducted in Iran to assess the risk of Covid-19 in the health system showed that environmental and individual contamination, as well as burnout of health care workers, are among the highest scores in the risk matrix. Therefore, the results of the study, like the present study, emphasize the environment contamination and the probability of increasing the incidence of the disease.

Because Covid-19 is an communicable disease and is spreading rapidly in countries, the WHO has adopted a strategy to reduce and stop the transmission, prevent the spread of the disease, and delay its spread” [13]. The results of studies have shown that mass gatherings and religious tourism can provide the potential for the spread of infections in borders and within communities and create significant risks to public health, thus canceling or delay in holding mass gatherings is very important to reduce this pandemic [10]. On the other hand, mass gatherings with a religious background can

affect the mental health of many people, encourage healthy behaviors, and have many social and economic effects on society. Therefore, any country that wants to hold large-scale religious mass gatherings should be able to implement adequate preventive measures considering the country's conditions in terms of the severity of disease transmission [14,1].

The results of the risk assessment of Arbaeen ceremony during the Covid-19 pandemic showed that holding the ceremony in the form of a caravan and completely controlled and with regard to health protocols can reduce the risk of disease. On the other hand, limited resources and equipment, fatigue, and burnout of manpower have created conditions for health systems that holding ceremonies in a limited and controlled manner can reduce the risk of increasing in new cases and demand for receiving health services, and can prevent the increase of the burden of disease on health systems [15]. Therefore, in line with other studies, the results of the present study emphasize preventive measures taken by health systems such as supply and distribution of COVID-19 diagnostic tests, mandatory submission of negative PCR test results, the need for vaccination, and continuous monitoring of pilgrims in terms of getting COVID-19 [2].

The results of the risk assessment in this study showed that the “the probability of getting respiratory diseases” in Arbaeen ceremony is one of the most important risks because, in this ceremony and other religious mass gatherings, pilgrims from different countries participate and in this situation, the prevalence of respiratory diseases and the risk of transmission of these diseases are increased after the ceremony [16], so these events can lead to the globalization of respiratory diseases [17]. Reducing the risk of getting respiratory infections, including COVID-19 in these events, require compliance with health requirements, the application of certain restrictions, and the avoidance of some religious customs.

In this regard, it is necessary to emphasize personal and environmental health through access to face masks, soap and water, and washing and disinfection of hands and surfaces [9]. Also, performing some religious customs such as shaking hands after prayers, touching and kissing holy places in shrines, washing graves by hands, using common prayer tools such as Mohr, Beads, Mat, and praying chador, and distributing food as charity should be abolished [13]. Standard hygiene measures depend on available resources and how protective equipment is used, therefore, health education are very important [2]. Therefore, educational planning as one of the important programs of the preparedness phase should be done before holding the Arbaeen ceremony, taking into account the educational content and target groups [18]. In this regard, the result of this study showed that In line with the principles of risk communication, the training should be understandable to the audience to be observed its impact on people's behavior. Another way to encourage people to comply with health requirements is to use the capacity of religious leaders. Religious missionaries according to their mission can strengthen people's morale, manage stress and promote adherence to hygienic principles by creating hope, inner peace and increasing acceptance [13].

The results of the study showed that environmental contamination due to improper collection and disposal of waste and poor condition of toilets is one of the public health risks in mass gatherings [19]. For this purpose, it is necessary to develop health protocols and guides for the health of pilgrims which focus on environmental health requirements in food distribution places and resting places, disinfection of places and surfaces exposed to pilgrims, sanitary disposal of waste to be considered by environmental health experts and supervisors. Natural and proper ventilation of the shrines, resorts and food distribution areas, and toilets by opening windows, doors, and entrances of spaces, and planning to observe physical distancing in these places are other important issues that should be considered [2]. Based on the results of the risk assessment in present study, the possibility of getting water- & food-borne diseases is another related risk in holding the Arbaeen ceremony during the Covid19 pandemic. The results of studies have shown that the safety and health of food, drink, and water are important public health challenges in the Arbaeen ceremony. Because in this kind of ceremony, the preparation, distribution, and consumption of water and food are often done incorrectly and unhealthily [20] which results in

**Table 2**  
Hazards and vulnerabilities assessment Arbaeen mass gathering and COVID19.

Hazard	Susceptible areas	Possible risks in each area	Vulnerability
Arbaeen Mass gathering in	People	<ul style="list-style-type: none"> <li>• The probability of increasing of the new cases of COVID19</li> <li>• The probability of incidence of physical and psychological complications due to COVID19</li> <li>• The probability of death</li> </ul>	<ul style="list-style-type: none"> <li>• The lack of definitive drug treatment for COVID19</li> <li>• Deficiency of primary screening, especially at points of entry</li> <li>• Late diagnosis of the disease due to inadequate test and disagreement with clinical symptoms</li> </ul>
	Property	<ul style="list-style-type: none"> <li>• The probability of increasing the number of hospitalization</li> <li>• The possibility of increasing patients' visits to the hospitals</li> <li>• The exacerbation of vulnerable groups' problems</li> </ul>	<ul style="list-style-type: none"> <li>• Insufficient rapid serology tests</li> <li>• Lack of PCR tests and limitations in conducting extensive testing to identify new cases</li> </ul>
	Livelihood	<ul style="list-style-type: none"> <li>• Asymptomatic carriers</li> <li>• The probability of getting water-borne diseases</li> <li>• The probability of getting food-borne diseases</li> <li>• The probability of getting insect- and animal-borne diseases</li> </ul>	<ul style="list-style-type: none"> <li>• Impossibility of full coverage of vaccination of pilgrims</li> <li>• Inadequate identification of high-risk groups</li> <li>• Insufficient coverage of patient tracking system</li> <li>• Impossibility of social distance</li> </ul>
	Services	<ul style="list-style-type: none"> <li>• The probability of animal and insect bites</li> <li>• The probability of heat exhaustion</li> <li>• The probability of dust storm</li> <li>• The shortage of healthy water and food</li> </ul>	<ul style="list-style-type: none"> <li>• Mismanagement of contacts, isolation, and treatment of patients</li> <li>• Inadequate quarantine places for incoming patients (lack of entries' control program)</li> <li>• Lack of PPEs and improper distribution</li> </ul>
	Environment	<ul style="list-style-type: none"> <li>• The probability of terrorist attacks</li> <li>• The probability of CBRNE events</li> <li>• The probability of traffic accidents</li> <li>• The probability of respiratory diseases</li> <li>• The probability of fire</li> <li>• The reduction of health services provision</li> <li>• The probability of the exacerbation of underlying diseases</li> <li>• The probability of security disturbance</li> <li>• The probability of exposure to new variants of COVID-19</li> <li>• The probability of reducing the effect of vaccinations</li> <li>• The probability of the infection of health care workers and support teams</li> <li>• The cultural conflicts</li> <li>• The probability of burnout</li> <li>• The environmental contamination</li> <li>• The probability of equipment wear and tear</li> <li>• The probability of the fraud and hoarding of goods</li> <li>• The supply and distribution of non-standard items, medicines, and food</li> <li>• the lack of supply of medical and health items</li> <li>• The reduction of medical services quality</li> <li>• Loss of resources (water, masks, disinfectants, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Religious misconceptions about disease transmission, vaccination, etc.</li> <li>• Non-compliance with health protocols</li> <li>• Elderly, underlying patients, pregnant</li> <li>• Inadequate and delayed information</li> <li>• Impossibility of optimal prevention of infectious diseases</li> <li>• Lack of comprehensive risk communication program</li> <li>• Open space for Media and overload information</li> <li>• Inadequacy of workforce and facilities with needs</li> <li>• Inadequacy of trained staff</li> <li>• Poor health infrastructure and the impossibility of full coverage in Iraq</li> <li>• Weaknesses in alternative infrastructure</li> <li>• Shortage of ICU beds</li> <li>• drug shortages and improper distribution</li> <li>• Lack of sufficient equipment and distribution program</li> <li>• Mismanagement in the use of resources</li> <li>• Lack of standard isolation rooms and negative pressure isolation in border hospitals and Iraq</li> <li>• Problems with water and food supply and distribution in a completely hygienic and controlled manner</li> <li>• Activities of peddlers especially food peddlers (sensitive and high-risk food)</li> <li>• Problems in environmental health</li> <li>• Inadequate disinfection of resorts of pilgrims</li> <li>• Inadequate disinfection of dishes and reusable equipment</li> <li>• Toilets hygiene and problems</li> <li>• Increasing of waste production and unsanitary disposal of waste in settlements</li> <li>• Lack of equipment to collect and dispose of waste and sewage</li> <li>• Lack of attention to personal hygiene by executives and people</li> <li>• Multiplicity of organizations and lack of unity of procedure</li> <li>• Lack of unit management (internal and external)</li> <li>• Incomprehensive syndromic surveillance</li> <li>• Inadequate urban facilities</li> <li>• Exhaustion and inadequacy of the transportation system</li> <li>• Increasing traffic load</li> <li>• Unfamiliarity of drivers with roads and routes</li> <li>• Insufficient coverage of traffic warning signs on transportation routes</li> <li>• Inadequate coverage routes by emergency teams</li> <li>• Lack of trauma centers in border provinces</li> <li>• The location of the walking pathway in the tropics</li> <li>• The difference between the climate of the region and the place where people live</li> <li>• Lack of pilgrims' knowledge about the symptoms of heat exhaustion and dehydration</li> <li>• Lack of appropriate and standard infrastructure for settlement</li> <li>• Inadequate supervision of responsible organizations</li> <li>• Defects in rules and regulations</li> </ul>
		Property theft	<ul style="list-style-type: none"> <li>• The getting lost of pilgrims</li> <li>• Improper ventilation of camps and resorts</li> <li>• Lack of camps and resorts and overcrowding</li> <li>• The probability of an earthquake</li> </ul>

increasing the risk of spreading diseases. Therefore, the health system must plan to deploy health teams and increase site visits of camps resorts, and cooking places, and distribution of food and water, waste disposal to ensure that health protocols are followed completely. Also, detection, isolation, and referral of suspicious cases to medical centers and follow them up should always be considered by health care teams. Border control and

surveillance is another point that must be considered for monitoring and identifying suspected cases of Covid19 and preventing them from entering the country [21]. Therefore, it is necessary to establish quarantine and isolation centers, mobile hospitals, and border health centers to accommodate, accept, and provide services to patients and people with suspected respiratory diseases in border provinces.

**Table 3**  
Risk matrix.

<b>Definitely</b>	4	8	12 <ul style="list-style-type: none"> <li>• the probability of getting respiratory diseases</li> <li>• the environmental contamination</li> </ul>	16 <ul style="list-style-type: none"> <li>• increasing the number of new cases</li> <li>• the exposure to a new variant of COVID-19</li> <li>• the probability of arrival of new variant of COVID-19 to the country</li> <li>• the increasing referrals to health care facilities</li> </ul>
<b>Likely</b>	3 <ul style="list-style-type: none"> <li>• The probability of animal and insect bites</li> <li>• The probability of burnout</li> <li>• The probability of equipment wear and tear</li> </ul>	6 <ul style="list-style-type: none"> <li>• The probability of terrorist attacks and CBRNE events</li> <li>• The cultural conflicts</li> <li>• The supply and distribution of non-standard items, medicines, and food</li> </ul>	9 <ul style="list-style-type: none"> <li>• the probability of death</li> <li>• the probability of increasing hospitalization</li> <li>• the probability of getting water-borne diseases</li> <li>• the probability of getting food-borne diseases</li> <li>• the probability of getting insect- and animal-borne diseases</li> <li>• the probability of heat exhaustion</li> <li>• The shortage of healthy water and food</li> <li>• the probability of traffic accidents</li> <li>• the probability of security disturbance</li> <li>• The probability of the infection of health care workers and support teams</li> <li>• Improper ventilation of camps and resorts</li> <li>• Lack of camps and resorts and overcrowding</li> </ul>	12
<b>Possibly</b>	2 <ul style="list-style-type: none"> <li>• The probability of an earthquake</li> </ul>	4 <ul style="list-style-type: none"> <li>• The probability of dust storm</li> <li>• The probability of fire and explosion</li> <li>• The probability of the exacerbation of underlying diseases</li> <li>• The exacerbation of vulnerable groups' problems</li> <li>• the lack of supply of medical items</li> <li>• The reduction of medical services quality</li> <li>• Loss of resources (water, masks, disinfectants, etc.)</li> <li>• Property theft</li> <li>• The getting lost of pilgrims</li> </ul>	6	8
<b>Rarely</b>		2	3	4
	<b>Low</b>	<b>Medium</b>	<b>Critical</b>	<b>Disastrous</b>

- Acceptable 1-3
- Tolerable 4-6
- Considerable 8-9
- Intolerable 12-16

## 5. Conclusion

In general, preparing for a mass gathering such as Arbaeen is very important in order to reduce the risk of communicable disease, and the first step in improving the readiness is to assess the risk and its continuity in the various stages of the ceremony. Since the risk level is dynamic and may change over time, it is necessary to review the risk assessment at regular intervals. Policy makers and planners of holding such events should conduct risk assessments with the participation of local and national public health authorities regularly. The results of the risk assessment of mass gatherings must be clearly informed to the public to build trust and ensure that people are aware of and understand the decisions made about the resumption of gatherings. General considerations and recommendations based on risk assessment should be considered by managers and health officials when planning and holding mass gatherings.

## Funding

This study did not receive any funding.

## Declaration of Competing Interest

The authors have stated that they have no conflict of interest.

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