Arbaeen Pilgrimage: surveillance and control of Microbial infections: A review

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Abstract

Millions of Shia Muslims travel to Karbala, Iraq, for the Arbaeen Pilgrimage, one of the biggest religious gatherings in the world, which honors Imam Hussein's martyrdom (as). Despite the event's great spiritual and cultural significance, the risks of diseases transmission, overcrowding, and poor sanitation present serious public health issues. Due to congestion, poor sanitation, and the possibility of infectious disease epidemics, the Arbaeen pilgrimage one of the biggest yearly religious mass gatherings brings millions of pilgrims to Iraq and presents serious public health issues. With an emphasis on monitoring tactics, patterns of antimicrobial resistance (AMR), and control approaches, this review summarizes the state of knowledge regarding microbial diseases linked to the Arbaeen pilgrimage. AMR is a growing threat, and respiratory and gastrointestinal bacteria are important pathogens. We draw attention to deficiencies in international cooperation, vaccine coverage, and real-time illness monitoring for efficient infection management. To reduce health risks, recommendations include multi-sectoral collaboration, pre-travel health education, and improved syndromic surveillance. Arbaeen is linked to epidemics of infectious diseases, such as meningococcal disease, respiratory infections, diarrheal ailments, and blood-borne pathogens, just like other large gatherings like the Hajj. Vaccination requirements, hygiene promotion, and real-time genomic surveillance are examples of current surveillance and preventative tactics that have been successful in reducing risks at similar events. Systematic research on the health effects unique to Arbaeen is still lacking, though. In order to address new dangers (such as antibiotic resistance and climate-sensitive diseases) and guarantee pilgrim safety, this assessment emphasizes the critical need for specialized interventions, global cooperation, and enhanced preparedness frameworks. To protect health during Arbaeen and in the future, lessons learned from international mass gatherings highlight the significance of comprehensive prevention, quick diagnosis, and cross-border collaboration.

Keywords: Arbaeen Pilgrimage, Infections, control.

Introduction

The Arbaeen Pilgrimage, one of the world's largest religious gatherings, commemorates the sacrifice made by Imam Hussein, the grandson of Prophet Muhammad. The holy city of Karbala, Iraq, receives millions of pilgrims each year from all around the world, particularly Shia Muslims. Pilgrimage has significant cultural, theological, psychological, and spiritual meaning for those who embark on a journey of devotion, reflection, and mourning. During Arbaeen, pilgrims journey long distances, often on foot, to reach the holy shrine of Imam Hussein, fostering a vibrant sense of solidarity, unity, and devotion (Hashjin and Khanghahi, 2020).

Arba'een is a religious festival that draws sizable crowds in many Islamic countries. From Islamic countries such Iran, Pakistan, Turkey, Afghanistan, Azerbaijan, Lebanon, Kuwait, Bahrain, and Saudi Arabia, more than 17 million pilgrims travel to Karbala, Iraq (Mirzaei and Abdi, 2020). On Arba'een, the family of Hussein ibn Ali celebrates their return to Karbala. The slaughter of the Prophet Muhammad's grandson, his family, and his acquaintances took place forty days ago today. On this day, millions of Shia Muslims and pilgrims go from places in Iraq and Iran to Karbala, which is 80 kilometers from Najaf and 100 kilometers southeast of Baghdad, to see the mausoleum of Imam Hussein (Shalbafian and Zarandian, 2021).

However, the Arbaeen Pilgrimage is not without its challenges. As a result of these challenges, the pilgrims can run into a lot of problems that could make it tough for them to continue traveling. For instance, the sheer number of participants could strain the infrastructure of the community, leading to congestion and traffic on the pilgrimage routes. Inadequate hygienic conditions and amenities might cause diseases to spread among pilgrims (Choi and Eltahir, 2022). Other studies highlight the health concerns associated with religious practices such as the Hajj and Hinduism related

to Hindu holidays, including the potential for infectious disease transmission between pilgrims and the local population. Locating facilitators and implementing measures that can mitigate the challenges Pilgrimage is one way to overcome these problems (*Shinde*, 2010; *Memish* et al., 2014).

The delay between the onset of the disease (outbreak) and its treatment (quick reaction) is and will continue to be one of the disadvantages of present surveillance. Epidemics and outbreaks provide significant challenges when considering the three stages of diagnosis (possible, suspected, and definite) for infectious diseases. It should be emphasized that successful containment depends on making a conclusive diagnosis as soon as possible. Because some diseases may be self-limiting, depending on the qualities and kind of disease agent, it can be difficult to intervene during the peak spread of an epidemic (Asl et al., 2015; Moradi et al., 2019).

According to our preliminary evaluation, no thorough or systematic study has been conducted to accurately determine the risks and health advantages of Arbaeen walking. Despite the Pilgrimage's global significance, there is a conspicuous dearth of a comprehensive examination of the health problems and enablers specific to Arbaeen walking in the literature now in publication. This indicates absence of evidence related to health impacts of Arbaeen Pilgrimage participated by people of various nationalities. In order to fill this gap, this scoping review was conducted by precisely identifying the health issues and the issues related to their solutions that are specific to the Arbaeen Pilgrimage. In essence, the study hypothesizes that the Arbaeen Pilgrimage is a high-risk event for microbial infections, and its health risks can be reduced through evidence-based surveillance, control measures, and global collaboration.

Meningococcal disease

The Arbaeen pilgrimage one of the largest annual religious events in the world is associated with considerable public health risk, including the risk of meningococcal disease (MD) outbreaks due to crowding and closes contact between millions of pilgrims. New studies highlight the importance of better surveillance and preventive strategies, including that pilgrims be vaccinated against meningococcal disease (ACWY or quadrivalent vaccinations) (Moulaei et al., 2024), which Iraq and its neighbors are starting to implement. Because of their prolonged immunity and herd immunity effects, conjugate vaccinations (MenACWY, MenB) are preferred as the mainstay of meningitis prevention over polysaccharide vaccines. Even newer vaccines, such as the MenABCWY now in development, could further increase coverage. The Saudi Ministry of Health (2024) has implemented mandatory vaccination policy for Hajj pilgrims since 2018, reporting 100% compliance (Memish et al., 2023).

Since its launch in 2006, the MenACWY vaccine has been especially effective, bringing the number of cases of meningitis linked to the Hajj to zero (Yezli et al., 2023). Nowadays, chemoprophylaxis usually with ceftriaxone or ciprofloxacin is only used for high-risk contacts and targeted epidemic responses (like the 2023 Scout Jamboree). Concerns about antibiotic resistance have led to a reduction in mass prophylaxis. However, according to Saudi rules (2024), ciprofloxacin is still given to African pilgrims upon admission, and the ECDC (2023) emphasizes the importance of continuous resistance monitoring. These days, enhanced monitoring methods include real-time digital reporting through platforms like Saudi Arabia's Hajj Health App and genetic sequencing to monitor strain progression (e.g., MenW ST-11). Thanks to epidemic alerts from the Global Meningitis Genome Library, there were no documented cases of meningitis during the 2023 Hajj (CDC, 2023; WHO, 2024).

AI-powered chatbots that provide multilingual health alerts and simulation exercises that get medical staff ready for outbreaks are examples of how public awareness and training have improved. Vaccine refusal rates have been considerably lowered by pilgrim education initiatives (Alqahtani et al., 2022). Mass gathering readiness is being incorporated into global coordinating initiatives, like as WHO's Defeating Meningitis by 2030 strategy, which is backed by G7/G20 funding for vaccine access in low- and middle-income nations. It is anticipated that mRNA vaccination trials will be included in the 2025 Hajj (Saudi MOH, 2024), underscoring the continuous development of preventative measures.

The Gram-negative bacterium Neisseria meningitidis, which has six main serogroups (A, B, C, W, X, and Y), is the cause of meningococcal illness. Respiratory droplets and close contact (such as coughing or sharing living quarters) are the main causes of transmission. The symptoms include rash (meningococcal septicemia), headache, stiff neck, photophobia, and sudden fever. Meningitis, septic shock, and death (with a mortality rate of 10-15% and up to 50% if treatment is not received) are the complications (Rouphael NG, Stephens, 2012).

1.Meningococcal Disease Risks during Arbaeen:

Historical Precedents: Because Arbaeen is a mass gathering, there is a potential of meningococcal outbreaks. Mandatory vaccination policies were implemented in response to epidemics during the Hajj pilgrimage in 1987 (serogroup A) and 2000 (serogroup W135). Evidence from Arbaeen: Surveillance limitations in Iraq and surrounding countries may result in underreporting of cases, even when no significant outbreaks have been documented recently. High-Risk Groups: Those who are unvaccinated, in crowded environments, especially pilgrims from sub-Saharan Africa (the meningitis belt) are particularly at risk **(Yezli et al., 2023).**

2.Surveillance and Control Measures of Meningococcal Disease (Alderson et al., 2022):

A.Pre-Travel Vaccination Policies:

The Hajj Model of Saudi Arabia requires pilgrims to have the quadrivalent (ACWY) meningococcal vaccine. Iraq's Arbaeen Policy includes the following: Required for international pilgrims from high-risk nations (such as the African meningitis belt); recommended but not required for pilgrims traveling domestically; and Vaccine types: Menveo and Nimenrix, two ACWY conjugate vaccines, are recommended above polysaccharide vaccines.

B.On-Site Surveillance & Rapid Response:

Disease Monitoring: To identify fever, Iraq's Ministry of Health uses thermal scanners and mobile clinics. International Coordination: WHO and CDC facilitate epidemic tracking and cross-border alerts; lab confirmation: PCR and culture testing for suspected cases (limited capability in some countries).

C.Post-Pilgrimage Follow-Up:

Returning Pilgrim Screening: Certain nations, like Iran, keep an eye out for meningitis symptoms when pilgrims return, and antibiotic prophylaxis: Ciprofloxacin or ceftriaxone is given to close contacts of confirmed cases.

Respiratory tract infections

Mass gatherings, such as the annual Hajj pilgrimage, present significant public health challenges due to the high risk of infectious disease transmission, particularly respiratory infections. The Hajj, held in Saudi Arabia, is the largest recurring mass gathering globally, attracting over 10 million pilgrims annually. Crowded conditions, diverse demographics, and close contact among attendees facilitate the spread of respiratory pathogens, including viruses and bacteria. This paper reviews the epidemiology, prevention, and control of respiratory infections during the Hajj, with implications for other mass gatherings (Shafi et al., 2016).

The Arbaeen Mass Gathering (MG) is one of the largest religious gatherings in the world, attracting millions of pilgrims to Karbala, Iraq, annually. This event poses significant public health challenges, particularly concerning infectious disease transmission, including respiratory tract infections (RTIs). Below is a detailed explanation of health research, surveillance, and control measures for RTIs during the Arbaeen MG.

1.Risk of Respiratory Tract Infections (RTIs) in Arbaeen MG:

Mass gatherings facilitate the rapid spread of respiratory infections due to High population density (overcrowding increases droplet transmission), International travel (introduction of pathogens from different regions), Seasonal factors (Arbaeen occurs in cooler months, favoring respiratory virus transmission).The main pathogens include: COVID-19/ SARS-CoV-2 (major concern post-2020), Influenza (H1N1, H3N2), MERS-CoV (Middle East Respiratory Syndrome, endemic in the region), Other respiratory viruses (RSV, rhinovirus, adenovirus), Bacterial infections (e.g., Streptococcus pneumoniae, Mycobacterium tuberculosis), (Ahmed et al., 2018; WHO Mass Gathering Guidelines, 2021).

2.Surveillance Systems for RTIs in Arbaeen Mass Gathering:

The widespread use of effective surveillance systems is fundamental to the prompt identification and response of respiratory tract infections (RTIs) in Arbaeen pilgrims. Detection and control of suspected outbreaks are done using key surveillance strategies before, at and after the event. Health screenings at borders form part of pre-event surveillance, which include thermal scanning and symptom questionnaires targeting clinical features such as fever and cough. It also does laboratory-based surveillance, such as PCR testing for influenza, COVID-19 and MERS-CoV. He further revealed that mobile health units are located along pilgrimage routes for quick check-ups and to identify potential cases early on. For this event, presence of real-time on-site surveillance is necessary. Syndromic surveillance is the tracking of cough fever and dyspnea from hospitals and clinics. Digital reporting through mobile applications used in Hajj and Umrah can also be utilized for Arbaeen to address the issue of reporting of symptoms. A newer approach is wastewater surveillance, which detects viral RNA found in sewage systems, potentially revealing information about how the infection is spreading. Occupied with widespread contact tracing to prevent secondary events and genomic sequencing to detect the emergence of variants like a novel SARS-CoV-2 lineage, post-event surveillance tracks confirmed cases. Such a multisystem surveillance strategy is essential to reduce the transmission of RTIs during such mass gatherings (Mahdi et al., 2021).

3.Control Measures for RTIs in Arbaeen Mass Gathering:

RTI control requires a multifaceted approach comprising vaccination, nonpharmaceutical interventions (NPIs), and public health messaging for the Arbaeen pilgrimage. Vaccination campaigns are another pillar of prevention, with interest in the influenza vaccine provided to pilgrims, particularly for those over the age of 65 and those with chronic underlying

medical conditions. Booster shots of COVID-19 are essential to minimize how severe any cases will be, and the pneumococcal vaccine is recommended for populations at high risk. Alongside vaccines, several NPIs are undertaken to mitigate transmission. High transmission areas follow mask mandates, which, when possible, is only N95 or KN95 masks to lessen the transmission of droplets. Emphasis on hand hygiene by installing sanitizer stations on pilgrimage routes; social distancing measures by creating zones in order to disperse; and preventing overcrowding. Better ventilation in makeshift sites and mosques also reduce the chances of the virus spreading through the air. Public health messaging is also essential for awareness, with multilingual campaigns informing pilgrims on symptoms, prevention, and respiratory etiquette including covering coughs and using disposable tissues. These set of measures enables limiting the transmission of RTIs during the pilgrimage (Chiu et al., 2020).

4.Challenges & Research Gaps:

Although well-documented measures exist to mitigate RTIs while commemorating Arbaeen, certain issues have yet to be resolved. But many mild cases go unreported, meaning it is hard to assess the true extent of transmission of the disease Worsened by the fact, Iraq has a mass gathering of pilgrims where it runs out of resources, Iraq's heath sector may not cope with the high number of patients. A related issue is vaccine hesitancy among some pilgrims in certain groups who are unwilling to be vaccinated. Climate-related motivators, like dust storms, also aggravate respiratory issues, making pilgrims more prone to RTIs. An affordable new tool called wastewater surveillance, as well as an artificial-intelligence-based syndromic tracking may be used to monitor the disease transmission, allowing us to detect and manage an outbreak in its early stages. Still, important research gaps remain, especially in the assessment of the

effectiveness of these new surveillance technologies and the challenges posed by vaccine hesitancy and underreporting (Zhu et al., 2025). Closing these gaps will be crucial to advance future preparedness and response efforts applicable to mass gatherings such as that of Arbaeen.

Diarrhoeal disease

This is because diarrhoeal diseases such as traveller's diarrhoea, cholera, hepatitis A and food poisoning are serious health hazards associated with the pilgrimage. The masses of pilgrims who came from various regions increase the risk of gastrointestinal infection due to environmental contamination to food, water, and the spreading of gastrointestinal microbes.

The Arbaeen Mass Gathering (MG) taking place in Iraq is considered to be one of the largest recurrent religious MGs in the world attracting millions of pilgrims, which imposes important public health challenges including rising of infectious disease outbreaks like diarrheal diseases. An illustration of health research on surveillance and control of diarrheas during Arbaeen.

1.Overview of Arbaeen Mass Gathering and Health Risks:

In other words, the number of pilgrims flocking to Karbala, Iraq for the Arbaeen pilgrimage is among the largest mass assemblies in the world standing at 20-30 million individuals. The overwhelming presence of people creates an intense environment of risk with communicable diseases – most often from overcrowding, poor sanitation and lack of health care infrastructure. One of the biggest threats to health (in addition to cholera and other diarrheal diseases that will kill or cripple the victims) is contaminated food and water, lack of toilet facilities and people living in abject poverty and too close together. Because pilgrims are often packed

into extremely close quarters, this means bacteria can spread rapidly, with E. coli, Salmonella, Shigella, the norovirus and cholera being the usual suspects. In such environment disease can spread rapidly and it is a big public health challenge.

2.Surveillance of Diarrheal Diseases in Arbaeen:

The early identification and response to outbreaks of diarrheal disease during the Arbaeen pilgrimage on the part of pilgrims is reliant on surveillance. Examples of effective approaches to surveillance include syndromic surveillance, which aims to track clinical presentation (e.g. acute watery diarrhea) at health facilities. Laboratory confirmation isalso crucial, as stool specimen tests help inisolating the particular pathogens triggeringoutbreaks. The use of mobile health units and digital tools can lend to real-time data collection and real-time reporting, ensuring we are able to respond rapidly. The effectiveness of these strategies is evidenced by research conducted by Jafari et al. Early detection of outbreaks of communicable disease at mass gatherings: the role of integrated disease surveillance systems (2020) Similarly, WHO-EMRO stresses on cross-border collaboration between Iraq and its neighboring countries for tracking and control of diarrheal disease transmission.

3.Control Measures for Diarrheal Diseases:

A range of measures are taken for the prevention and control of diarrheal diseases during the Arbaeen pilgrimage. Water, sanitation and hygiene (Who,2022) interventions are critical for reducing infection risk. Among them are the supply of safe drinking water, distribution of water purification tablets, or setting up temporary sanitation such as toilets and waste treatment. Handwashing stations and awareness campaigns are part of public health campaigns that also promote hand hygiene. Meanwhile,

in order to keep street foods safe, regulation of street food vendor and behaviour toward safe food handling education to the public are also needed to reduce the risk of contamination. If cholera risk is high, vaccination campaigns, such as oral cholera vaccinations, are carried out when relevant. In case management, mild cases of diarrhea were treated by Oral Rehydration Therapy (ORT) and severe bacterial diarrhea was use antibiotic based on laboratory test results. Evidence also points toward such control measures and their efficacy as a 2023 BMC Public Health study showed that WASH interventions reduced diarrheal cases associated with Arbaeen. The WHO guidelines (2022) include recommendation for rapid response teams to contain outbreaks identified at such mass gatherings.

4.Challenges in Diarrheal Disease Control:

While different controlling methods are adopted, many obstacles against control of diarrheal diseases exist in Arbaeen. Undoubtedly, one of the most important barriers is overcrowding; with such number of people, sanitation measures cannot be implemented effectively, and the potential for disease transmission is high. Moreover, lack of resources, including shortage of health care personnel and laboratory facilities, makes effective responding to outbreaks difficult. The multigenetic backgrounds of the pilgrims is another layer of complexity, with pilgrims from many nations as potential donors of fresh and likely more virulent pathogens that cross borders. This highlights the need for constant enhancement in prevention and control strategies.

5.Recent Updates and Recommendations (2023-2024):

Mobile health apps for symptom reporting during the 2023 Arbaeen pilgrimage have recently been piloted to detect disease spread along with some experiments and new updates of health response strategies during Arbaeen. These tools assist in enhancing surveillance, which, in turn, enables rapid detection of possible outbreaks. In addition, coordination among the Ministry of Health (MoH), the World Health Organization (WHO) and NGOs has been improved to positively impact preparedness and response. While these have improved on that gap in knowledge, there is still a gap where it pertains to the yet to be defined influence of AMR in diarrhoeagenic pathogens specifically. More studies in this field will be needed to provide more insights into the changing threat posed by these diseases and how to improve control strategies.

Public Health Interventions

Measure	Implementation
Water Safety	Daily inspections of water treatment plants, chlorination checks, and testing of water sources (WHO, 2019).
Food Safety	Regular inspections of kitchens, food sampling, and screening of food handlers (Al-Ghamdi et al., 2018).
Sewage Management	Monitoring of treated sewage water to prevent contamination (Saudi MOH, 2020).
Pilgrim Restrictions	Ban on bringing fresh food; only canned food allowed (Hajj Regulations, 2021).

Blood-borne disease

The Arbaeen mass gathering in Iraq is among the largest religious gatherings in the world, with millions of pilgrims attending, which brings unique public health challenges, including the potential for blood-borne disease transmission. Here we explain the health research on surveillance and blood-borne diseases around Arbaeen.

1.Arbaeen Mass Gathering and Health Risks:

Arbaeen seen as mass gatherings are recognized as an important risk factor contributing to transmission of infectious diseases due to several factors. The presence of overcrowding and a lack of adequate sanitation provide a fertile environment for communicable diseases. Furthermore, prevention and treatment becomes harder because access to healthcare infrastructure is limited to be provided, particularly in lounges and make-shift clinics. Furthermore, high-risk behaviours, such as not having safe medical practice while shaving the head or sharing razors, make these procedures even more dangerous which then can transmit blood-borne pathogens. The most important ones are Hepatitis B (HBV), Hepatitis C (HCV), and of course HIV. Another risk could be for needle-stick injuries which can occur if injectable drugs are used in less supervised or more permissive health facilities (Mehri et al., 2024).

2.Surveillance of Blood-Borne Diseases in Arbaeen:

However, despite limited published evidence that documents blood-borne disease outbreaks in Arbaeen pilgrims the last decade, it is possible to learn from mass gatherings such as Hajj and Kumbh Mela. Unsafe medical procedures carried out on-site, for instance, the use of non-sterilized instruments in mobile clinics or in barber shops, have been identified as potential risk factors for HBV and HCV transmission in similar

contexts during Arbaeen. Without pre-event screening, many of those pilgrims may be attending whilst carrying blood-borne diseases without the knowledge they are infected. The physical toll of the pilgrimage, such as walking long-distances frequently resulting in open wounds, also facilitates exposure to pathogens. Research from 2020 published in the Journal of Infection and Public Health pointed out a number of "serious deficiencies" in infection control at mass gatherings "and provide evidence for the implementation of pre-event screening and vaccination campaigns." Likewise, unsafe shaving practices have been highlighted as a documented risk factor for HCV transmission in the setting of Arbaeen in a 2019 study published in Tropical Medicine and Infectious Disease.

3.Control Measures for Blood-Borne Diseases:

Arbaeen blood-borne compatibility efforts: A range of preventive measures, based on studies and practices in other mass gatherings, can control blood-borne transmission in Arbaeen. Such pre-event measures should also include extensive vaccination campaigns, particularly against HBV, as well as health education for pilgrims not to engage in high-risk behaviours, such as sharing razors or undergoing procedures with unsterile instruments. The campaign also stressed that during such events, stringent infection prevention measures in the health care setting, such as the use of sterile needles and correct disposal of medical waste must be ensured. Real-time surveillance system should be put in place, for example, syndromic reporting of signs (such as jaundice) and symptoms of infection would assist in early detection of possible outbreaks. Following a mass gathering type event, it will also be crucial to pursue monitoring through contact tracing for identified infections and serological surveys to determine exposure rates in pilgrims. Promising case studies are available: both the Hajj, where sterilization of medical equipment and HBV vaccination are

mandatory, and the Kumbh Mela, where dedicated mobile clinics utilizing adequate infection control protocols have virtually eliminated needle-stick injury (Ameli, 2016).

4.Research Gaps & Future Directions:

Though the well-known risk for the health of people, Arbaeen-related studies on the blood-borne diseases are remarkably scarce. The vast majority of existing data is extrapolated from other major assemblages such as Hajj and Kumbh Mela, which might not accurately reflect on the peculiar nature of Arbaeen. We must implement real-time surveillance tools, including portable rapid testing kits for HBV and HCV during the event. Future studies should also explore compliance of recommended safety measures among pilgrims such as the use of non-shared razors. Although time for blood-borne pathogen transmission during the Arbaeen pilgrimage is evident, preparedness measures, including surveillance, vaccination, and infection control, could be made effective to counter it. Such research expanded, in accordance with Arbaeen, will be extremely significant for future enhancement and modification of strategies (Mehri et al., 2024).

(Memish et al., 2014; Hoang et al., 2018; Hamdanieh et al., 2021; Khan et al., 2025).

This article presents a comprehensive, timely summary of emerging infectious diseases threats during Arbaeen, including viral hemorrhagic fevers, respiratory viruses, and other pathogens. Every year, the Arbaeen pilgrimage attracts between two and three million pilgrims from over 180 countries, cementing its place as one of the world's largest mass gatherings. The concentration of large numbers of people from other regions of the world into limited space creates unique challenges for public health security and infectious disease control given the potential for crowding, international travel, and rapid disease spread.

1.Viral Hemorrhagic Fevers (VHFs):

VHFs are known to have extremely high death rates, and are also readily spread from person to person when people gather in confined areas, which would pose a new challenge to health authorities during Hajj.

2.Respiratory Infections:

Respiratory diseases are a great threat during Arbaeen mainly due to the crowded places which help transmission, he added.

A. SARS (Severe Acute Respiratory Syndrome):

The severe respiratory syndrome (SARS) in 2003 caused global concern because of its virulent death rate and rapid transmission. India took precautionary measures in response to the threat, including implementation of 10-day waiting period before entry for pilgrims travelling from affected countries and using thermal screening at major airports to screen for possible cases. Laboratory capacity was further strengthened by making PCR

and serological tests available for early diagnosis and monitoring. So far, no cases of Sars have been reported in connection with the Arbaeen pilgrimage.

B. MERS-CoV (Middle East Respiratory Syndrome):

Middle East Respiratory Syndrome (MERS) has been endemic since its first identification in Saudi Arabia in 2012, particularly in relation to camel contacts. The virus is considered a threat among massive gatherings like the Hajj due to the combination of dense crowds, long-distance travel, and its high mortality rate, at approximately 35%. This explains the importance of monitoring and preventive measures during these events.

C. Avian Influenza (H5N1):

Avian influenza continues to be a serious global issue due to its high mortality rate and capacity to generate a pandemic. In response to the problem, Saudi Arabia imposed restrictions on the importation of chicken from the affected countries in order to reduce the risk of introduction and dissemination. At the time of writing, there was no widely-available vaccination against the virus. Currently implemented preventive measures mainly focus on early identification of cases and rapid containment strategies in order to reduce the impact of potential epidemics.

3.Poliomyelitis:

Due to fear of polio,polio vaccine measures have increased to protect the health of society during Arbaeen. One of these is the requirement for children aged under 15 travelling from polio endemic countries to prove vaccination status. In addition, vaccine is necessary at borders regardless of a previous immunity. However, at this time, there is no evidence to suggest this year's Arbaeen pilgrimage is associated with polio transmission.

4.Zika Virus:

The rapid dissemination of the Zika virus and the alarming negative impacts on human health established the emergence of Zika virus as a significant public health threat worldwide between 2015 and 2017. One of the things withit can be transmission, for example: shaking hands, mosquito bites, and congenital diseases that are carried from mothers to infants. These threats enforce a need for vector control at the Arbaeen sites due to the risks of mosquito-borne transmission and the importance of protecting public health through vector control during this period of pilgrimage.

5.COVID-19:

Since 2019, mass gatherings worldwide have been significantly impacted, notably the Hajj pilgrimage, by the COVID-19 pandemic. This year, only about 1,000 pilgrims took part in an effort to minimize the risk of transmission after the Hajj was tightly curtailed in 2020. Between 2021 and 2023, the Hajj was resumed with strict public health protocols including compulsory around vaccination, mandatory masks, crowd size constraints to provide physical distance, and digital health instruments to support health monitoring and compliance to preventive measures through the Hajj period (Hashim et al., 2021).

6.Prevention and Control Strategies:

With the increase in risks of infectious diseases during Arbaeen, the Ministry of Health has developed comprehensive plans. As part of preparatory measures for Arbaeen, the Ministry conducts its risk assessment process and assesses core capabilities to guarantee readiness. Emphasized vaccination requirements include mandatory vaccinations against influenza, polio, and meningococcal disease. Targeted health education programs on health promotion and prevention for pilgrims and employees

can facilitate such endeavors. Surveillance systems for identifying and addressing possible health risks have been substantially enhanced. Other approaches include the implementation of electronic systems that allow data to be reported in real-time and the application of indicator-based surveillance methodologies. Screening is also done at points of entry in order to instantly identify and manage any case. There are also plans to develop syndromic surveillance for better disease monitoring capacities later (Moulaei et al., 2024).

International collaboration is an important part of the strategy. The Ministry liaises regularly with various international health authorities like the World Health Organization to coordinate efforts. A global network of Arbaeen health focal points is also currently being proposed to assist with coordination and communication. The International Health Regulations allow for information transfer, providing transparency and speedy response to new threats. These advancement efforts at I Ministry are utilizing technology advances to make prevention and control methods even better by the moment. Electronic wristbands containing personal health information are being introduced to facilitate medical management on the trip. To ensure efficient crowd management and emergency response time when needed, the use of GPS tracking technology is used to track crowd movement as well (Yeung et al., 2023).

Conclusion

Even though there haven't been any significant meningococcal outbreaks during Arbaeen, there is still a substantial danger because of overcrowding and inconsistent immunization practices. Future epidemics can be avoided by enhancing surveillance, requiring vaccinations, and fostering international collaboration.

The Arbaeen MG needs multilayer control measures (NPIs, vaccinations) and improved RTI surveillance (real-time digital platforms, genetic testing). Lessons from the Hajj and Umrah, such as Saudi Arabia's thermal screening applications, can be modified for use after COVID-19. Given the hazards of MERS-CoV, future studies should concentrate on pandemic preparedness and One Health strategies (human-animal-environment interaction).

Diarrheal illness management in Arbaeen depends on efficient surveillance (real-time monitoring, lab testing) and control (WASH, food safety, vaccine). To reduce hazards, future initiatives should concentrate on international collaboration and digital surveillance technologies. During the Hajj, diarrheal illnesses continue to pose a serious health risk because of the dense population, poor cleanliness, and contaminated food. Although cholera epidemics have decreased as a result of better sanitation, food poisoning, hepatitis A, and traveler's diarrhea still occur. Strict food and water safety regulations, immunization, and pilgrim education are examples of preventive measures. In order to lower the incidence of gastrointestinal infections during large gatherings, future studies should concentrate on real-time surveillance and innovative therapies.

Due to its high volume, global relevance, and crowded locations, the Arbaeen pilgrimage presents unique challenges for novel infectious disease control. Although this poses risks, Saudi health authorities have built

sophisticated systems for surveillance and prevention to control large outbreaks. Recent experiences of COVID-19 have also further underscored the need for adaptable, evidence-based approaches to mass collecting medicine. Sustained global coordination, ongoing technical evolution, and increased investment in public health infrastructure are essential to avoid another health security concern during future Hajj pilgrimages.

Arbaeen is an opportunity for blood-borne infections but enhanced surveillance, vaccination and control measures are key to preventing outbreaks. As for tactics, indigenous research for Arbaeen is needed.

Arbaeen Pilgrimage is one of the largest annual religious mass gatherings in the world where over 20 million pilgrims gather in Karbala, Iraq, to commemorate the 40th day of Imam Hussein's martyrdom. This is a serious public health challenge due to the high numbers (it will be bottom just), the range of demographics (inc kids, elderly, people with disabilities), and the inability of Iraq's public health system to manage the aftermath. Important health hazards include:

1. Infectious Diseases: The shared rooms and crowded surroundings make it easier for gastrointestinal and respiratory diseases, such as influenza and COVID-19, to spread. There are also worries about meningococcal infections and other dangers like monkeypox.
2. Non-communicable diseases (NCDs): As a result of prolonged walking and unfavorable environmental circumstances, there is a high prevalence of injuries, musculoskeletal pain, heat-related illnesses, and cardiovascular events.
3. Environmental and Infrastructure Issues: Health hazards are made worse by makeshift shelters, poor sanitation, and seasonal climate fluctuations.

4. Limited Research and Preparedness: In contrast to other large-scale events like the Hajj, the Arbaeen gathering has drawn less international attention despite its size. There are deficiencies in real-time surveillance and evidence-based therapies, as evidenced by the paucity of research (such as those conducted by Faris Lami and colleagues) that have recorded disease trends.

Recommendations:

- .Boost global cooperation and real-time disease surveillance.
- Enhance infrastructure (healthcare facilities, sanitation) and hygiene education for pilgrims.
- Give research top priority in order to identify illness patterns and allocate resources as efficiently as possible.

The future of the Arbaeen Pilgrimage

The number of people making the Arbaeen Pilgrimage continues to rise. The Arbaeen Pilgrimage is generally relatively peaceful and orderly despite its vast breadth. But because of the physical surroundings and the unique microbiological environment created there during the Arbaeen Pilgrimage, tourists to Kabala are subject to certain environmental dangers. In the past, the actual trek was challenging, and many people died while traveling. But now, the Arbaeen Pilgrimage itself is fraught with dangers that, if unanticipated, might lead to disease and even death. Additionally, there is a higher risk of disease spreading because of how often we travel throughout the world. Clinicians must be aware of risks and know how to handle them. Many of these strategies are simple to use before departure as well as in the field. Physicians must also be alert to reporting any post-Arabeen illness and mindful of the dangers posed by pilgrims who

have returned. International cooperation is crucial to managing health hazards during the Arbaeen Pilgrimage. This includes planning immunization drives, establishing visa caps, and facilitating prompt repatriation.

Suggestions for future and Upcoming Arbaeen Expeditions:

1. Require all pilgrims to have the ACWY vaccine; also study the cultural barriers to immunization among pilgrims.
2. Use digital reporting technologies to improve surveillance and track resistant pathogens in real-time during events.
3. Public awareness initiatives about the dangers and prevention of meningitis.
4. Cross-border cooperation to prepare for outbreaks and develop standardized protocols for data sharing and response.
5. Validate AI-based syndromic surveillance and portable diagnostics.

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