Mass Gathering Risk Assessment: Hajj 1445H (2024)

Developed internally by Gulf CDC Public Health Emergency Department on 5 June 2024

I. Background of the Mass Gathering

(a) Overview

Hajj is the annual religious ritual gathering of Muslims that takes place in Makkah, Saudi Arabia, and it is one of the largest annual mass gatherings in the world. Every year, more than one million people perform Hajj. Historically, the number of pilgrims reached nearly 3 million in some years; however, last year, 1444/2023, the number of pilgrims surged to 1,845,045, a significant increase from the number of pilgrims in the previous year, 1443/2022, 926,062 due to COVID-19 restrictions [(1)(2)]. The historical travel origin of the pilgrims is described in Figures 1 and 2.

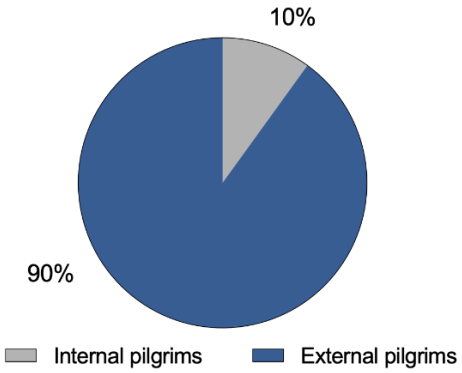

Figure 1: Percentage of pilgrims' original destination, 1444/2023

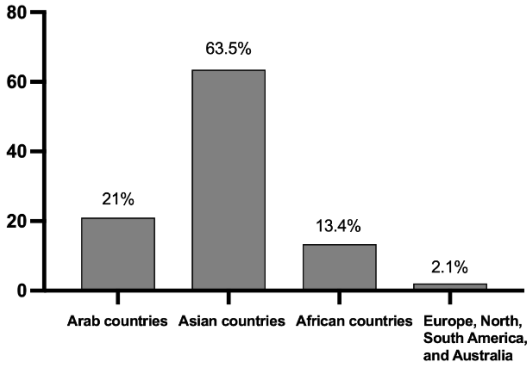

Figure 2: Percentage of external pilgrims by country, 1444/2023

Hajj is a mass gathering that has a high possibility of spreading infectious diseases and requiring public health monitoring. The risk of infectious disease transmission during Hajj may extend to the local population, other GCC countries, and the home population of returning pilgrims after Hajj. There are several public health risks increased in mass gatherings such as Hajj, including heat-related illnesses and the risk of transmission of respiratory diseases, food and water-borne diseases, and meningococcal diseases [(3)(4)(5)]. Some large infectious disease outbreaks that previously occurred during Hajj were:

- Meningococcal disease: In 1987, serogroup A caused an outbreak, while serogroup W135 was responsible for outbreaks in 2000 and 2001 [(6)].
- Cholera: In 1821, an estimated 20,000 pilgrims died during the Hajj due to a cholera epidemic, which started in India in 1817 and spread across the world. Similarly, in

1865, an estimated 15,000 out of 90,000 pilgrims died due to the cholera epidemic that spread throughout the world [7].

Other public health hazards have been documented in the past, such as heat-related illnesses, stampedes, and suffocation. In Hajj season 1997/1417, a fire occurred in Mina tents, which led to the death of 343 people and the injury of more than 1,500 people as a result of a gas cylinder explosion [8].

Therefore, a risk assessment of prevailing priority hazards would support identifying appropriate public health precautions to be considered by health authorities in GCC countries to prevent or reduce the potential emergencies that could occur in the region as a result of Hajj.

(b) Potential Hazards

There are several hazards to be considered in preparation for the upcoming Hajj pilgrimage in 2024. These include:

- **Infectious diseases with a risk of immediate transmission (e.g. COVID-19, measles, etc).**
- **Infectious diseases that can have high consequences but are typically reported sporadically (i.e. MERS, anthrax, meningococcal disease, avian influenza, Crimean Congo hemorrhagic fever, ebola, botulism, kyasanur forest disease, marburg virus disease).**
- **Infectious diseases that do not present as an immediate transmission risk during the Hajj but have a risk of long-term establishment in Saudi Arabia due to the presence of a competent vector (i.e., chikungunya, malaria, yellow fever, zika, dengue) as well as the potential of introducing or importing a new vector to the Hajj region.**
- Injuries due to stampedes caused by overcrowding.
- Heat-related illnesses include heat stroke and exhaustion due to prolonged outdoor exposure to high temperatures.
- Fires due to accidental events (such as gas canister explosions).
- Food-borne and water-borne diseases/outbreaks.
- Complications from non-communicable diseases.

The Gulf CDC has reviewed the potential hazards and prioritized the assessment of infectious disease transmission (first three hazards listed above) as a focus for this report.

II. Risk Assessment

(a) Risk Question

What is the risk of infectious disease transmission occurring in the GCC in the next 3 months as a result of the 2024 Hajj based on the diseases with the highest chance of importation or exportation during/after Hajj?

(b) Likelihood & Impact

Diseases with the highest importation or exportation (Importation likelihood refers to the chance of one case of the disease being imported to Saudi Arabia within the Hajj period, around 30 days and Exportation likelihood refers to the chance of one case of the disease being exported from Saudi Arabia as a result of the Hajj) have been identified based on the epidemiological situation in the top 10 countries where the highest number of pilgrims would come from in 2024 (see Appendix A for importation likelihood) and based on the national priorities set by the Ministry of Health of Saudi Arabia [9].

Note: Risk has been calculated based on the levels of **likelihood** and **impact** of the transmission across the GCC countries (see **Appendix B** for the **risk matrix**) and the **Risk Level** is shown for the identified diseases in the tables below. Details of the analyses conducted to allocate the levels of **likelihood** and **impact** are documented in a separate internal report (available upon request), and only high-level assessment outcomes disease-by-disease are summarized below.

COVID-19					
Negligible	Very Low	Low	**Moderate**	High	Critical
Gulf CDC Risk Assessment of this Hazard					
COVID-19 is an infectious disease caused by the SARS-CoV-2 virus. Most individuals infected with the virus will experience mild to moderate respiratory illness and recover without needing special treatment. The likelihood of an increased number of COVID-19 cases due to importation by incoming pilgrims is 0.711 from India, 0.163 from Bangladesh, and 0.100 from Pakistan. Additionally, new FLiRT COVID variants have been reported in many countries in the world, including India. The term "FLiRT" encompasses a range of variants, including KP.2, JN.1.7, and other variants starting with KP or JN, that have independently acquired similar mutations. Vaccines targeting JN.1 produce some cross-reactive antibodies. The recent concerns about the FLiRT subvariants circulating globally and reports of increased hospitalizations associated with these variants could elevate the risk; however, the focus of this report is on the top 10 countries of pilgrim origins. The Saudi Ministry of Health has recommended that all pilgrims aged 12 and above be vaccinated. As for pilgrims from Saudi Arabia, vaccination against COVID-19 is mandatory [(11)]. Health education was provided to the community about the COVID-19 disease and preventive measures across the GCC countries; several pilgrims may opt to use masks during pilgrimage to reduce personal risk and the vaccination coverage for COVID-19 is high in the GCC countries.					

Influenza					
Negligible	Very Low	Low	**Moderate**	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Individuals infected with influenza frequently experience an immediate onset of cough, fever, headache, and myalgia. Influenza has a high likelihood of spreading due to its respiratory nature and some practices during Hajj that could enable its transmission [(12)]. However, the Saudi Ministry of Health has advised that all external pilgrims receive vaccination and has mandated vaccinations for internal pilgrims. Oman health authorities have also mandated the vaccination for pilgrims. Additionally, constant and active vaccination campaigns that raise awareness and promote influenza prevention have been conducted across GCC countries.					

Measles					
Negligible	Very Low	Low	**Moderate**	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Measles is a severe disease caused by a virus. It spreads easily when an infected person breathes, coughs or sneezes. Measles has an incubation period of 10-12 days. Based on the current global epidemiological situation due to increasing vaccination hesitancy, measles can be imported through Hajj from multiple countries and spread as pilgrims return to their home countries after the Hajj. Current estimates suggest that the likelihood of a measles case being imported during Hajj from Pakistan (0.820) is the highest, followed by Iraq (0.652), Nigeria (0.144), and India (0.070). However, pilgrims are not considered a high-risk group for measles, as the primary at-risk individuals are children and the unvaccinated population [13]. The Saudi Ministry of Health has recommended that all pilgrims have completed the required vaccinations in their national vaccination schedule, including vaccination against diphtheria, tetanus, pertussis, polio, measles, varicella, and mumps [11]. The GCC countries have high vaccination coverage against measles in 2022 with high detection and response capacities for measles; this would contribute to early detection and management of any increased importation of Measles cases.					

Dengue					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Dengue is a vector-borne disease that can be imported during Hajj. The likelihood of one dengue case being imported during Hajj is estimated to be 0.999 from Indonesia, 0.948 from Pakistan, 0.876 from India, and 0.351 from Bangladesh. It is almost certain for several cases to be imported during the Hajj period. However, the surveillance and case management capacities of GCC countries are high enough to detect and treat these imported cases early, meriting a “low” impact on case fatality rates. In addition, although autochthonous transmission has already been established in some GCC countries as well as the importation of cases throughout the year from global and neighbouring countries, the Hajj mass gathering itself might not have a bigger effect on Dengue importation into the GCC. However, there remains a chance of local transmission due to the presence of competent vectors in several GCC countries. The possible extent of this transmission is currently unknown due to information unavailability, and it is difficult to determine outbreak risk with limited data on vector/s.					

Mumps					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Mumps is a contagious viral disease that typically presents with initial symptoms such as fever, headache, muscle aches, fatigue, and loss of appetite over a few days. The incubation period for mumps ranges from 16 to 18 days, and the disease may spread when pilgrims return to their country after performing the Hajj. Based on estimates from the top ten countries of pilgrim origin, the likelihood of one case being imported to Saudi Arabia is only from India and is projected to be 0.829. The severity of mumps is low, as serious complications are rare. The Saudi Ministry of Health advised that all pilgrims should be vaccinated against mumps as part of their national vaccination schedule [(11)]. Mumps risks spreading to those who are unvaccinated or not fully vaccinated due to missed vaccine schedules following the COVID-19 pandemic. In the GCC countries, vaccination coverage against mumps in 2022 is high, and the countries have the capability to detect and respond to mumps and will be able to manage any new imported cases.					

Malaria					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Malaria is a vector-borne disease that poses a risk of importation during Hajj. The likelihood of a malaria case being imported during Hajj is estimated to be one from Indonesia and Nigeria and 0.311 from India. There is a widespread distribution of malaria vectors in several Gulf countries; however, malaria poses a low risk to the GCC population, despite the potential for "moderate" impact if an outbreak occurs, the likelihood of introduction, either through travel or local transmission, is "Unlikely". Strong public health measures and existing capacities within the GCC effectively manage any imported cases, minimizing the chance of further spread.					

Meningococcal disease					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Meningococcal disease is a severe disease caused by the bacterium *Neisseria meningitides*. It is potentially fatal within 24 hours of infection and requires urgent medical care. On May 17, 2024, twelve cases with a history of travel to Makkah were reported globally and in neighbouring states, with four from France, three from the United Kingdom, and five from the United States. From the top 10 countries that pilgrims will be arriving from this year, current estimates indicate that there is a 0.081 likelihood of importing one meningococcal case from Nigeria. However, all pilgrims (internal and external) and seasonal workers in the Hajj zones (Makkah, Madinah, Jeddah, Taif) in contact are required to have a valid vaccination certificate. Entering the Hajj area (Makkah) is only permissible for individuals carrying Hajj permits (and Hajj visas), and these permits are not issued if vaccination proof is not provided. Saudi Health authorities at the point of entry also administer antibiotics to pilgrims from countries with frequent meningococcal meningitis epidemics or countries at risk of meningitis epidemics if deemed necessary [(10)(11)] (see Appendix C). Most of the GCC countries have meningococcal vaccine included in their routine immunization schedules and have robust public health systems and infrastructure that can detect and respond to outbreaks of meningococcal disease					

Cholera					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Cholera is a bacterial disease that causes severe diarrhoea and dehydration. There has been an increasing number of cholera outbreaks globally, increasing the likelihood of infected pilgrims arriving from countries with ongoing cholera outbreaks. The current ongoing seventh global cholera pandemic is caused by the bacterium Vibrio cholerae, with El-Tor strain (serogroup O1) being one of the dominant strains and considered hemolytic [(14)]. Based on estimates, the likelihood of cholera one case being imported during Hajj is 0.798 from Pakistan, 0.740 from Bangladesh, 0.487 from Turkey, and 0.084 from India and could be considered as "unlikely". Strong WASH infrastructure and high healthcare capacity in the GCC will effectively prevent local transmission. The overall impact of a potential outbreak is expected to be "moderate" due to these existing mitigation measures.					

Crimean-Congo Hemorrhagic Fever (CCHF)					
Negligible	Very Low	**Low**	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Crimean-Congo Hemorrhagic Fever is a widespread disease caused by a tick-borne virus (*Nairovirus*) of the *Bunyaviridae* family. CCHF cases have been increasing in a neighboring country to GCC, Iraq, whereby fifty cases and eight deaths were reported. [(15)]. CCHF poses a low risk to the GCC population, as the likelihood of outbreaks is considered "likely" due to Eid Al-Adha occurring during the summer months, which coincides with a potential peak in viraemic animals due to increased tick activity. However, the impact is considered "moderate" due to existing robust public health measures like case surveillance, isolation protocols, potential implementation of travel and livestock screening programs from high-risk regions, and awareness campaigns held around Eid Al-Adha, which serve to mitigate outbreak risks.					

Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV)					
Negligible	**Very Low**	Low	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
The majority of MERS-CoV infections to date have occurred due to exposure to dromedary camels. Nevertheless, human-to-human transmission of MERS-CoV can occur among close contacts and in healthcare settings. The likelihood of a case being imported into Saudi Arabia is "negligible". However, there is a slight chance of an internal pilgrim being infectious and performing Hajj. Nevertheless, the human-to-human sustained transmission of MERS-CoV has not previously occurred, so despite its respiratory nature, it is "unlikely" to spread during Hajj mass gatherings. However, robust public health surveillance in Saudi Arabia and the GCC countries are in place to identify and isolate cases rapidly.					

Yellow Fever					
Negligible	**Very Low**	Low	Moderate	High	Critical
Gulf CDC Risk Assessment of this Hazard					
Yellow fever is a mosquito-borne disease considered to have a severe pathogen severity. The case-fatality rate for severe cases is 30%–60% [16]. There are no approved treatments for yellow fever. Saudi Arabia has mandated the presentation of a yellow fever vaccination certificate during applications for Hajj visas/permits for individuals traveling from countries or areas at risk of yellow fever transmission (See Appendix D). However, GCC nationals and long-term residents may not be routinely vaccinated, which could slightly increase the chance of importation. While the *Aedes aegypti* mosquito is present in the GCC, the virus itself is not circulating. Strong public health measures are in place in all countries to effectively manage any imported case.					

(c) Level of Confidence

The level of confidence in the assessment is **moderate**. The available data provide a reasonable basis for assessment. However, estimates have been produced by a mathematical model based on assumed parameters and do not accurately reflect the situation. Any estimates and their interpretation should be considered with caution.

V. Recommendations to GCC Countries

1. Review national policies for the vaccination of Hajj pilgrims and consider mandating COVID-19, influenza, and meningococcal vaccinations for all pilgrims.
2. Request Hajj clinics to ensure the validity of pilgrim's (1-year-old and above) meningococcal vaccination certificates and appropriate vaccination type and timing (including clear dates) as follows:
    a. Quadrivalent (ACYW) Polysaccharide Vaccine, 10 days prior to arrival and should not exceed 3 years.
    b. Quadrivalent (ACYW) Conjugated Vaccine within the last 5 years and at least 10 days prior to arrival.
3. Enhance Gulf CDC and GCC-national epidemic intelligence activities with a focus on Hajj zones (Makkah, Jeddah, Madinah, Taif) and languages spoken by pilgrims from the top ten countries.
4. Conduct a national risk assessment to identify any additional measures to be taken based on national needs.
5. Increase risk communication activities, particularly at travel clinics and Hajj centers, to raise pilgrim's awareness before coming to Hajj regarding personal protective measures against the high-priority diseases identified (e.g. hygiene, mask use, choosing a suitable barber, etc.).
6. Review screening measures at points of entry and exit (in all GCC countries for Hajj pilgrims) and conduct refresher training of staff, particularly on the high-priority disease.
7. Consider implementing enhanced screening measures for high-priority diseases identified from at-risk-countries for individuals transiting through major airports
8. Raise awareness of high-priority diseases identified for Hajj via regular communications (e.g. circulars) to all relevant public health professionals, particularly clinicians.
9. Enhance surveillance and laboratory capacities for early detection of any infectious disease with a focus on Hajj.
10. Enhance vector surveillance and vector control programs and activities for vector-borne diseases.
11. Enhance preparedness and readiness measures for necessary medicines, supplies, and health awareness materials and tools.
12. Consider enforcement of vaccination and other public health measures for Hajj pilgrims, as set per Saudi Guidelines (see example in Appendix E).

VI. References

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VII. Appendices

Appendix A: Importation likelihood ratios of Infectious diseases in the top 10 countries with the most Hajj visas granted and where the highest number of pilgrims is expected to come from.

Table 1. Average Importation Likelihood of Active Infectious Diseases (BlueDot, 2024) in the potential Top 10 origin/Countries of most pilgrims for 2024.

	Algeria	Bangladesh	Egypt	India	Indonesia	Iran	Iraq	Nigeria	Pakistan	Turkey	Grand Total
Brucellosis	0.00			0.00					0.00		0.00
Chikungunya				0.06	0.01				0.01		0.03
Cholera		**0.74**	**0.00**	**0.08**		**0.02**	**0.01**	**0.01**	**0.80**	**0.49**	**0.27**
COVID-19		**0.16**		**0.71**	**0.02**	**0.00**		**0.00**	**0.10**	**0.01**	**0.14**
Crimean-Congo Hemorrhagic Fever (CCHF)						0.00	0.00		0.00	0.00	0.00
Dengue		**0.35**		**0.88**	**1.00**	**0.00**			**0.95**		**0.64**
Diphtheria								0.03			0.03
Hand Foot And Mouth Disease					**0.72**						**0.72**
Hepatitis A										0.00	0.00
Japanese Encephalitis		0.00		0.00							0.00
Kyasanur Forest Disease				0.01							0.01
Lassa Fever								0.11			0.11
Leprosy				0.00							0.00
Leptospirosis				0.00	0.00				0.00		0.00
Lyme										0.00	0.00
Malaria				**0.31**	**1.00**			**1.00**			**0.77**
Measles		**0.00**	**0.00**	**0.07**		**0.01**	**0.65**	**0.14**	**0.82**	**0.04**	**0.22**
Meningococcal Meningitis								0.08			0.08
Mpox (Monkeypox)					0.00						0.00
Mumps				**0.83**							**0.83**
Pertussis										**0.17**	**0.17**
Poliomyelitis									0.00		0.00
Rubella				0.00							0.00
Vaccine-derived Poliomyelitis								0.00			0.00
West Nile				0.01							0.01
Grand Total	0.00	0.25	0.00	0.19	0.34	0.01	0.22	0.17	0.30	0.09	

Importation likelihood refers to the chance of **one case of the disease** being imported to Saudi Arabia within the **next 30 days.**
The blanks in the table represent importation likelihoods that were not computed due to disease counts not identified in the last 60 days.

Appendix B: Gulf CDC Risk Characterization Matrix

Likelihood	Impact				
	Negligible	***Minor***	***Moderate***	***Major***	***Severe***
Negligible	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Unlikely	*Negligible*	**VERY LOW**	**LOW**	**LOW**	**MODERATE**
Likely	*Negligible*	**LOW**	**LOW**	**MODERATE**	**MODERATE**
Highly likely	*Negligible*	**LOW**	**MODERATE**	**MODERATE**	**HIGH**
Almost certain/sure	*Negligible*	**MODERATE**	**MODERATE**	**HIGH**	**CRITICAL**

Appendix C: Countries/areas with frequent epidemics of meningococcal meningitis and countries at risk for meningitis epidemics (WHO International Travel and Health, 2015*):*

Africa		
Nigeria	Ethiopia	Burkina Faso
South Sudan	Gambia	Burundi
Rwanda	Ghana	Cameroon
Senegal	Guinea	Central African Republic
Sudan	Guinea-Bissau	Chad
Tanzania	Kenya	Côte d'Ivoire
Togo	Mali	DR Congo
Uganda	Mauritania	Eritrea
Niger	Benin	

Appendix D: Countries/areas at risk of Yellow Fever transmission, as per the WHO International Travel and Health Guidelines, are:

America		Africa	
Guyana	Argentina	Ghana	Angola
Panama	Venezuela	Guinea	Benin
Paraguay	Bolivia	Guinea-Bissau	Burkina Faso
Peru	Brazil	Kenya	Burundi
Surinam	Colombia	Liberia	Cameroon
Ecuador	Trinidad and Tobago	Mali	Central African Republic
	French Guiana	Mauritania	Chad
		Niger	Congo
		Nigeria	Côte d'Ivoire
		Senegal	DR Congo
		Sierra Leone	Equatorial Guinea
		Sudan	Ethiopia
		Gambia	Gabon
		Togo	South Sudan
		Uganda	

Appendix E: Vaccines required for intenal and external pilgrims (Saudi Ministry of Health 2024/1445)

VIII. Acknowledgments

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