



Addressing The Public Health Concerns

At The 1440 (2019) Hajj

1.0 Background

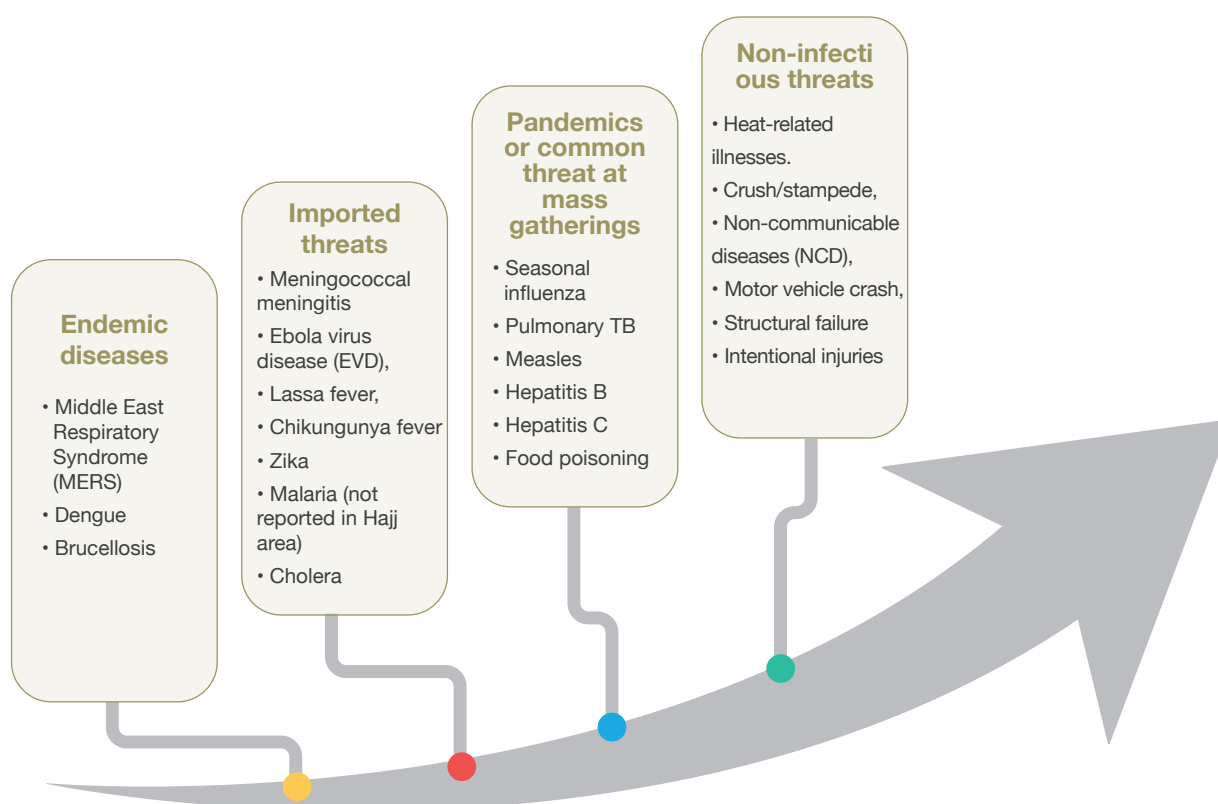
Approximately 2 million Muslim pilgrims from over 180 countries perform the Hajj yearly, in the Kingdom of Saudi Arabia (KSA).¹ Both infectious and non-infectious health conditions originating from within and outside the Kingdom may affect the wellbeing and safety of pilgrims during Hajj.² Without adequate measures, these health risks may also weaken global health security and the reputation of the mass gathering.

The Saudi Ministry of Health (MoH) has implemented several public health measures to prevent the occurrence of these threats and to minimise their effect on the Hajj. This document summarises the main health risks at the Hajj and the relevant recommendations for prevention and control.

1.1 Main health risks

Based on recent Hajj strategic health risk assessment, the main health risks are highlighted in the figure below.

Figure 1: Main Health risks at the 1440 (2019) Hajj



1.2 General MoH Recommendations



1.2.1. Before departure from home/resident country (pre-Hajj)

1. Pilgrims/visitors should ensure they receive appropriate doses of the recommended vaccines within the desirable period; meningococcal meningitis is mandatory for everyone in the Hajj area; polio and yellow fever vaccines are required for pilgrims from certain countries; seasonal influenza is optional but highly recommended
2. Pilgrims/visitors are not allowed to carry food items with them to Saudi Arabia.
3. Pilgrims should visit a travel clinic or any recommended health facility for relevant travel advice and assistance
4. Pilgrims/visitors with chronic diseases like diabetes and hypertension should ensure that their conditions are well-managed before travel and should carry enough prescribed medicine/ drugs to last throughout the period of travel



1.2.2. On arrival in KSA (During Hajj)

1. Pilgrims/visitors should adhere to proper respiratory hygiene etiquettes; cover nose and mouth with tissue while sneezing and coughing and discarding used tissues in appropriate waste containers
2. Regular handwashing is recommended for the prevention and control of many infectious pathogens
3. Pilgrims/visitors should have regular fluid intake, avoid unnecessary sun exposure and get adequate sleep and rest during Hajj
4. Pilgrims/visitors should seek care at the nearest MoH health facility, if running out of medicine, for routine clinic visit or if feeling unwell. The MoH provides free health services for pilgrims/ visitors through 16 hospitals and over 120 primary health centres (PHCS) in the Hajj areas



1.2.3. After departure from KSA (Post Hajj)

1. After Hajj, pilgrims/visitors should report any unusual symptoms, including high fever, to the health authorities in the home country

2.0 Specific Health Risks-Infectious Diseases Threats



2.1 Meningococcal Meningitis

Meningococcal meningitis outbreaks are often reported in 26 countries that make up the African Meningitis Belt.³⁻⁵ Many of these countries have large population of Muslims who participate in the Hajj.

Historically, 2 international Hajj-related meningococcal disease outbreaks were reported in 1987 and 2000/2001.^{2,6} The latter resulted in > 400 cases, with more than 40 deaths in 16 countries.⁶ Indeed, no Hajj-related outbreaks of the disease have been reported ever since, partly due to the preventive measures implemented by the MoH, including mandatory meningococcal vaccination. However, given that overcrowding facilitate spread of the disease and the tendency for healthy people to remain carriers of the bacteria even after vaccination, meningococcal meningitis is still considered a significant public health threat at the Hajj.



MoH Recommendations

1. All pilgrims/visitors aged 2 years and above, Hajj and Umrah workers and residents of Makkah and Medina are required to submit a certified proof of vaccination with either an ACYW135 conjugate meningococcal vaccine or the ACYW135 polysaccharide meningococcal vaccine, administered not less than 10 days before arrival or onset of Hajj/Umrah
2. The certificate validity period for the polysaccharide and conjugate vaccines are 3 years and 5 years respectively. If the type of vaccine administered to a pilgrim is not indicated in the vaccination certificate, a validity period of 3 years would be assumed
3. The latest scientific evidence suggests that conjugate vaccines reduces nasopharyngeal carriage and are safer and more effective for those above 55 years of age
4. The health authorities of pilgrims' countries are advised to ensure the vaccination of their pilgrims within the required vaccine validity period and clearly state the type of vaccine administered on the vaccination certificate
5. The Saudi MoH may administer chemoprophylaxis to some travelers at the point of entry if deemed necessary



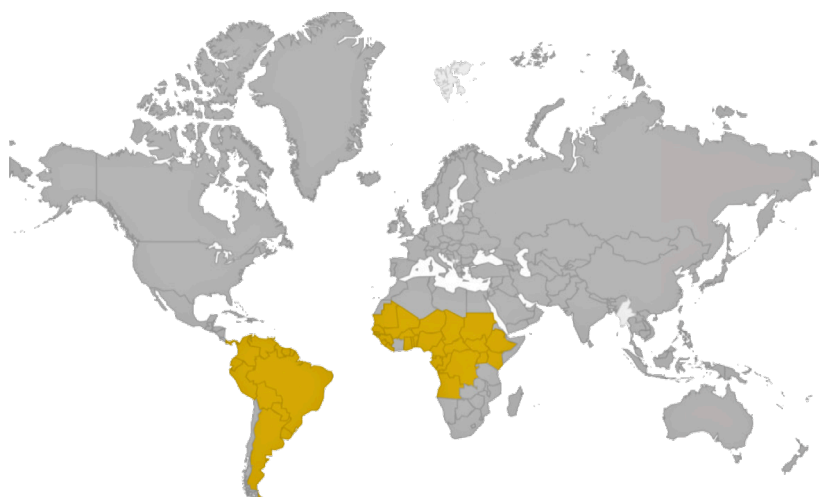
2.2 Yellow fever

Yellow fever is endemic in 47 countries in Africa and Central and South America (Figure 2). These countries include:

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

Yellow fever may be associated with mild febrile illness but a small proportion of symptomatic cases develop severe disease leading to death in 50% of cases.⁷ Due to the presence of the disease vector (aedes mosquito) in KSA and with many pilgrims arriving from countries at risk of yellow fever, potential Hajj-related outbreak and sustained transmission of the disease is a public health concern.

Figure 2: Global geographical distribution of yellow fever endemicity (yellow areas)





MoH Recommendations

1. All travelers arriving from countries or areas at risk of yellow fever transmission must present a valid yellow fever vaccination certificate, administered not less than 10 days before arrival for Hajj and Umrah. The yellow fever vaccination certificate is valid for life starting 10 days after vaccination
2. Aircraft, ships and other means of transportation arriving from countries affected by yellow fever are requested to submit a valid certificate indicating that disinsection was applied in accordance with methods recommended by the World Health Organization (WHO). Inspection as a condition of granting free Pratique may be considered, including permission to enter a port, to embark or disembark, and to discharge or load cargo or stores



2.3 Poliomyelitis

Polio causes flaccid paralysis in children aged less than 5 years old. Afghanistan, Pakistan and Nigeria are recognized polio endemic countries. The three countries combined contribute about 15% of the total population of international pilgrims at the Hajj. As of 2 July 2019, the number of confirmed wild polio cases reported globally in 2019 was 42 cases. These cases were reported in Pakistan (32 cases) and Afghanistan (10 cases). Within the same period, 23 circulating vaccine-derived polio virus cases (type 2) have been reported in seven countries globally (Figure 3): China (1), Ethiopia (1), Somalia (3), Nigeria (9), Angola (2), DR Congo (6) and Niger (1).⁸

Figure 3: Countries with confirmed circulating vaccine-derived polio virus (type 2) cases in 2019 (blue areas)





MoH Recommendations

1. Travelers from areas with active poliovirus transmission (i.e. those with active transmission of a wild or vaccine-derived poliovirus) and from countries at risk of polio reintroduction are required to submit a valid polio vaccination certificate
2. Travelers arriving from Afghanistan, Democratic Republic of the Congo, Mozambique, Niger, Nigeria, Pakistan, Papua New Guinea, Syria, Myanmar, Yemen and Somalia should present proof of vaccination with at least one of the following vaccines:
3. At least one dose of bivalent oral polio vaccine (OPV) within the previous 12 months and administered at least 4 weeks prior to arrival
4. At least one dose of inactivated polio vaccine (IPV) within the previous 12 months and administered at least 4 weeks prior to arrival
5. Travelers arriving from Afghanistan, Nigeria, Pakistan, Papua New Guinea, Syria, Myanmar, Yemen and Somalia will also receive one dose of OPV at the points on entry in Saudi Arabia



2.4 Food and water borne diseases

Cholera bacteria (*vibrio cholerae*) is transmitted through contaminated food and water, especially in areas with inadequate access to clean water and basic sanitation facilities, such as peri-urban slums, refugee camps and disaster areas.⁹ Cholera causes acute watery diarrhea, which result in severe dehydration and death, if left untreated. Between 1 January 2018 and 30 June 2019, the Ministry of Public Health and Population of Yemen have reported 823,221 cases of cholera, including 1210 deaths.¹⁰ Similarly, a cumulative 7994 cholera cases, including 46 deaths, were notified in 3 Somalian states within the same period.¹¹

Historically, cholera was transmitted rapidly across international borders resulting in devastating mass-gatherings related outbreaks in the 19th century.¹ Cholera outbreaks are now rare in Hajj, as no outbreaks of cholera have been reported since the 2009 Hajj season.¹²

Like other mass gatherings, foodborne and water diseases, such as cholera and food poisoning are potential public health threats at the Hajj. Cholera remains a significant health risk due to the arrival of many pilgrims from countries with ongoing cholera outbreaks, such as Yemen and Sudan.



MoH Recommendations

1. Pilgrims are not permitted to travel to Saudi Arabia with food for Hajj and Umrah except in small quantities and in canned or well-sealed containers
2. Pilgrims are advised to observe the following
 - Handwashing is recommended before and after eating and after going to the toilet
 - Fresh vegetables and fruit should be cleaned and washed thoroughly before eating
 - All individuals involved in preparing foods for pilgrims should ensure food is adequately cooked before consumption
 - Food should be covered, kept in safe temperatures and in safe areas
 - Pilgrims should avoid reserving served meals/partially eaten meals for the next meal time
 - Raw and cooked food should be kept separated
3. Pilgrims should avoid meals served by street vendors
4. Pilgrims should seek care at the nearest health facility, if passing frequent watery stools with or without fever or vomiting



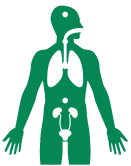
2.5 Influenza (Seasonal)

Seasonal influenza is a common acute viral respiratory illness that causes epidemics worldwide and can affect any age group. Influenza transmission occurs rapidly in crowded environments, such as the Hajj. Severe complications of seasonal influenza are common among elderly people, pregnant women, children aged 6-59 months and people with coexisting medical conditions, such as immunosuppressive disorders and chronic lung and heart diseases.¹³⁻¹⁵ Healthcare workers are at a higher risk of being infected with seasonal influenza. Vaccination remains the most effective method for the prevention of seasonal influenza.¹⁶



MoH Recommendation

1. All pilgrims/visitors arriving for Umrah, Hajj or for seasonal work in Hajj zones should get vaccinated against seasonal influenza
 - Countries are encouraged to secure adequate quantities of the most recent influenza vaccine recommended for use in their country to be administered to those intending to perform Hajj
 - All pilgrims from the southern hemisphere or from countries which use the southern hemisphere vaccine should receive the requisite vaccine at least 10 days prior to commencing Hajj
 - All domestic pilgrims and health workers in the Hajj and Umrah areas should receive the most recently available seasonal Influenza vaccine 10 days prior to their arrival to Hajj and Umrah areas
2. Pilgrims/visitors should wash hands regularly and ensure hands are dried properly after handwashing
3. Pilgrims/visitors should cover mouth and nose when coughing or sneezing, using tissues and disposing of them correctly
4. Pilgrims/visitors should seek care at the nearest health facility if feeling unwell and practice early self-isolation if feverish and having other symptoms of influenza
5. Pilgrims/visitors should avoid close contact with sick people
6. Pilgrims/visitors should avoid touching one's eyes, nose or mouth

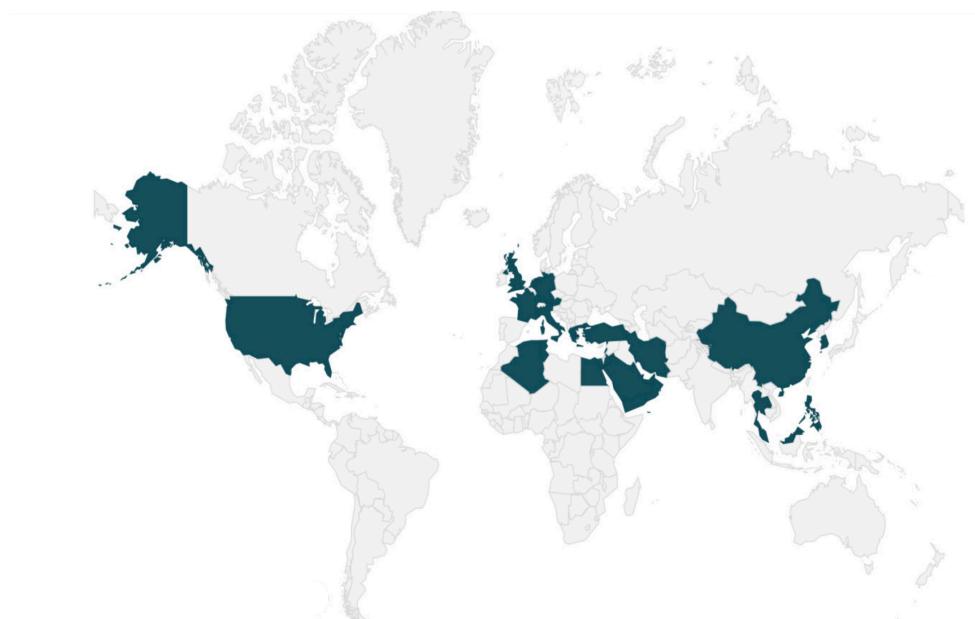


2.6 Middle East Respiratory Syndrome (MERS)

MERS is a severe viral respiratory disease. [19, 26] As of 2 July 2019, the Saudi MoH has notified 2022 MERS cases, including 39% fatalities, in the Kingdom.¹⁷ MERS has been notified in 27 countries since the onset of the epidemic in 2012 (Figure 4). Dromedary camels, which constitute 95% of the world's camel population is the main reservoir of the coronavirus (MERS-CoV) and viral shedding in camel secretions and dairy products have been documented.¹⁸ Indeed, no Hajj-related MERS outbreaks have been reported worldwide, since the onset of the epidemic in 2012.

The MERS control and management guidelines are well-developed and disseminated to relevant stakeholders by the MoH. Healthcare workers are well-trained on infection prevention and control (IPC), surveillance and case management well before Hajj. Camels are restricted from the Hajj areas to prevent contacts between pilgrims and camels during the pilgrimage.

Figure 4: Twenty Seven countries with reported MERS cases globally, since 2012



MoH Recommendations

1. Pilgrims/visitors should wash hands with soap and water or a disinfectant, especially after coughing and sneezing, after using toilets, before handling and consuming food, and after touching animals
2. Pilgrims/visitor should use disposable tissues when coughing or sneezing and dispose of used tissues in a wastebasket
3. Pilgrims/visitors should wear regular face masks in crowded places
4. Pilgrims/visitors should avoid contact with those who appear ill and avoid sharing their personal belongings
5. Pilgrims/visitors should avoid visits to camel farms, markets and bans and generally avoid contact with camels
6. Pilgrims/visitor should avoid drinking unpasteurized milk or eating raw camel meat or other animal products that are not thoroughly cooked
7. Pilgrims/visitors should seek care early in any MoH health facility if feeling unwell
8. Gloves and other recommended personal protective equipment (PPE) should be worn when dealing with sick patients



2.7 Pulmonary Tuberculosis (TB)

Pulmonary TB is a chronic inflammatory disease of the respiratory system caused by *mycobacterium tuberculosis*.¹⁹ The bacterium is transmitted as aerosol droplets by people with active TB disease through coughing, spitting or sneezing. The symptoms of active pulmonary TB may include cough, shortness of breath, night sweat and weight loss.^{19,20}

Pulmonary TB is a significant public health concern during mass gatherings, including the Hajj. In a 2015 GCMGM study, a proportion of pilgrims from TB high burden countries arrive Saudi Arabia with undetected active TB disease during Hajj.²¹ The evidence of possible TB transmission among pilgrims was described in another study.²² However the burden of TB in Hajj is difficult to estimate given the long incubation period of TB bacteria.



MoH Recommendations

1. All pilgrims/visitors arriving for Hajj/Umrah with a known diagnosis of active TB should carry enough anti-TB drugs to last during the duration of travel
2. All pilgrims/visitors arriving for Hajj/Umrah with a known diagnosis of active TB should report their conditions to healthcare workers at the nearest MoH health facility, if feeling unwell or if in need of resupply of prescribed anti-TB drugs
3. Countries should ensure that active TB patients have commenced recommended anti-TB drugs and are sputum negative for TB before traveling for Hajj
4. Pilgrims/visitors should use disposable tissues when coughing or sneezing, and should dispose of used tissues in a wastebasket



2.8 Dengue

Dengue fever is frequently associated with flu-like symptoms, which resolves within 2-7 days of onset. Few patients may develop a severe complication known as dengue hemorrhagic fever (DHF). The annual incidence of dengue is estimated to be 390 million cases (95% credible interval 284–528 million), with about 500,000 cases requiring hospitalization from severe dengue.²³ Another study estimated that 3.9 billion people worldwide are at risk of infection with dengue viruses in 128 countries.²⁴

Aedes. aegypti, the predominant vector in the Kingdom, bites during the day (peak period early morning and late evening) and breeds mostly in open household water containers in urban areas.^{23,25} As part of preparedness for Hajj, several rounds of insecticide spraying is completed in the weeks before Hajj and the vector surveillance teams increasingly monitor the impact of vector control interventions and recommend supplementary approaches when needed.



MoH Recommendations

1. Pilgrims/visitor are advised to take necessary measures to avoid mosquito bites during the day and evening, which includes wearing protective clothing (preferably light-colored) that covers as much of the body as possible; using physical barriers such as window screens and closed doors; and applying insect repellent (as per the label instructions on the product) to skin or clothing that contains DEET, IR3535 or icaridin
2. All household water storage containers should be covered, emptied and cleaned weekly
3. Pilgrims/visitors should seek care at the nearest MoH health facility if feeling unwell or having the symptoms of dengue



2.9 Blood-borne viruses

Unprotected sexual intercourse, infected blood transfusion and sharing of contaminated sharp instruments, such as shaving blades and surgical tools, are among the recognized modes of transmission of HIV, hepatitis B and hepatitis C viruses. Hepatitis B infection is preventable with a safe and affordable vaccine which confers life-long immunity.²⁶ About 399,000 deaths occur yearly from hepatitis C and an estimated 71 million people live with chronic hepatitis C infection worldwide.²⁷ There are currently no licensed vaccines for hepatitis C virus infections globally, but anti-viral drugs provides effective cure in 95% of cases to prevent the potentially fatal complications of liver cirrhosis and cancer.²⁷

In the context of the Hajj, sharing of contaminated shaving blades during rituals may increase the risk of transmission of hepatitis B and hepatitis C viruses.



MoH Recommendations

1. Pilgrims/visitors should avoid sharing shaving blades during preparation for Hajj rituals
2. Pilgrims/visitors should safely dispose of used shaving blades in designated waste containers
3. Pilgrims/visitors should avoid unlicensed street barbers
4. Healthcare workers should receive 3 doses of hepatitis B vaccine before deployment for Hajj duties
5. Healthcare workers should report any potential nosocomial exposure from cuts and needle injuries at the nearest MoH health facility, for further investigation and administration of appropriate post-exposure prophylaxis

3.1 Hemorrhagic fevers (Ebola and Lassa fever)



3.1.1 Ebola virus disease (EVD)

EVD is an often fatal and highly infectious condition which spreads to humans through close contact with the body fluids of infected animals such as fruit bats, chimpanzees and monkeys. Human-to-human spread occurs through direct contact with body fluids of a living or dead EVD patient or contact with a contaminated surface or object. The initial symptoms of EVD may be similar to those of other common infectious diseases and may include fever, fatigue, muscle pain, headache and sore throat. This could be followed by diarrhea, vomiting, rash and internal and external bleeding.²⁸

As of 11 July 2019, 2437 confirmed and probable EVD cases, including 1646 deaths (CFR 68%) have been reported in the current outbreak of the disease in Congo Democratic Republic.²⁹ An international spread of EVD to Uganda was reported in June 2019. The current EVD outbreak has just been declared as a public health event of international concern by WHO.²⁹ The transmission risk of EVD to KSA during Hajj is reduced by the low number of pilgrims that arrive from Congo Democratic Republic. However, the Saudi MoH has implemented a preparedness plan for potential EVD spread to the Kingdom, including entry screening procedures, improved surveillance, well-trained rapid response teams and designated treatment facilities.



3.1.2 Lassa fever

Lassa fever (LF) is a zoonotic viral disease.^{30,31} The main reservoir of Lassa virus is the *Mastomys* rats. Humans are infected through aerosol or direct contact with the feces or urine of infected rats. Human-to-human transmission of the virus occurs through contact with the blood, feces, urine or other body secretions of an infected individual.³² The Nigerian Center for Disease Control reported 603 confirmed Lassa fever cases, including 136 deaths (CFR 22.6%), from 1 January-30 June 2019.³³ The risk of spread of Lassa fever to Saudi Arabia during Hajj is heightened by the large population of Nigerian pilgrims (>50,000) that arrive for Hajj.



MoH Recommendations

1. Pilgrims/visitors should avoid contact with the body fluids of sick people in their residences/camps or during visit to health facilities
2. Pilgrims/visitors should wash their hands with soap and water after caring for a sick patient, after contact with a sick patient's surroundings and after visiting a health facility
3. Pilgrims/visitors who arrive from EVD/Lassa fever outbreak areas should seek care at the nearest health facility, if sick with fever
4. Gloves and other recommended personal protective equipment (PPE) should be worn when dealing with sick patients



3.2 Measles

Measles is a highly contagious viral disease that spreads through coughing and sneezing, as well through close personal contact or direct contact with infected nasal or throat secretions. Measles may manifest with a high fever which is often associated with cough, running nose, red eyes and tiny red skin rash starting in the head and upper neck and then progressing up to the hands and feet.³⁴ Outbreaks of measles have been reported in several countries in 2019 due to low uptake of measles vaccine. The crowded conditions of mass gatherings, such as the Hajj, may increase the transmission of measles and cause illness among pilgrims/visitors.



MoH Recommendations

1. Unvaccinated pilgrims/visitors should receive an appropriate dose of measles vaccine in their home country before arrival for Hajj
2. Pilgrims/visitors having symptoms of measles should seek care at the nearest MoH health facility



3.3 Zika

Zika virus (ZIKV) is known to cause Guillain-Barre syndrome, as well as microcephaly in new born babies ³⁵ Despite the spread of ZIKV to several countries with competent vector (aedes mosquito) in the Americas, Africa and Asia, Saudi Arabia is yet to report any cases of the disease. The WHO classifies Saudi Arabia as: “area with established competent vector but no known documented past or current transmission”



MoH Recommendations

1. Aircrafts, ships, and other means of transportation coming from countries affected with the Zika virus are requested to submit a valid certificate indicating that disinsection was applied in accordance with methods recommended by WHO
2. Pilgrims are advised to take necessary measures to avoid mosquito bites during the day and evening, which includes wearing protective clothing (preferably light-colored) that covers as much of the body as possible; using physical barriers such as window screens and closed doors; and applying insect repellent (as per the label instructions on the product) to skin or clothing that contains DEET, IR3535 or icaridin

4.0 Specific Health Threats- Non-Infectious risks



4.1 Heat-related illnesses

Generally, climatic conditions in the Kingdom are characterized by extreme heat and limited annual rainfall. Thus heat-related illnesses are recognized public health threats to the Hajj, especially when the Hajj is held in the summer months (April-October).³⁶ Temperatures exceeding 45°C could be reported in Makkah during Hajj. People with chronic diseases and the elderly are at higher risk of complications from heat-related illnesses. The burden of heat illnesses during Hajj is highest in Mina. This is because pilgrims spend 3-4 days in Mina, performing the “stone throwing” ritual, which involves walking in largely unshaded areas to the ritual area.^{2,36}



MoH Recommendations

1. Pilgrims/visitors should stay hydrated by drinking enough fluids (water and juices) regularly
2. Pilgrims/visitors should avoid direct sun exposure for prolonged period
3. Pilgrims/visitors should use light-colored umbrella to avoid direct sun exposure
4. If possible, pilgrims/visitors should delay the performance of certain rituals to the evening period when temperatures are lower
5. Pilgrims/visitors should have adequate rest and avoid excessive physical exertion
6. Countries should create awareness of heat-related illnesses among their pilgrims prior to travel
7. Pilgrims/visitors that are taking medications that increase fluid loss, such as diuretics, may visit their doctor for dosage adjustment



4.2 Non-communicable diseases (NCDs)

Globally, an estimated 71% of deaths each year are caused by NCDs.³⁷ Cardiovascular diseases, diabetes, cancer and chronic respiratory disease account for 82% of NCD deaths.³⁸ The morbidity and mortality indices for Hajj also reflects the current global trend of NCDs.² Potentially, many pilgrims arrive to perform Hajj with chronic diseases which could be exacerbated during the pilgrimage.



MoH Recommendations

1. Pilgrims/visitors with chronic diseases, such as diabetes and hypertension should ensure their conditions are properly managed before departure for Hajj/Umrah
2. Pilgrims/visitors above 45 years of age should have appropriate medical screening/test for chronic diseases in their home countries
3. Pilgrims/visitors with chronic diseases should travel with enough medications to last throughout the period of travel
4. Pilgrims/visitors should obtain a full medical report of their health conditions from their home country and present such reports to healthcare workers in Saudi Arabia during clinic/hospital visit
5. Pilgrims/visitors should ensure they are physically fit before departure for Hajj
6. Pilgrims/visitors should seek care at the nearest MoH health facility, before running out of prescribed medications, for routine checkup or if feeling unwell

7. The emergency toll line in Saudi Arabia is 937, you may call this number for an ambulance in case of a health emergency
8. Countries should ensure their pilgrims are physically fit to perform Hajj. Screening of pilgrims for chronic diseases risk factors and ensuring pilgrims with chronic diseases are well-managed before arrival may help reduce the burden of NCDs at the Hajj



4.3 Crowd-related incidents

Crush and stampedes are among the most hazardous threats to mass gatherings globally.³⁹⁻⁴¹ Human stampede is triggered by uncontrolled movement of a large group of people responding to fear or panic situation and escaping from a perceived or actual threat.⁴² on the other hand, crush is a sequelae of compressive forces that are observed in large crowds, especially when crowd density is ≥ 4 persons/m².⁴² Because pilgrims ought to perform Hajj rituals simultaneously within 5 days at the same location, crowd control is logistically challenging. Historical incidents have also been linked to belief systems, which underpin potential “risky behaviour” among the diverging groups that attend the Hajj.³⁶



MoH Recommendations

1. Pilgrims/visitors should take their turns to perform rituals
2. Pilgrims/visitors should maintain a safe distance behind the pilgrim directly in front
3. Pilgrims/visitors should avoid pushing others in crowded areas
4. Pilgrims/visitors should avoid creating any panic in crowded areas
5. Pilgrims/visitors should ensure they follow road signs and instructions from crowd control officials
6. The uni-directional traffic flow in some Hajj areas should be maintained
7. Pilgrims/visitors should avoid crowded areas when necessary
8. Countries should create awareness about crowd-related incidents among their pilgrims and address any behaviour or culture that might create panics or crowd disturbance in the Hajj/Umrah

5.0 References

1. Alotaibi BM, Yezli S, Bin Saeed AA, Turkestani A, Alawam AH, Bieh KL. Strengthening health security at the Hajj mass gatherings: characteristics of the infectious diseases surveillance systems operational during the 2015 Hajj. *J Travel Med* 2017; 24(3).
2. Ahmed QA, Arabi YM, Memish ZA. Health risks at the Hajj. *The Lancet* 2006; 367(9515): 1008-15.
3. World Health Organization. Meningococcal Disease Fact Sheet. 2018. <http://www.who.int/mediacentre/factsheets/fs141/en/> (accessed 11 July 2019).
4. Harrison LH, Trotter CL, Ramsay ME. Global epidemiology of meningococcal disease. *Vaccine* 2009; 27: B51-B63.
5. Chang Q, Tzeng Y-L, Stephens DS. Meningococcal disease: changes in epidemiology and prevention. *Clin Epidemiol* 2012; 4(1): 237-45.
6. Yezli S, Assiri AM, Alhakeem RF, Turkistani AM, Alotaibi B. Meningococcal disease during the Hajj and Umrah mass gatherings. *International Journal of Infectious Diseases* 2016; 47: 60-4.
7. Organization TWH. Yellow fever fact sheet. 2019. <https://www.who.int/news-room/fact-sheets/detail/yellow-fever> (accessed 7 July 2019).
8. Initiative PGE. Circulating Vaccine-Derived Polio Virus Information. 2019. <http://polioeradication.org/polio-today/polio-now/this-week/circulating-vaccine-derived-poliovirus/> (accessed 14 July 2019).
9. WHO. Cholera Fact Sheet. 2016. <http://www.who.int/mediacentre/factsheets/fs107/en/>.
10. Organization WH. Epidemic and pandemic-prone diseases outbreak update-cholera in Yemen. Cairo; 2019.
11. Organization WH. Epidemic and pandemic-prone diseases outbreak update-cholera in Somalia. 2019.
12. Alotaibi BM, Yezli S, Bin Saeed A-AA, Turkestani A, Alawam AH, Bieh KL. Strengthening health security at the Hajj mass gatherings: characteristics of the infectious diseases surveillance systems operational during the 2015 Hajj. *Journal of Travel Medicine* 2017; 24(3).
13. Fell DB, Platt RW, Lanes A, et al. Fetal death and preterm birth associated with maternal influenza vaccination: systematic review. *BJOG : an international journal of obstetrics and gynaecology* 2015; 122(1): 17-26.
14. Kang SH, Cheong HJ, Song JY, et al. Analysis of Risk Factors for Severe Acute Respiratory Infection and Pneumonia and among Adult Patients with Acute Respiratory Illness during 2011-2014 Influenza Seasons in Korea. *Infection & chemotherapy* 2016; 48(4): 294-301.
15. Organization TWH. Influenza (Seasonal) Fact Sheet. 2016. <http://www.who.int/mediacentre/factsheets/fs211/en/> (accessed 2 May 2017).
16. Osterholm MT, Kelley NS, Sommer A, Belongia EA. Efficacy and effectiveness of influenza vaccines: a systematic review and meta-analysis. *The Lancet Infectious Diseases*; 12(1): 36-44.
17. Health Mo. Command and Control Center MERS Weekly Update. 2019.
18. Omrani AS, Al-Tawfiq JA, Memish ZA. Middle East respiratory syndrome coronavirus (MERS-CoV): animal to human interaction. *Pathogens and Global Health* 2015; 109(8): 354-62.
19. Kasper D, Fauci A, Hauser S, Longo D, Jameson J, Loscalzo J. *Harrison's principles of internal medicine*, 19e. 2015.
20. Organization WH. Compendium of WHO guidelines and associated standards: ensuring optimum delivery of the cascade of care for patients with tuberculosis: World Health Organization; 2017.

21. Yezli S, Zumla A, Yassin Y, et al. Undiagnosed Active Pulmonary Tuberculosis among Pilgrims during the 2015 Hajj Mass Gathering: A Prospective Cross-sectional Study. *The American journal of tropical medicine and hygiene* 2017; 97(5): 1304-9.
22. Wilder-Smith A, Foo W, Earnest A, Paton NI. High risk of *Mycobacterium tuberculosis* infection during the Hajj pilgrimage. *Tropical Medicine & International Health* 2005; 10(4): 336-9.
23. Organization TWH. Dengue and severe dengue Fact Sheet. 2019. <http://www.who.int/mediacentre/factsheets/fs117/en/> (accessed 14 July 2019).
24. Brady OJ, Gething PW, Bhatt S, et al. Refining the global spatial limits of dengue virus transmission by evidence-based consensus. *PLoS neglected tropical diseases* 2012; 6(8): e1760.
25. Shahina W, Nassara A, Kalkattawia M, Bokharia H. Dengue fever in a tertiary hospital in Makkah, Saudi Arabia. 2009.
26. Organization WH. Hepatitis B Fact Sheet. 2019. <http://www.who.int/mediacentre/factsheets/fs204/en/> (accessed 14 July 2019).
27. Organization WH. Hepatitis C Fact Sheet. 2019. <http://www.who.int/mediacentre/factsheets/fs164/en/> (accessed 14 July 2019).
28. Organization WH. Ebola virus disease fact sheet. 2019. <https://www.who.int/news-room/fact-sheets/detail/ebola-virus-disease> (accessed 14 July 2019).
29. Organization WH. Disease outbreak news-Ebola. 2019. <https://www.who.int/csr/don/en/> (accessed 11 July 2019).
30. Carey D, Kemp G, White H, et al. Lassa fever epidemiological aspects of the 1970 epidemic, Jos, Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 1972; 66(3): 402-8.
31. Organization WH. Disease Outbreak News. Geneva; 2019.
32. Organization WH. Emergencies-Lassa Fever. Geneva; 2019.
33. Control NCfD. Disease situation report-Lassa fever. 2019. <https://ncdc.gov.ng/diseases/sitreps> (accessed 14 July 2019).
34. Organization WH. Measles fact sheet. 2019. <https://www.who.int/news-room/fact-sheets/detail/measles> (accessed 14 July 2019).
35. Organization TWH. Zika virus fact sheet. 2016. <http://www.who.int/mediacentre/factsheets/zika/en/> (accessed 2 May 2017).
36. Health Mo. 1437 Hajj Strategic health risk assessment report. 2016.
37. Organization WH. Noncommunicable Disease Fact Sheet. 2019. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases> (accessed 14 July 2019).
38. Organization WH. Global status report on noncommunicable diseases 2014: World Health Organization; 2014.
39. Hsu EB, Burkle FM. Cambodian Bon Om Touk stampede highlights preventable tragedy. *Prehospital and disaster medicine* 2012; 27(5): 481-2.
40. Ehiawaguan IP. Mass casualty incidents and disasters in Nigeria: The need for better management strategies. *The Nigerian postgraduate medical journal* 2007; 14(4): 341-6.
41. Ngai KM, Burkle FM, Jr., Hsu A, Hsu EB. Human stampedes: a systematic review of historical and peer-reviewed sources. *Disaster medicine and public health preparedness* 2009; 3(4): 191-5.
42. H. A. Towards the scientific dimension of integrated crowd management. General Directorate of Civil Defence, Riyadh 2014.

