

An Insight into the Challenges Posed by Communicable Diseases During Pilgrimage Seasons

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Abstract-The annual performance of Hajj by Muslims from around the globe that takes place in Makkah poses many logistical and preparation challenges to Saudi Authorities and the World Health Organization (WHO). These challenges mainly arise from monitoring old and emerging infectious diseases that may be spread by the large number of pilgrims that can exceed three million, gathering in a small defined area. Different infectious diseases have been reported frequently, during and following the Hajj season. The spread of diseases (communicable diseases) was found to be very high during Hajj. They are mainly caused by respiratory infections such as influenza viruses that become more dangerous each year with the emergence of new kinds such as pandemic influenza A (H1N1), severe acute respiratory syndrome (SARS), and avian influenza (H5N1). Recently, there are special concerns to an emerging infectious agent known as the Middle East respiratory syndrome coronavirus (MERS-CoV), and to the re-emergence of the Ebola virus. Examples of communicable diseases are meningococcal meningitis infections and blood-borne diseases, including hepatitis B, C and HIV that can lead to a high mortality rate among pilgrims and other people around the globe. In this study, a review is performed on the most recent cases of communicable disease infections that occurred during the Hajj in past years and the safety measures taken to prevent these diseases from spreading and ultimately avoid a worldwide epidemic. Finally, some recommendations are highlighted that may contribute to the prevention and control of infectious diseases in Saudi Arabia during the Hajj season.

Keywords- Hajj; Disease; Communicable Diseases; Pilgrims; Risk Factors; Saudi Arabia

I. INTRODUCTION

Hajj is a unique Islamic obligatory ritual done once in a lifetime by adult Muslims who are physically fit and can afford the cost of performing it. It is the fifth pillar of Islam and Muslims around the globe are eager to perform it during the last month of the Islamic Hijri calendar (Dhu-al-Hijjah) [1]. It is performed in Saudi Arabia, around the Makkah area and lasts for 4-7 days [1, 2]. Hajj is considered the largest annual gathering of people in a small area in the world. The government of Saudi Arabia has a huge responsibility for organizing this massive gathering. Thus, Saudi authorities update an inclusive plan annually to make certain that all Hajj rituals are performed securely and healthily. In 2012, more than three million Muslims from more than 184 countries gathered at the same time in a small area (Ranging from 8 – 13.7 sq km for the three main pilgrimage places Mina, Muzdalifah and Arafah), according to Saudi Arabia's Central Department of Statistics and Information [3]. The total number of pilgrims has increased tremendously since 2004, as shown in (Fig. 1) [3].

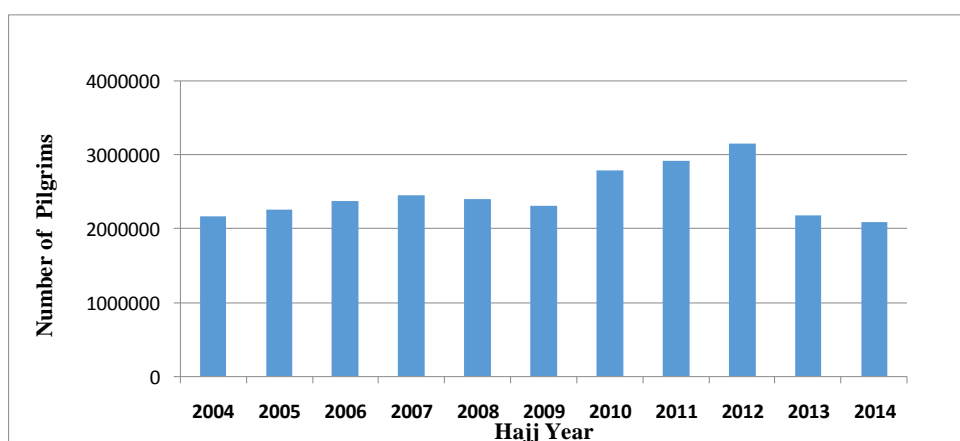


Fig. 1 Total Number of Pilgrims During Hajj from 2004 - 2014 [3, 4]

There are many health problems and risk factors that may impact the pilgrims' health during Hajj [5]. These factors are a result of extreme overcrowding, travel fatigue, inadequate and contaminated nutrition, excessive humidity and dense air

pollution, as well as restrictions and limitations to hygienic water supply, improper sewage management and improper sanitary habits among some pilgrims, which could raise the risk of disease transmission. Other risks include: sunstroke caused by long exposure to the sun's heat; trauma/crush injuries, fire related injuries [6, 7] and the slaughtering of animals for sacrifice which is associated with the risk of infection transmission through contact with an infected animal or a contaminated object. Moreover, long-distance transportation of personal food supplies without proper temperature control and close skin-to-skin contact between pilgrims all contribute to potential health hazards [7]. This article is more concerned with communicable diseases that spread extensively in the season of Hajj. Communicable diseases are infectious diseases that pass directly from an infected individual or can pass by indirect contact through a vector [8].

Air transportation and the complexity of modern transport causes difficulties for governments when implementing strategies for disease control. Pilgrims may contract infectious diseases at their time of departure and may not have obvious symptoms until they arrive in their home countries, resulting in the spread of diseases [7, 9]. Many pilgrims are elderly and have pre-existing chronic medical problems that may be exacerbated by the conditions at Hajj and may also increase their risk of getting an infectious disease.

Furthermore, the increase in the death toll is not only caused by health hazards that the pilgrims are exposed to during Hajj, but also results from patients who do not receive adequate treatment. For example, asthma patients should rest and avoid crowds as much as possible [5].

Many factors increase the communicable diseases' spreading rate during Hajj. Most importantly, the overcrowding of people in a small area that could trigger many communicable diseases, including meningococcal meningitis infections, several influenza viruses, the pandemic influenza A (H2N1), severe acute respiratory syndrome (SARS) and avian influenza (H5N1) [7, 10-15]. Recently, there is an emerging virus called the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) that caused death to hundreds of people, especially in Saudi Arabia in 2013-2014, due to the lack of proper vaccines produced for these types of infections [16-19].

The Ebola virus was discovered in 1979, but has reemerged in 2014 and is considered an epidemic disease by the World Health Organization (WHO) which raised an international alert [20]. Ebola has a high mortality rate. Human-to-human transmission can occur via direct contact with blood or bodily fluids from an infected person or via contaminated medical equipment like needles. Initial symptoms include unexpected fever, muscle pain, extreme weakness and both internal and external bleeding [20].

Viral, bacterial and fungal respiratory infections can spread through the nose and mouth, causing infections in the trachea or lungs that can lead to breathing difficulties [18]. Severe acute respiratory infections could result in blocking the oxygen uptake to the lungs, thus causing the infected to die [21].

Respiratory infections can be picked up from infected people, birds, animals, etc. Hence, these infections are easily widely spread, threatening in particular the lives of older adults, children and people suffering from an immune system disorder [21]. Pilgrims in Hajj are highly affected by respiratory infections; in 2012, there were more than a hundred deaths among pilgrims [22].

Most of the infections arising during the Hajj season are preventable. Proper vaccinations are a protective measure. In addition, curative treatments are available for many respiratory infections. However, some of the emerging resistant microorganisms and the new serotypes of viruses that are emerging, such as MERS-CoV and Ebola virus, are difficult to control, since there is lack of specific vaccination or any discovered cures.

Meningococcal disease originates from a bacterium called *Neisseria meningitidis* (also known as meningococcus) [23, 24]. It can be transmitted from one person to another through saliva. Meningococcal disease can infect the blood stream and reach the brain, resulting in severe illness, disability and death. Being vaccinated with the meningococcal vaccine before starting the Hajj proved to be an excellent measure to limit the spread of this infection [23, 24].

Blood-borne diseases are extremely life threatening to pilgrims; as hepatitis B, C and HIV can be transmitted by undergoing hair shaving with contaminated blades and razors used by unlicensed barbers for shaving pilgrims' heads. The Saudi government has enforced licensed barbers to use sterile tools to protect people from that hazard [6].

Food poisoning is an additional cause of diarrhea and vomiting during Hajj [25]. Traveler's diarrhea is common during the Hajj. It is transmitted by the consumption of contaminated food or water. There have also been outbreaks of cholera, a severe bacterial enteric disease caused by *Vibrio cholerae*, during the Hajj seasons [26].

Hajj holds a unique challenge that affects international public health. Thus, the WHO is becoming more and more concerned about the health of pilgrims returning back to their countries. The WHO fear originates from the possible transmission of the diseases to other people around the globe and the possibility these diseases might develop into epidemics that increase the mortality rate in any part of the world.

The health challenges associated with Hajj need to be addressed properly as new emerging pandemic communicable diseases have been discovered in recent years.

Performing Hajj rites is physically demanding. Dangerous physical stressors can contribute to an increase in communicable and noncommunicable diseases. The health of pilgrims is of substantial importance for Saudi Arabian officials preparing for the Hajj season. The objectives of this study include a review of the communicable diseases that pilgrims face and a suggestion of proper strategies to manage health hazards efficiently and improve Hajj safety for all pilgrims, and ultimately reinforce global health security.

In Saudi Arabia, the health measures are crucial and need to be implemented appropriately to prevent emerging health pandemics in Saudi Arabia and the countries to which pilgrims return. As a result of the new implemented measures, such as the request for each pilgrim to have a certificate of vaccinations for certain diseases and doing medical check up on pilgrims upon their arrival in Saudi Arabia when there is pandemic health concern, there are tangible improvements in the health conditions of pilgrims as reflected in the lower mortality rate, despite the increased number of pilgrims and the emergence of new diseases (Fig. 2).

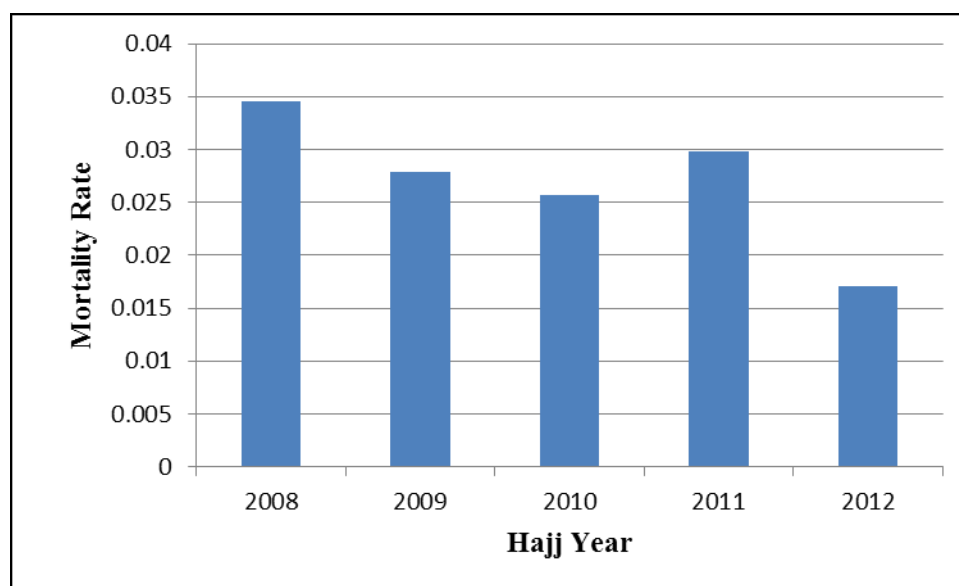


Fig. 2 Mortality Rates Based on Total Number of Pilgrims For Hajj 2008 - 2012 [22]

II. COMMUNICABLE DISEASES PREVENTION AND CONTROL

Communicable disease prevention and control is the basis of public health and especially in Hajj season, when many kinds of diseases can be transmitted among pilgrims. In 2012, the Ministry of Health in Saudi Arabia announced 585 fatalities among pilgrims caused by non-communicable and communicable diseases [22]. The number of fatalities caused by communicable diseases ranked second [22]. The highest fatalities were caused by stroke and cardiorespiratory failure, both non-communicable diseases [22]. The second most common cause of death was by communicable diseases such as respiratory diseases, infections like flu, pulmonary T.B., measles disease caused by contact with infected persons and parasitic diseases (Fig. 3).

Most of the communicable diseases were found to be transmitted through air by breathing, sneezing or coughing, spreading bacteria and viruses [8]. The vast majority of these diseases affect people's lungs [8].

Pneumococcal infections, including pneumonia, continue to cause high mortality worldwide. In 2012, pneumonic disease classified as a communicable disease is reported to be one of the top causes of fatalities among pilgrims [22]. A variety of organisms, including bacteria, viruses and fungi, can cause pneumonia [26, 27]. The bacterium *Streptococcus pneumonia* is the main cause of pneumonia and it develops as a result of inflammation of the lungs, targeting the alveoli by inflaming the air sacs in one or both lungs [26, 27]. The infection can easily be spread to people through air by breathing, sneezing or coughing [26, 27].

Washing hands frequently and using hand sanitizer to kill germs can help to prevent pneumonia. Pneumonia can be treated by antibiotics and antiviral medications and it is preventable through vaccinations, which help controlling the disease in Hajj season and reduce the number of fatalities among infected pilgrims, particularly those pilgrims with medical risk factors for invasive pneumococcal disease [28].

Pulmonary tuberculosis (TB) is another common communicable disease reported in Hajj season [22]. It can be spread by air through coughing, sneezing or breathing [29]. TB is caused by *Mycobacterium tuberculosis*, a strain of mycobacteria that attacks the lungs [30]. Tuberculosis is strictly connected to both, overcrowding and malnutrition. Pre-departure screening should stay to exclude those with an active disease. The treatment for TB can be executed by taking antibiotics, in addition to

vaccinations that can be taken as a preventable measure [30, 31].

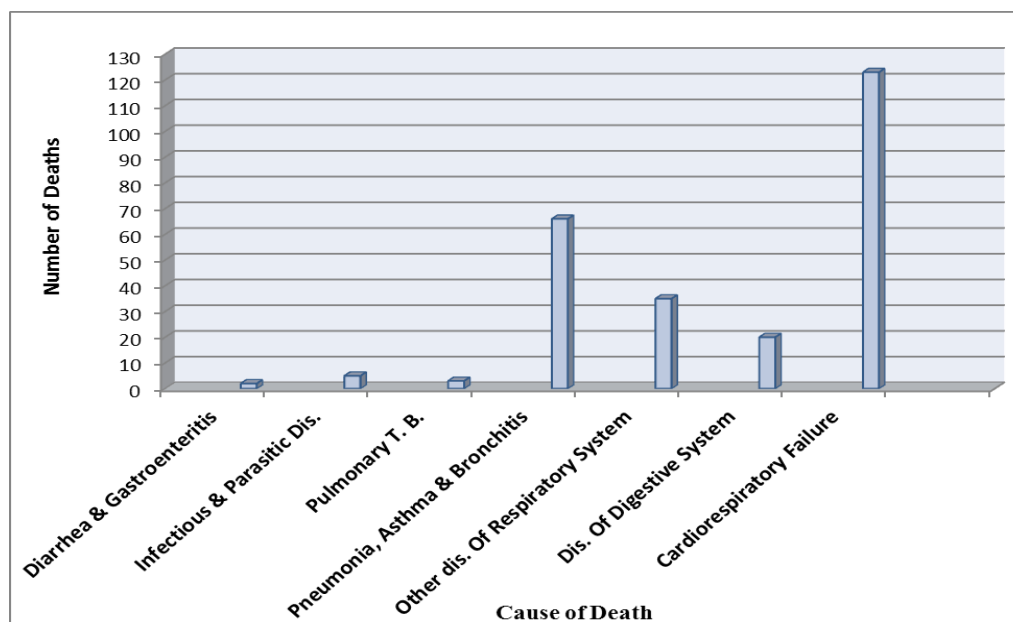


Fig. 3 Pilgrims Deaths by Cause in Saudi Arabia during Hajj of 2012 [22]

Different influenza viruses, including the pandemic influenza A (H1N1), SARS, avian influenza (H5N1) spread from infected people by air [7, 9-14].

MERS-CoV was first identified and reported in Saudi Arabia in September 2012. MERS-CoV acts like a cold virus and attacks the respiratory system, which can lead to pneumonia and kidney failure [19]. The infection can be spread from one person to another through respiratory secretions [19]. It is also known to be transmitted by air and thus it was one of the current challenges for Saudi Arabia's Ministry of Health for the 2014 Hajj. MERS-CoV was reported to cause the deaths of hundreds of people, especially in Saudi Arabia in 2013-2014, due to the lack of proper vaccines produced for these types of infections [15-18].

Vaccines do not only protect the immunized person. They prevent the spread of disease from person to person. Lacking proper drugs, treatment and vaccinations for any disease is the major challenge of any health organization in the world, because the success rate of controlling and managing the disease's spread to other people can be low when appropriate drugs, treatment and vaccinations for the targeted disease are unavailable.

The Hajj season in recent years has faced many kinds of health challenges due to the emergence of pandemic communicable diseases. The spread of communicable diseases especially the pulmonary diseases that count for a high percentage of communicable diseases is rapid and the number of infected people increases when they are crowded in a small area. Protecting around three million pilgrims crowded in a small area in Hajj season is a challenging task that needs planning and adequate health facilities that can serve pilgrims.

Disease control measures include the isolation of infected people, recommending and practicing personal hygiene, and implementing vaccinations to improve immunity. Other control measures include adopting sanitary and hygiene measures to control food and water-borne infectious agents to prevent infections and diseases. Taking care of regular hand hygiene by using soap and water, or an alcohol based hand sanitizer, avoiding close contact with sick people, and avoidance of touching one's eyes, nose and mouth can help reduce the spread of viruses.

The Saudi Ministry of Health has increased surveillance of pilgrims coming from endemic countries, based on the latest WHO reports to avoid future outbreaks. All suspected cases will be isolated at ports of entry. Moreover, pilgrims are not allowed to bring food items into the country [22].

To control and minimize the spread of diseases in Hajj season, Saudi Arabia's authorities have taken several measures including the requirements for vaccinations, if available against communicable diseases and issuing an embargo for air travel to countries affected by endemic communicable diseases both of which were shown to be effective during Hajj seasons. These measures were adopted effectively during the Hajj season of 2013, as the pandemic avian flu virus (H5N1) infected many people worldwide. Due to the Ebola epidemic disease occurrence in West African countries (Sierra Leone, Guinea and Liberia) in 2014, Saudi Authorities have banned the people from these countries from performing Hajj in 2014 [32].

The number of pilgrims during the Hajj of 2013 and 2014 was lower than in previous years due to the unprecedented expansion of the two holy mosques coupled with fear of introducing/spreading the deadly pandemic avian flu virus as shown in

(Fig. 1). These health measures are shown to be effective in lowering the number of fatalities among Hajj pilgrims and in preventing the spread of disease in Saudi Arabia. The number of fatalities among pilgrims is becoming lower year after year (Fig. 2).

For travelers to Saudi Arabia, it is necessary to follow all the instructions of health regulations, to take preventive measures before departing and during Hajj, to be safe and illness-free. Vaccination before travelling and at the port of entry can be taken for preventing several diseases including influenza, meningococcal disease (ACYW-135), Polio (mandatory for all pilgrims from countries or areas at risk), Pneumococcal disease, Rabies, Hepatitis B, Cholera, Typhoid, Tetanus and Yellow Fever. This vaccination should be mandatory for all pilgrims coming from countries or areas at risk.

Table 1 shows instructions that are given to pilgrims before starting Hajj season that should be available in different languages at ports.

TABLE 1 INSTRUCTIONS FOR PREVENTING COMMON ILLNESSES IN HAJJ [MODIFIED FROM 22 AND 31]

| Disease | Respiratory diseases: | Gastrointestinal Diseases: | Heat stroke and heat exhaustion: | Hepatitis, Vector-borne diseases & Ebola viruses |
|---------|---|--|---|--|
| | <ul style="list-style-type: none"> Wear mask, especially in crowded places, and replace it regularly. Wash hands with soap and water or disinfectant, especially after coughing and sneezing. Use disposable tissues when sneezing or coughing and then dispose in the trash. If there is no tissue, it is preferable to use your upper arm, not your hands. Do not touch your eyes, nose or mouth only after washing your hands well. Use handshakes only to greet others. Do not drink ice water or very cold water. Avoid direct exposure to the air conditioning when sweating. Take a rest and drink a lot of fluids containing vitamin C such as lemon, lime or orange juice. Take analgesics (pain killers) and antipyretics (drugs that reduce fever). Visit your doctor if you have severe symptoms. <p>MERS-CoV</p> <ul style="list-style-type: none"> Avoid close contact with all wild or farmed animals, such as bats and camels. Avoid consuming undercooked meat and unpasteurized dairy products such as raw camel milk. | <p>Diarrhea:</p> <ul style="list-style-type: none"> Stay away from meals that are high in fat. Ensure the cleanliness of food and that being cooked well. Intake a lot of fluids to avoid dehydration. Visit the nearest health center if the diarrhea continues without interruption. <p>Food poisoning in Hajj:</p> <ul style="list-style-type: none"> Wash your hands thoroughly before and after eating. Use of clean water, preferably bottled mineral water for drinking and cooking. In case you are not sure of the cleanliness of the water, it must be boiled before use. Do not drink tap water if not sure of the source. Consume only pasteurized milk and dairy products, and sealed juice packs. Check the validity date of canned goods. Ensure the preservation of easily spoiled food. Avoid eating perishable food such as meat, poultry and dairy products that has been left at dangerous temperature zone (above 5C ° and below 60C °) for more than 2 hours. Cook food thoroughly to kill germs. Avoid buying food from street vendors, and ensure the disposal of the rest of the food and not to store it. Wash fruits and vegetables. Use clean bowls and dishes, it's preferable to use paper dishes and cups. Remember that change in the food color, taste and smell are evidence of food spoiling and poisoning. | <ul style="list-style-type: none"> Drink adequate amounts of fluids. Avoid exposure to sunlight for long periods, and it is recommended to use good quality bright colored or white umbrellas. Avoid excessive stress on the body. Take enough rest after performing each rite as much as possible, to revitalize the body. | <p>Hepatitis</p> <ul style="list-style-type: none"> Ask your barber to wash his hands well with soap and water or use of sterile hand gel before shaving or cutting hair. Ensure the use of a single use razor. Do not share shaving equipment with others. Do not walk barefooted, to avoid injuries by sharp objects such as contaminated razors. <p>Vector-borne diseases</p> <ul style="list-style-type: none"> Practice insect bite avoidance measures. <p>Ebola viruses</p> <ul style="list-style-type: none"> People suspected of having Ebola virus disease should be encouraged to seek medical care. Home care of family members confirmed with Ebola infection is strictly not recommended. These individuals must seek professional health treatment. Use of infection-control measures, including complete equipment sterilization. For medical staff: wear protective clothing including masks, gloves, gowns, and goggles. |

III. RECOMMENDATIONS FOR IMPROVING PUBLIC HEALTH

There are several recommendations that can make Hajj season much safer and healthier. One of these recommendations is to implement non-contact infrared thermometers (NCITs) in all the airports, seaports and land ports in Saudi Arabia, to screen visitors' body temperatures during the Hajj season or throughout the year. Non-contact infrared thermometers have been

proven to be effective in screening people with high body temperature in major airports [33]. It is a fast method to screen people for infections as a common symptom for most of the infected people is high body temperature [19, 27-29]. This method can save time and lives if implemented effectively as it can detect the infected visitors to Saudi Arabia and allow for proper medications to be prescribed for those infected, and thus prevent the spread of disease.

Another recommendation is to create centers for disease control and prevention in Saudi Arabia, under the control of the Ministry of Health, to better control any emerging pandemic diseases in Saudi Arabia, and to hire medical experts in disease control and prevention. The availability of centers for disease control and prevention would facilitate the communications with other centers around the world, allowing for better detection of emerging pandemic diseases and faster treatments.

Offering small clinics with quarantine facilities at all the airports, seaports and land ports during Hajj season and for any pandemic disease that may emerge throughout the year would be helpful in checking visitors for symptoms to prevent the disease from spreading in the country. In a previous study, the author found that dust generated while pilgrims travel on foot between different ritual places remarkably increases the number of microorganisms in the air [34]. Introducing water misters along pedestrian paths can effectively control dust and thus lower the number of microorganisms carried by the air that are eventually breathed in by pilgrims.

Establishing a comprehensive Environmental Health Program is also recommended. This should encompass sanitary standards, close and regular monitoring of food and water suppliers, inspection of pilgrim accommodations and housing facilities, sanitary waste water and solid waste management, pest control, as well as health education and a medical facilities auditing program.

More research studies should be carried out to explore innovative ways for early detection of infectious disease thereby enhancing public health protection.

Saudi Arabia's government dedicates a large portion of its budget to serve the pilgrims and ensure a safe and a healthy Hajj season. Hajj is becoming safer each year, reflecting the efforts made to serve the pilgrims.

IV. CONCLUSION

Hajj season is no doubt a substantial challenge for Saudi authorities. A major international effort is required to provide the highest level of public health services during Hajj. The gathering of a huge number of pilgrims at one place needs special attention in terms of organizing effective strategies for health safety. Infectious diseases have been the focus of considerable attention worldwide because they do not recognize international boundaries. There is no fully effective treatment for new pandemic diseases, due to the lack of proper medications and vaccinations for these emerging diseases. The Ministry of Health in Saudi Arabia implemented regular updates about Hajj travel advice and health regulations for pilgrims in the past five years. The preventive measures recommended in this review can prevent the spreading of diseases during pilgrimage season.

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