

# WHO MERS-CoV Global Summary and risk assessment

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## Global summary

Between 2012 and 02 December 2016, 1841 laboratory-confirmed cases were reported to WHO, 80% of whom were reported by the Kingdom of Saudi Arabia (Figure 1). In total, cases have been reported from 27 countries in the Middle East, North Africa, Europe, the United States of America, and Asia. Since the last update, one new country, Bahrain, reported a case of MERS-CoV (Table 1). Since the last update [published in early July 2015](#), 473 laboratory-confirmed cases of MERS-CoV were reported to WHO (445 from Saudi Arabia, 16 from Jordan, 3 from Qatar, 3 from the United Arab Emirates, 2 from Thailand, 1 from Oman, 1 from Bahrain, 1 from Kuwait and 1 from Austria).

The epidemiology and transmission patterns of MERS-CoV are consistent with past patterns described in previous WHO risk assessments: MERS-CoV is a zoonotic virus that has repeatedly entered the human population via contact with infected dromedary camels in the Arabian Peninsula. Males above the age of 60 with underlying conditions are at a higher risk of infection and severe disease, including death. To date, at least 652 individuals have died (crude CFR 35%).

## MERS-CoV and health care –associated outbreaks

Since the last update, most of the cases reported from Saudi Arabia and all of the cases from Jordan were associated with nosocomial outbreaks, including an outbreak of more than 100 cases in a Ministry of the National Guard Health Affairs Hospital in Riyadh, Saudi Arabia, in the summer of 2015. All of the cases reported from Jordan were associated with nosocomial transmission in several hospitals in Amman in August-October 2015.

Transmission in health care settings in Saudi Arabia and Jordan is believed to have occurred before adequate infection prevention and control procedures were applied and cases were isolated.

Though not unexpected, these transmission events continue to be deeply concerning, given that MERS-CoV is still a relatively rare disease about which medical personnel in some health care facilities have little awareness. Globally, awareness for MERS-CoV is low, and because symptoms of MERS-CoV are non-specific, initial cases are sometimes easily missed.

These early cases, when occurring in health care facilities, can sometimes generate large numbers of secondary cases among health care workers and patients.

- The outbreak in the Republic of Korea (ROK) started in May 2015 – resulting from a single imported case with travel history in the Middle East and subsequent human-to-human transmission to close familial contacts, to patients who shared rooms/wards with infected patients and to health care workers providing care for patients before suspicion and diagnosis of MERS-CoV. It is similar to nosocomial outbreaks in other countries (e.g., Saudi Arabia and the United Arab Emirates). This outbreak, with a total of 186 MERS-CoV cases in more than 17 health care settings and including one case who travelled to China, is the largest outbreak reported outside of the Middle East. The last case associated with this outbreak died in November 2015. Several studies evaluating the role of environmental contamination during this outbreak seem to indicate that persistence of the virus on surfaces could have contributed to some of the transmission in hospitals.
- In August 2015, WHO was made aware of a large nosocomial outbreak in a National Guard Hospital in Riyadh, Saudi Arabia. This outbreak, which resulted in more than 100 cases, involved patients, family members and health care workers who were caring for or visiting MERS-CoV patients prior to their diagnosis. Human-to-human transmission is believed to have occurred in the emergency room prior to the patients' diagnosis of MERS and before control measures, including isolation and improved IPC, were implemented.
- A nosocomial outbreak in Jordan was reported to WHO in August 2015. At the time of notification, four cases were associated with a single health care facility in Amman. Between August-October 2015, a total of 16 laboratory-confirmed cases and nine hospitals were associated with this outbreak. A WHO Mission was conducted in September to support the Jordanian Ministry of Health in its investigation of this outbreak. Evidence suggests that human-to-human transmission occurred, possibly within the cardiac care units and intensive care units of two hospitals. All cases in this cluster are epidemiologically linked, but the reported link between some of the cases was weak (e.g., shared ward but no shared visitors, health care workers, or equipment). Genetic sequencing of the virus indicates that the isolates from Jordan were similar to isolates from Riyadh (Lamers et al EID 2016).

- In October 2015, a cluster of eight MERS-CoV cases was reported from an expatriate community in Riyadh, Saudi Arabia. The eight women were residents of a dormitory for approximately 800 expat women in very crowded conditions. The index case of this cluster was likely missed, and serologic study is underway by the Saudi Arabian Ministry of Health to evaluate the extent of and risk factors for infection. It is believed transmission occurred within the housing complex. Two additional female health care worker contacts were infected while caring for the first case identified in this outbreak before she was diagnosed with MERS-CoV. All cases survived.
- Smaller nosocomial outbreaks have been reported in several Saudi Arabia cities since the last update, including Riyadh and Medina, and seem to have been stopped quickly with the implementation of basic IPC measures.
- One of the most recent outbreaks in Saudi Arabia occurred in Riyadh in June 2016. In this outbreak, the majority of cases were asymptomatic and identified through rapid initiation of [contact tracing and testing of all healthcare and household contacts](#).

### Community-acquired cases – links to dromedary camels

All cases reported in United Arab Emirates (3), Qatar (3), Oman (1), Kuwait (1) and Bahrain (1) since the last update have links to dromedary camels and are believed to have been infected via direct or indirect contact with infected dromedaries or were close contacts of primary cases (as in the case of UAE).

Improvement in multi-sectoral investigation of community-acquired cases is evident, including testing of dromedary animals/herds in the vicinity of community-acquired cases and follow-up of human contacts of laboratory-confirmed cases.

### Exported cases – cases identified outside the Middle East

Since the last update, three cases were reported outside of the Middle East. The two cases identified in Thailand are believed to have been infected with MERS-CoV in the Middle East (one in Kuwait, one in Oman) and the one in Austria is believed to have been infected in Saudi Arabia.

### Summary – information available to date

Thus far, no sustained human-to-human transmission has occurred anywhere in the world. WHO continues to work

with health authorities in the affected countries. WHO understands that health authorities in affected countries, especially those in the most affected countries, are aggressively investigating cases and contacts and applying mitigation measures to stop human-to-human transmission in health care settings.

Of all reported laboratory-confirmed cases reported to date (n=1841), the median age is 52 (IQR 36-65; range >1-109 years old) and 65.6% are male.

At the time of reporting, 20.6% of the 1841 cases were reported to have no or mild symptoms while 19.9% had moderate symptoms and 47.5% had severe disease or died. Approximately 20% are reported to be health care workers.

Since 2012, 27 countries have reported cases of MERS-CoV infection, including countries in the Middle East: Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Oman, Qatar, the Kingdom of Saudi Arabia, United Arab Emirates and Yemen; in Africa: Algeria, and Tunisia; in Europe: Austria, France, Germany, Greece, Italy, the Netherlands, Turkey and the United Kingdom; in Asia: China, the Republic of Korea, Malaysia, Philippines and Thailand; and in North America: the United States of America (Table 1).

The majority of cases (approximately 80%) have been reported from Saudi Arabia (Figure 1).

Populations in close contact with dromedaries (e.g. farmers, abattoir workers, shepherds, dromedary owners) and health workers caring for MERS-CoV patients are believed to be at the highest risk of infection. Healthy adults tend to have mild subclinical or asymptomatic infection. To date, limited human-to-human transmission has occurred between close contacts of confirmed cases in household settings.

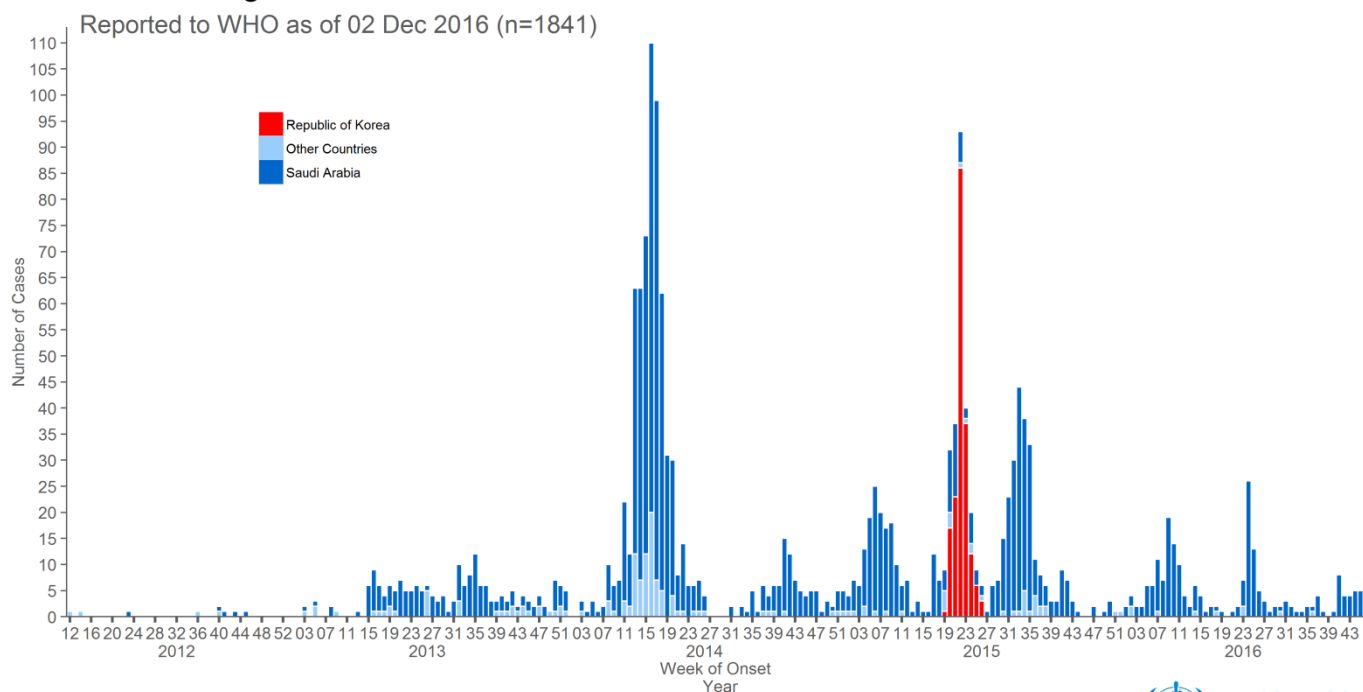
More efficient human-to-human transmission occurs in hospital settings due to inadequate and/or incomplete compliance with basic infection, prevention and control (IPC) measures and slow triage or isolation of suspected MERS patients.

Nosocomial transmission has been documented in several countries between 2012-2016, including Saudi Arabia, Jordan, United Arab Emirates, France, United Kingdom, and the Republic of Korea with varying outbreak sizes (2-180 reported cases per hospital).

The largest outbreak outside of the Middle East occurred in the Republic of Korea resulting in 186 cases (including one case who travelled to China) and 36 deaths (two additional deaths have been attributed to the patients' underlying conditions).

Overall, the reproduction number ( $R_0$ ) of MERS-CoV is <1 with significant heterogeneity in specific contexts. Specifically, outbreaks in hospitals can have  $R>1$ , but they can be brought under control ( $R<1$ ) with application of basic IPC measures and early isolation of subsequent cases.

## Confirmed global cases of MERS-CoV



Other countries: Algeria, Austria, Bahrain, China, Egypt, France, Germany, Greece, Iran, Italy, Jordan, Kuwait, Lebanon, Malaysia, Netherlands, Oman, Philippines, Qatar, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States of America, Yemen  
Please note that the underlying data is subject to change as the investigations around cases are ongoing. Onset date estimated if not available.



Figure 1. Epidemic curve of MERS-CoV human cases as of 2 December 2016

\*\*Red= Republic of Korea; blue = Saudi Arabia; light blue = all other countries reporting MERS-CoV cases to date including Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Oman, Qatar, United Arab Emirates, Yemen, Algeria, Tunisia, Austria, France, Germany, Greece, Italy, the Netherlands, Turkey, the United Kingdom, China, Malaysia, Philippines, Thailand, and the United States of America

Table 1. Number of laboratory-confirmed MERS-CoV cases reported by countries by year since 2012\*

Country reporting	Number of laboratory Confirmed MERS-CoV Cases reported
Algeria	2
Austria	2
Bahrain	1
China	1
Egypt	1
France	2
Germany	3
Greece	1
Iran	6
Italy	1
Jordan	28
Kuwait	4
Lebanon	1
Malaysia	1
Netherlands	2
Oman	7
Philippines	2
Qatar	16
Republic of Korea	185
Saudi Arabia	1482
Thailand	3
Tunisia	3
Turkey	1
United Kingdom	4

United Arab Emirates	79
United States of America	2
Yemen	1
Total	1841

\*Data as of 2 December 2016

## WHO MERS-CoV activities and guidance

- On 27 July 2015, WHO updated guidance on the management of asymptomatic persons who are RT-PCR positive for MERS-CoV. The clinical spectrum of MERS-CoV infection ranges from asymptomatic infection to severe pneumonia with acute respiratory distress syndrome (ARDS) and other life-threatening complications. This document provides a standardized approach for public health authorities and investigators at all levels to plan for and conduct investigations around confirmed and probable cases of MERS-CoV infection. It should be read in conjunction with other detailed guidance referenced throughout the text, such as current laboratory testing guidelines and study protocols. It will be updated as necessary to reflect increased understanding of MERS-CoV transmission and control. Available here: [http://www.who.int/csr/disease/coronavirus\\_infections/management\\_of\\_asymptomatic\\_patients/en/](http://www.who.int/csr/disease/coronavirus_infections/management_of_asymptomatic_patients/en/)
- On 23 August 2015, WHO conducted a mission to the Kingdom of Saudi Arabia to meet with senior officials from the Ministry of Health and to better understand a large outbreak caused by MERS-CoV that involved at least two hospitals in Riyadh City. In addition to better understanding the scope and basis for the outbreak, the objectives of the mission included providing guidance on public health control measures undertaken by the government.
- The Ministry of Health of Jordan requested technical assistance from WHO to advise it and assist with the investigation of an ongoing MERS outbreak in the country that began in August 2015. A mission of international experts from WHO HQ/EMRO/Country office, Institut Pasteur, Erasmus Medical Center, European Centre for Disease Prevention and Control, and the University of Toronto took place in Amman from 20-22 September 2015. The technical team met with Jordanian Ministry of Health staff, staff of three affected hospitals, the Ministry of Agriculture and others to evaluate the epidemiological situation and advise on activities to control the outbreak.
- The tenth meeting of the Emergency Committee (EC) convened by the Director-General under the International Health Regulations (2005) regarding MERS-CoV was held by teleconference on 2 September 2015. During the meeting, the WHO Secretariat updated the Committee on epidemiological and scientific developments, including recent cases and transmission patterns in Saudi Arabia, Jordan and the United Arab Emirates. The Secretariat also provided current risk assessments with regard to these events, and information on control and prevention measures. The statement from the EC can be found:

<http://www.who.int/mediacentre/news/statements/2015/ih-r-emergency-committee-mers/en/>

- In January 2016, with the support of the Ministry of Health of KSA, WHO organized a mission to Riyadh to review the ongoing MERS-CoV situation in Saudi Arabia and discuss progress in the country's implementation of previous mission recommendations. The multi-disciplinary, international mission included individuals from WHO HQ, WHO EMRO, WHO KSA Country office, Institut Pasteur, University of Bonn, Mount Sinai Hospital Toronto, University of Hong Kong, Public Health England, the US Centers for Disease Control and Prevention and the European Centre for Disease Prevention and Control. The mission found that Saudi Arabia made considerable progress in the last year in developing a coordinated public health response, including improvements in joint animal and human health investigations of community-acquired cases; learning from and responding to health care-associated outbreaks; identifying research priorities and coordinating research studies to address critical unknowns; improving laboratory capacity; and managing and coordinating intersectoral MERS-CoV activities.

## Risk assessment

WHO is continuing to work with ministries of health in all affected countries, and with international partners, to better understand transmission patterns and risk factors of MERS-CoV infection in community and health care settings and to develop measures to prevent human infections. WHO's global risk assessment of MERS-CoV remains unchanged from the last publication, on 7 July 2015.

The cases reported to WHO since the last risk assessment have largely been associated with transmission in health care settings. All other reported cases have reported links to dromedary camels.

The continued occurrence of nosocomial outbreaks is deeply concerning and is the result of low awareness and early suspicion of MERS-CoV infections in many countries. The non-specificity of MERS-CoV symptoms complicates surveillance activities for MERS, often resulting in early missed cases, including the index case in outbreaks, and thereby providing the opportunity for human-to-human transmission in health care settings.

Investigations into transmission within health care facilities are ongoing in Saudi Arabia, Jordan and the Republic of Korea. Secondary cases have reported varying levels of contact with confirmed patients, ranging from direct contact (e.g., health care workers providing direct care to MERS patients before diagnosis with MERS) to no clear contact (e.g., patients sharing wards with MERS patients, but without sharing health care workers or rooms). At present,

it is unclear what exposures result in transmission of the virus in health care settings or what the role of environmental contamination may play in such transmissions. Several studies from the Republic of Korea have identified MERS-CoV virus on surfaces inside patient rooms and on equipment during patient stays and after discharge or death. These findings highlight the importance of adequate disinfection of patient rooms.

WHO has updated its surveillance guidance for MERS-CoV and has specifically stated that any individuals presenting with respiratory symptoms who have recently visited the Middle East must be asked whether they have visited any health care facility there or had any direct or indirect contact with dromedary camels.

WHO stresses that it is a person's activities and exposures while in the Middle East that are relevant for MERS-CoV rather than the fact that he or she may have visited a particular country. The movement of patients between hospitals within countries and between countries for treatments and/or surgery (medical tourism) complicates the epidemiologic picture. Genetic sequencing of samples collected from MERS-CoV patients should be a routine part of investigations into MERS-CoV clusters to better understand transmission patterns between patients and to help identify the source of the infection.

[WHO, since July 2015, recommends](#) that in documented cases of human-to-human transmission in a health care setting, all health care contacts (e.g., health care workers and patients sharing space with a confirmed case), household contacts, and social contacts should be tested for MERS-CoV, regardless of whether they display symptoms. Among contacts who are at the highest risk of infection are those who were in direct physical contact with the patient or the patient's biological fluids before MERS-CoV was diagnosed (e.g., treating physicians, health care professionals who performed intubation, cleaning staff). For these people, multiple specimens, including lower-respiratory specimens, should be collected and tested for MERS-CoV until the 14-day incubation period passes.

In 2016, the epidemiologic patterns of MERS-CoV remain the same: multiple introductions from dromedary camels in the Middle East to humans and secondary transmission in health care settings. Transmission among close family members within households remains limited for unclear reasons. What is different, however, is that the hospital outbreaks in the Middle East are occurring more frequently and, often, though not always, are small in size and can affect several hospitals. The large outbreaks in Jeddah/Riyadh in 2014, in the Republic of Korea in June 2015 and in Riyadh in August 2015, remind us that MERS-CoV, if not adequately controlled, can cause explosive outbreaks with substantial socio-economic consequences.

Until zoonotic transfer of the virus from infected dromedary camels into the human population is halted, the risk remains that further nosocomial outbreaks in the Middle East and beyond will occur. The repeated and ongoing hospital outbreaks in the Middle East are concerning and more work is needed to better understand the reasons behind these outbreaks. Cases have been exported to a number of countries outside of the Middle East and could happen again

anywhere. The combination of factors that has previously [been described](#) illustrates that low awareness and the inability to rapidly limit exposure to MERS-CoV patients can lead to large outbreaks.

The WHO Missions to affected countries have provided an opportunity to fully evaluate the ongoing challenges to tackling MERS-CoV. Control of MERS-CoV requires national leadership, coordination between animal and human sectors (and others), public trust, frequent and clear communication to all hospitals and hospital staff on measures to limit human-to-human spread, thorough investigation of all cases, and rapid dissemination of knowledge gained during outbreak investigations and research on MERS. WHO is pleased that affected countries have improved their responses to MERS-CoV and encouraged by the sharing of information on individual MERS-CoV cases and investigations of clusters.

### Have MERS-CoV transmission patterns changed?

There is no evidence of sustained human-to-human transmission in the community nor is there evidence of airborne transmission from all information available from recent MERS-CoV cases.

Therefore, the overall transmission patterns previously observed remain unchanged. WHO bases this assessment on the evidence that:

1. The clinical picture seen in recent outbreaks appears to be similar to that observed throughout previous outbreaks; secondary cases in the absence of comorbidities tend to present with milder disease than primary cases, and many of the recently reported secondary cases have been mild, or were people whose tests were positive for MERS-CoV but were reported to be asymptomatic;
2. The cases recently exported to countries outside the Middle East have not resulted in sustained onward transmission to persons in close contact with these cases in the community; this is true for all affected countries, including Austria, the Philippines, Thailand, the Republic of Korea and China;
3. Intensive screening of MERS-CoV contacts has revealed very few instances of household transmission and there has been no transmission identified thus far on airplanes or other forms of transportation;
4. There has been no increase in the size or number of observed household clusters; and
5. While there is variation of the reproduction number in different settings, the overall reproduction number of MERS-CoV is less than 1. The reproduction number can be higher in health care settings, as has been seen in several nosocomial outbreaks in Saudi Arabia and Korea. Experiences in Saudi Arabia, the United Arab Emirates, China, Austria and Thailand have shown that the reproduction number can be brought to below one with early isolation of cases and adequate infection prevention and control measures.

## Can we expect additional cases of MERS-CoV infection in the Middle East? And can we expect additional cases exported to other countries?

WHO expects that additional cases of MERS-CoV infection will be reported from the Middle East, and that cases will continue to be exported to other countries by individuals who might acquire infection after exposure to an animal (for example, while visiting farms or markets or consuming raw dromedary products --e.g. milk, urine) or human source (possibly in a health care setting for planned or emergency treatment).

Until more is understood about mode of transmission and risk factors for infection, cases resulting from zoonotic transmission will continue to occur, and will eventually lead to limited community transmission within households and possibly significant hospital-associated outbreaks such those seen in the Republic of Korea and Saudi Arabia. Consistent application of adequate infection-prevention and -control measures has been used to end transmission in previous clusters.

Investigation into the exported cases who reported performing Umrah in Saudi Arabia revealed that all of them had visited a health care facility, had come into contact with camels or had consumed raw camel products while in Saudi Arabia.

## Recommendations

A number of epidemiologic investigations into the transmission patterns of MERS-CoV have been conducted and published and more studies are planned/underway. WHO hopes that these investigations can be shared with affected countries dealing with MERS-CoV and published quickly. The most urgent needs remain: a better understanding of how humans become infected from animal or environmental source(s) in the community; identification of risk factors for infection from humans or the environment in occupational settings and health care settings; and enhancement of community studies and surveillance for community-acquired pneumonia. Collaboration between human and animal health sectors in affected countries is essential to understanding the risk of transmission of MERS-CoV between animals and humans, whether there is any seasonal variation in the circulation of the virus in animals and the natural reservoir(s) of MERS-CoV. It is also important to work towards limiting the spread of infection in animal populations (through development of vaccines and better management of infected animals/herds) so as to reduce the opportunity for further human exposure.

In addition, a better understanding of transmission in health care settings, especially the exposures that result in human-to-human transmission, the potential role of asymptomatic PCR-positive health care workers and the possible role of environmental contamination, is urgently needed.

Enhancing infection prevention and control awareness and implementation measures is critical to preventing the possible spread of MERS-CoV in health care facilities. It is

not always possible to identify patients with MERS-CoV early because some have mild or non-specific symptoms. For this reason, it is important that all health care facilities establish and implement clear triage policies for rapid screening and assessment of potential MERS-CoV cases and all cases with acute respiratory symptoms. It is also important that health care workers apply standard precautions consistently with all patients, regardless of their diagnosis, in all work practices -- all the time. Droplet precautions should be added to the standard precautions when providing care to any patient with symptoms of acute respiratory infection.

Health care facilities that provide care for patients suspected or confirmed to be infected with MERS-CoV should take appropriate measures to decrease the risk of transmission of the virus from an infected patient to other patients, health care workers and visitors. These measures involve interventions at the patient-carer interface and other general measures such as linen management, cleaning and disinfection and waste management. Contact precautions and eye protection should be added when caring for probable or confirmed cases of MERS-CoV infection, and airborne precautions should be applied when performing aerosol-generating procedures. Hospital cleaning staff should also be informed of and trained to take proper precautions when cleaning rooms of MERS-CoV patients.

Until more is understood about MERS, people at high risk of developing severe disease (any person who is older, has diabetes, renal failure, chronic lung disease, or is immunocompromised), should take precautions when visiting farms or markets where dromedary camels are present (especially in the Middle East and Africa). These precautions include: avoiding contact with camels; not drinking raw camel milk or camel urine; and not eating camel meat that has not been thoroughly cooked.

Recently published studies in Qatar, Saudi Arabia and the United Arab Emirates indicate that people handling or working with dromedary camels in these countries are at increased risk of infection with MERS-CoV compared with people who do not have contact with camels. Until more evidence is gathered, it would be prudent for camel farm workers, slaughterhouse workers, market workers, veterinarians and anyone else handling dromedary camels to practice good personal hygiene, including frequent hand hygiene. Hands should be washed with soap and water and/or alcohol gel after every contact with an animal. Workers should wear facial protection where feasible; protective clothing that should be removed after work (followed by hand hygiene) and washed daily.

Workers should avoid exposing family members to soiled work clothing, shoes, or other items that may have come into contact with camel secretions and excretions. These clothes and other items should remain at the workplace for daily washing and workers should have access to and use shower facilities at their workplaces before leaving the premises.

Dromedary camels infected with MERS-CoV may not show any signs of infection. It is therefore not possible to know whether an animal on a farm, in a market, race track or slaughterhouse is excreting MERS-CoV that can potentially

infect humans. However, infected animals may shed MERS-CoV through nasal and eye discharge, faeces, and potentially in their milk and urine. The virus may also be found in the raw organs and meat of infected animals. Therefore, until more is known about infection in animals, the best protection is to practice good hygiene and avoid direct contact with all of these. Obviously sick animals should never be slaughtered for consumption; dead animals should be safely buried or destroyed.

Unless protected, people should avoid contact with any animal that has been confirmed positive for MERS-CoV until subsequent tests have confirmed that the animal is free of the virus.

Health officials in countries outside of the affected region should maintain a high level of vigilance, especially those in

countries with large numbers of travellers or migrant workers returning from the Middle East. Surveillance should continue to be enhanced in these countries according to WHO guidelines, along with infection-prevention and control procedures in health care facilities. WHO continues to request that Member States report all confirmed and probable cases along with information about their exposures, testing, and clinical course to inform the most effective international preparedness and response.

WHO does not advise special screening at points of entry with regard to MERS nor does it currently recommend the application of any travel or trade restrictions.

WHO guidelines and tools on epidemiologic investigations can be found at [http://www.who.int/csr/disease/coronavirus\\_infections/technical-guidance-surveillance/en/](http://www.who.int/csr/disease/coronavirus_infections/technical-guidance-surveillance/en/).

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