Between 2012 and 17 October 2022, 2600 laboratory-confirmed cases of Middle East respiratory syndrome coronavirus (MERS-CoV) infection have been reported to WHO, of which 84% (2193/2600) have been reported by the Kingdom of Saudi Arabia. Cases of MERS have been reported from 27 countries in the Middle East, North Africa, Europe, the United States of America, and Asia. To date, 935 MERS deaths have been reported to WHO (crude case fatality rate: 36%).

Recent MERS cases reported to WHO

Since the last global update published in July 2019, 148 laboratory-confirmed cases of MERS-CoV from four countries were reported to WHO (135 from Saudi Arabia, 6 from the United Arab Emirates, 6 from Qatar, 1 case from Oman), of whom 53 (35%) have died (51 from Saudi Arabia and 2 from Qatar). Among these 148 cases, 125 (84.5%) were male and the median age was 58 years (IQR 44-70; range 23-98 years). In addition, three cases of MERS from 2017 were retrospectively reported to WHO from Qatar, including one death.

Since the last update, around 81% (120/148) of cases reported at least one underlying condition, including conditions such as chronic renal failure, heart disease, diabetes mellitus, and hypertension. At the time the cases were reported to WHO, 8 of the 148 (5%) cases detected since the last update in July 2019 were asymptomatic or had mild disease. The proportion of those with asymptomatic infection or mild disease at the time of reporting is lower than the 22% of cases that were asymptomatic or had mild disease at the time of reporting in the previous global summary for MERS published in July 2019. However, this likely reflects reductions in testing and case detection as a result of the ongoing COVID-19 pandemic, rather than any change in virulence.

Overall, the epidemiology, transmission patterns, clinical presentation of MERS patients and viral characteristics reported since the last update in 2019 are consistent with past patterns described in previous WHO global summaries and assessment of risk. That is, MERS-CoV is a zoonotic virus that has repeatedly entered the human population via direct or indirect contact with infected dromedary camels in the Arabian Peninsula. Human-to-human transmission has occurred among close contacts and in health care settings. Outside the health care setting, there has been limited human-to-human transmission.

Impact of ongoing COVID-19 pandemic on detection and reporting of MERS cases to WHO

The number of MERS cases reported to WHO has substantially declined since the beginning of the COVID-19 pandemic. This is likely the result of epidemiological surveillance activities for COVID-19 being prioritised, resulting in reduced testing and detection of MERS-CoV. Measures to reduce SARS-CoV-2 transmission (e.g. mask wearing, hand hygiene, physical distancing, improving ventilation of indoor spaces, respiratory etiquette, stay-at-home orders, reduced mobility) also likely reduce opportunities for onwards human-to-human transmission of MERS-CoV. However, circulation of MERS-CoV in dromedary camels is not likely to have been impacted by the measures introduced to limit SARS-CoV-2 transmission. Therefore, while the number of reported secondary cases of MERS has been reduced, the risk of zoonotic transmission remains.

WHO expects that additional cases of MERS-CoV infection will be reported from the Middle East, especially as epidemiological surveillance activities for MERS-CoV resume, and that cases will continue to be exported to other countries by individuals who might acquire the infection after exposure to dromedaries, animal products (for example, consumption of camel’s raw milk), or humans (for example, in a health care setting). Therefore, early identification of cases in the community and in health care systems, increasing public knowledge about MERS-CoV and ways to prevent infection and transmission among at risk groups, adherence with the infection prevention and control measures and contact follow up remain major priorities for MERS outbreak prevention and control.

Recent clusters of MERS-CoV infections

Since the last update published in July 2019, several small MERS clusters were reported to WHO, including the following:

- In August 2019, a household cluster of 2 cases was reported in Riyadh city, Saudi Arabia. Both patients were hospitalised, but discharged after recovery.

- In September-October 2019, there were two suspected nosocomial clusters, each of 2 cases reported in Abha city and in Wadi Aldwasir city, Saudi Arabia. In both clusters, a patient was admitted to hospital where MERS diagnosis was made. Following
In November 2019, a household cluster of 3 cases was reported in Doha, Qatar – this included the son and housekeeper of the suspected primary case. All patients were hospitalised, including two asymptomatic patients placed in an isolation ward, but discharged after recovery.

In December 2019, there was a suspected nosocomial cluster of 2 cases reported in Abha city, Saudi Arabia. A HCW was admitted to where MERS diagnosis was made. Following this, another HCW that provided care to the patient subsequently tested positive for MERS-CoV. There were no fatalities.

In May 2020, a nosocomial cluster of 5 cases was reported in Alkharij city, Saudi Arabia. A patient was admitted to hospital where MERS diagnosis was made. Following this, 5 other cases were identified, including 4 patients and 1 HCW. The suspected primary case and three patients died.

**Zoonotic transmission of MERS-CoV**

Improvements in multi-sectoral investigations of community-acquired cases are evident, including testing of dromedary camels/herds in the vicinity of community-acquired laboratory-confirmed cases and follow-up of human contacts of laboratory-confirmed cases. Typically, Ministries of Health in affected countries notify the Ministries of Agriculture when human cases report an exposure or potential link to dromedary camels through occupational, recreational, husbandry or other contact. Investigations in dromedaries are carried out by officials from the Ministries of Agriculture and results, if positive for MERS-CoV, are reported to WOAH.

Results of laboratory testing of dromedary camels in affected countries is available from WOAH, as is technical guidance on the diagnostic tests to be used.

**Human-to-human transmission of MERS-CoV**

To date, all available information from reported cases detected through molecular and serologic testing indicates that human-to-human transmission remains limited. Most human-to-human transmission has occurred in health care facilities, and this remains a prominent feature of the epidemiology of MERS-CoV. WHO continues to work with health authorities in the affected countries to prevent and minimize health care-associated cases and improve infection prevention and control measures in all health facilities in affected areas. To date, MERS remains a relatively rare disease for which medical personnel in health care facilities, even in the Middle East, generally have low awareness. In addition, as symptoms of MERS-CoV infection are non-specific ranging from no symptoms to pneumonia and acute respiratory distress syndrome, initial cases presenting with mild respiratory signs and symptoms are sometimes easily missed.

Drivers of transmission and the exact modes of transmission in health care settings still are not well defined and are the focus of active collaborative scientific research in the affected countries. From observational studies, transmission in health care settings is believed to have occurred before adequate infection prevention and control procedures were applied and before cases were isolated. Numerous investigations at the time of the nosocomial outbreaks indicate that aerosolizing procedures conducted in crowded emergency departments or medical wards with sub-optimal infection prevention and control measures in place have resulted in human-to-human transmission and environmental contamination. With improved compliance to infection prevention and control measures in affected countries, human-to-human transmission in health care facilities can be reduced and possibly eliminated with the use of transmission-based precautions.

**Global summary of MERS cases since 2012**

Of the 2600 laboratory-confirmed cases reported to WHO since 2012, the median age is 53 years (IQR 38-66 years) and 1804 (69%) are male. At the time of reporting, around 20% (518/2600) of cases had no or mild symptoms, while 48% (1259/2600) had severe disease or died. 53% (1388/2600) cases reported to WHO also reported having at least one of the following underlying conditions: diabetes mellitus, hypertension, heart disease, chronic renal failure or lung disease. Over 70% of fatal MERS cases had at least one of these underlying conditions.

Since 2012, 27 countries have reported cases of MERS-CoV infection. In the Middle East: Bahrain, Egypt, Islamic Republic of Iran, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen; in Europe: Austria, France, Germany, Greece, Italy, the Netherlands, Türkiye and the United Kingdom; in Asia: China, the Republic of Korea, Malaysia, the Philippines and Thailand; and in the Americas: the United States of America (Table 1). The majority of cases (2193/2600, 84%) have been reported from Saudi Arabia (Table 1).

Based on available data, populations in close contact with dromedary camels (e.g. farmers, abattoir workers, shepherds, dromedary owners) and health care workers caring for MERS-CoV patients are at higher risk of MERS-CoV infection. Health care-associated transmission has been documented in several countries between 2012-2016, including Saudi Arabia, Jordan, the United Arab...
Emirates, France, the United Kingdom, and the Republic of Korea with varying outbreak sizes (2-180 reported cases per outbreak). Among the 2600 MERS cases reported to WHO to date, at least 17% (454/2600) have been health care workers.

The largest outbreak outside of the Middle East occurred in the Republic of Korea in 2015 resulting in 186 cases (including one case who travelled to China) and 39 deaths. An exported case to the Republic of Korea in September 2018 did not result in further human-to-human transmission. This was likely attributable to early suspicion of MERS-CoV infection, immediate isolation, clinical management of the patient upon his return from Kuwait and thorough contact tracing.

Overall, the reproduction number ($R_0$) of MERS-CoV is <1 with significant heterogeneity in specific contexts. Within health care settings, the reproduction number can be above 1, but outbreaks can be brought under control ($R<1$) with proper application of infection prevention and control measures and early isolation of subsequent cases.1

Figure 1. Confirmed MERS cases reported to WHO as of 17 October 2022 (N=2591*)

*At the time of publishing, the date of symptom onset was not available for 9 cases.

**Symptomatic cases are plotted by date of symptom onset; asymptomatic cases are plotted by date of notification to WHO.

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

Table 1. Number of laboratory-confirmed MERS cases reported by countries, since 2012

<table>
<thead>
<tr>
<th>Country reporting</th>
<th>Number of confirmed MERS-CoV cases reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>2</td>
</tr>
<tr>
<td>Austria</td>
<td>2</td>
</tr>
<tr>
<td>Bahrain</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
</tr>
<tr>
<td>Egypt</td>
<td>1</td>
</tr>
<tr>
<td>France</td>
<td>2</td>
</tr>
<tr>
<td>Germany</td>
<td>3</td>
</tr>
<tr>
<td>Greece</td>
<td>1</td>
</tr>
<tr>
<td>Islamic Republic of Iran</td>
<td>6</td>
</tr>
<tr>
<td>Italy</td>
<td>1</td>
</tr>
<tr>
<td>Jordan</td>
<td>28</td>
</tr>
<tr>
<td>Kuwait</td>
<td>4</td>
</tr>
</tbody>
</table>


-3-
Impact of MERS on COVID-19 pandemic

Since the first reported cases of SARS-CoV-2 in late 2019 and the significant disruptions caused by the ongoing COVID-19 pandemic, many of the activities of Ministries of Health in affected countries, and technical partners around the world have been redirected from MERS to COVID-19. However, one of the successes of the WHO Global Program of Work for MERS-CoV and the Public Health Research Agenda for MERS has been the way it has informed the response to COVID-19, particularly in the beginning of the pandemic.

In many countries, this program of work has provided a critical foundation for response to COVID-19 activities, enabling early informed actions by Member States and WHO. For example:

- Expert networks for MERS-CoV including laboratory, infection prevention and control, mathematical modelling and clinical care networks were rapidly utilized for COVID-19;
- Reference laboratories for MERS-CoV were leveraged, particularly in the early stages of the pandemic, to provide laboratory support and confirmatory testing for affected countries;
- Technical guidance documents, training materials, commodity packages, assessment tools and checklists developed for MERS-CoV were used to inform initial technical guidance documents and information products for COVID-19;
- Standardized seroepidemiological protocols developed for MERS-CoV were quickly adapted for COVID-19 and implemented across many countries to rapidly understand extent of infection, risk factors for infection and identify key epidemiologic parameters of SARS-CoV-2.

Recent WHO MERS activities

The following describes the MERS activities by WHO since the publication of the last global update from July 2019:

- In September 2019, WHO officials conducted a technical mission to the Kingdom of Saudi Arabia to meet with senior officials responsible for MERS-CoV surveillance, case management, infection prevention and control, data collection and analysis, data base management and training. The Ministry of Health also arranged for a joint informal meeting with Ministry of Agriculture officials to discuss their ongoing surveillance and research activities in dromedary camel populations. The meetings have helped to outline WHO technical support for national activities on MERS-CoV surveillance and epidemiological activities in Saudi Arabia.

- In January 2021, a WHO Collaborating Centre for MERS was designated in the Kingdom of Saudi Arabia. The functions of the WHO Collaborating Centre for MERS include the development of MERS technical guidance, conducting MERS research and the development of training materials for MERS.

- In August 2021, the WHO Regional Office for the Eastern Mediterranean (EMRO) convened a virtual meeting on MERS. The meeting provided the opportunity to review the MERS situation across the EMRO Region in the context of the ongoing COVID-19 pandemic and discussed the current situation of human MERS surveillance and the impact of the MERS on COVID-19 pandemic preparedness and response activities. Participants included representatives from Ministries of Health, academia, research institutions, and partner organizations.

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lebanon</td>
<td>2</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2</td>
</tr>
<tr>
<td>Oman</td>
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<tr>
<td>Philippines</td>
<td>2</td>
</tr>
<tr>
<td>Qatar*</td>
<td>28</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>186</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>2193</td>
</tr>
<tr>
<td>Thailand</td>
<td>3</td>
</tr>
<tr>
<td>Tunisia</td>
<td>3</td>
</tr>
<tr>
<td>Türkiye</td>
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</tr>
<tr>
<td>United Arab Emirates</td>
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</tr>
<tr>
<td>United Kingdom</td>
<td>5</td>
</tr>
<tr>
<td>United States of America</td>
<td>2</td>
</tr>
<tr>
<td>Yemen</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2600</strong></td>
</tr>
</tbody>
</table>

*Includes 3 cases from (year) that have been retrospectively reported to WHO
In November 2021, the FAO-WHO-WOAH tripartite convened a virtual **Global Technical Meeting on MERS-CoV and Other Emerging Zoonotic Coronavirus**s with attendance from affected and at-risk countries, academia, research institutions, partner organizations, donors and others. The meeting provided the opportunity to review the MERS situation globally, the impact of the ongoing COVID-19 pandemic and ways to recommence and integrate preparedness and response activities for MERS.

In September 2022 WHO officials conducted a technical mission to the Kingdom of Saudi Arabia to review the MERS situation within the context of the ongoing COVID-19 pandemic and its impact on MERS surveillance, preparedness and response activities. Field sites were visited and recommendations were proposed to strengthen surveillance, preparedness and response systems and capabilities. Collaborative work between WHO and the Kingdom of Saudi Arabia, including the role of the Public Health Authority as a WHO Collaborating Center (CC) for MERS, were discussed and agreed upon.

EMRO has developed an operational framework for integrated respiratory disease surveillance in which MERS is one of the priority viruses to be included in existing influenza sentinel surveillance systems.

WHO continues to support filed-based epidemiological studies at the animal-human interface to evaluate the extent of MERS-CoV infection in individuals with occupational exposure to dromedary camels. Since July 2019, studies have been completed in Pakistan and Somalia in collaboration with Ministries of Health and other technical partners.

**Risk assessment**

WHO continues to work with Ministries of Health in all affected and at-risk 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 improved measures to prevent human infections. Despite a reduction in human case detection, MERS-CoV is circulating in dromedary camels across large parts of the Middle East and Africa² and WHO’s global risk assessment of MERS remains unchanged from the last publication in July 2019.

Since early 2020, epidemiological surveillance activities have been prioritised for COVID-19, resulting in substantially reduced testing and therefore reduction of detection of MERS cases. In addition, the non-specificity of MERS symptoms complicates surveillance activities for MERS-CoV, often resulting in early cases that may be missed, including the index case of each spillover event, in outbreaks and thereby providing the opportunity for human-to-human transmission in health care settings. WHO continues to recommend and work with Member States and partners to place much more emphasis on improving standard IPC measures in all health care facilities.

Investigations and scientific studies continue to evaluate transmission within health care facilities and more comprehensive scientific studies are underway to better understand the drivers of transmission, including studies of surface and air survival and persistence. Secondary cases have reported varying levels of contact with confirmed patients, ranging from direct contact (e.g., health care workers providing direct care to infected patients before diagnosis with MERS) to no clear contact (e.g., patients sharing wards with infected patients, but without sharing health care workers or rooms). At present, it is unclear which 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 cleaning and disinfection of patient rooms.

WHO continues to review and update, as necessary, all WHO information products and guidance materials. WHO will continue to update all guidance materials for MERS and updates are done in collaboration with our international partners and posted online once available. The latest updates are listed in the section above.

WHO stresses that it is a person’s activities and exposures in an affected country that are relevant for MERS-CoV exposure 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 plays a critical role in understanding transmission and virus evolution and sequencing of samples collected from confirmed patients should be a routine part of investigations into MERS-CoV clusters to further our understanding of transmission patterns between patients and to help identify the source of the infection.

Since July 2015, WHO advises 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 higher risk of infection are those who are 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 whenever possible, should be collected and tested for MERS-CoV within the 14-day

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incubation period. WHO encourages full genome sequencing be conducted routinely when cases are identified in humans in contact with dromedary camels, as well as when clusters of cases/outbreaks in human populations occur.

Since the last update, there have continued to be sporadic introductions from dromedary camels into the human population in the Middle East. Detection of secondary human-to-human transmission in health care settings and household settings has been noticeably reduced. Nonetheless, the large outbreaks in Jeddah/Riyadh in 2014, in the Republic of Korea in June 2015 and in Riyadh in August 2015, demonstrate that MERS-CoV, if not adequately controlled, can cause explosive outbreaks with substantial health and socio-economic consequences. Human-to-human transmission and large outbreaks of MERS can be prevented with early suspicion, case isolation and clinical management.

Until zoonotic transmission of the virus from infected dromedary camels into the human population is halted, the risk of human infections, each posing a risk of further spread, particularly in health care settings, remains. WHO advocates for the development of dromedary vaccines to prevent human infection. WHO is committed to better understand the geographic extent of MERS-CoV infection in dromedary camel and human populations, as well as the spillover risk, and is funding studies at the dromedary camel-human interface in a number of countries in Africa, the Middle East and South Asia. WHO also highlights the importance of testing and genomic sequencing of MERS-CoV and SARS-CoV-2 given the intense circulation of SARS-CoV-2 globally and the potential for recombination of coronaviruses (i.e. creating a novel virus that combines genetic materials from two different viruses affecting the same host cell at the same time). During a FAO-WHO-WOAH Global technical meeting on MERS-CoV and other emerging zoonotic coronaviruses in 2021, experts suggested that MERS-CoV recombination with SARS-CoV-2 is a remote possibility. Field investigations into this possibility are underway and surveillance systems should be set up so that recombinants can be detected in a timely manner in areas where both viruses circulate.

Control of MERS-CoV, as for any other zoonotic coronavirus, requires national leadership, coordination between animal and human sectors (and others) using a One Health approach, public trust, frequent and clear communication to all hospitals and hospital staff on measures to limit human-to-human transmission, thorough investigation of all cases and rapid dissemination of knowledge gained during outbreak investigations and research on MERS-CoV. WHO is working closely with FAO and WOAH to better understand MERS-CoV dynamics at the animal-human interface through a One Health approach.

**Have MERS-CoV transmission patterns changed?**

While there is human-to-human transmission detected among some close contacts of confirmed MERS patients, there continues to be no evidence of sustained human-to-human transmission in the community.

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: males above the age of 60 years with an underlying medical condition, such as diabetes, hypertension and renal failure, are at a higher risk of severe disease, including death; cases without comorbidities tend to present with milder disease;

2. The cases recently reported to WHO have not resulted in sustained onward transmission to persons in close contact with these cases;

3. There has been no increase in the size or number of observed household clusters; and

4. While there is variation of the R0 number in different settings, the overall R0 of MERS-CoV is < 1. The R0 in outbreaks in health care settings is higher, and this has been documented in health care associated outbreaks in several countries Saudi Arabia and the Republic of Korea. With early isolation of cases and adequate infection prevention and control measures R0 can be brought to <1.

**Can additional cases of MERS-CoV infection be expected to be reported from countries in the Middle East? Can additional exported cases be expected to be reported from countries outside the Middle East?**

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

Despite a limited number of human infections reported outside the Arabian Peninsula, recent seroprevalence studies in occupationally exposed populations, MERS-CoV specific T cell responses, and asymptomatic infection in camel-exposed African
populations indicate that there is zoonotic transmission in countries across the African continent.\textsuperscript{3,4} MERS-CoV appears to have three distinct clades: Clade C viruses circulating in Africa have lower replication competence and less efficient viral entry as compared with clade A/B viruses found in KSA, which suggests that MERS-CoV infection in Africa may be less transmissible.\textsuperscript{6}

Until more is understood about mode of transmission and risk factors for infection, cases resulting from animal to human (zoonotic) transmission will continue to occur and will eventually lead to limited community transmission within households and possibly significant health care-associated outbreaks such as 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 dromedary camels or had consumed raw camel products while in Saudi Arabia.

**WHO advice for MERS**

WHO has developed a roadmap for the R&D of MERS-specific diagnostics, therapeutics and vaccines in 2015, an updated roadmap for MERS diagnostics in 2018, and a broader public health research agenda for MERS in 2018. WHO, FAO and WOAH have repeatedly brought together technical partners to assess and advance research needed for MERS in dromedary populations, at the human-animal interface and in human populations. The latest Global Technical Meeting on MERS-CoV and Other Emerging Zoonotic Coronaviruses was convened virtually on 15-16 November 2021 and provided the opportunity to review the MERS situation globally, the impact of the ongoing COVID-19 pandemic and ways to recommence and integrate preparedness and response activities for MERS.

A number of epidemiologic investigations into the transmission patterns of MERS-CoV have been conducted and published and more studies are planned or are underway. WHO expects that the results of such investigations will be shared with affected countries dealing with MERS-CoV and published quickly. The most urgent research needs continue to be:

**In dromedary camels:**
- Conduct natural history studies and evaluate evidence of re-infection
- Conduct studies to better understand the risk of zoonotic transmission from dromedary products and excretions
- Conduct value chain and production system analyses
- Improve surveillance to evaluate seasonal/temporal variation, if any, in viral shedding
- Identify critical points for interventions and interruption of within species and zoonotic transmission
- Accelerate the development of vaccine candidates

**At the animal-human interface**
- Map virus circulation and geographic range of MERS-CoV infection in humans and dromedary camels
- Evaluate geographic extent of spillover to humans in Africa, the Middle East and South Asia
- Conduct animal/human serological and virological studies in specific locations to evaluate risk factors for human infection and exact routes of zoonotic transmission, including food/oral routes, if any
- Conduct social science and anthropological studies to describe and quantify exposures to dromedary camels and identify opportunities for risk-mitigating interventions

**In human populations**
- Accelerate the R&D, implementation and evaluation of medical countermeasures to reduce morbidity and mortality associated with MERS
- Identify the risk factors for infection among healthcare workers in hospital settings and role environmental controls for transmission of infection
- Understand the role of silent/asymptomatic cases in transmission of infections in humans and whether any specific behaviors may result in human infection from non-human sources
- Conduct targeted epidemiological studies in clinical settings to better understand immune response and duration of infectiousness
- Integrate testing for MERS-CoV into existing respiratory disease surveillance systems in affected countries to identify extent and spectrum of mild infection in the community

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• Develop multiplex diagnostic platforms to allow for simultaneous investigation of different respiratory pathogens such as MERS-CoV, SARS-CoV-2 and different influenza viruses, including any novel, recombinant viruses, and develop appropriate, risk-based testing strategies for global and national-level surveillance.

As with all zoonotic pathogens, collaboration between human and animal health sectors using a One Health approach in affected countries is essential to better understand 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. WHO stresses that it is 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, spillover risk and amplification.

WHO is supporting field-based studies at the animal/human interface to evaluate the extent of spill over in countries outside of the Arabian Peninsula and in Africa. 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 infected health care workers and the possible role of environmental contamination, is urgently needed.

Enhancing infection prevention and control awareness and implementation measures remains critical to preventing the possible spread of MERS-CoV in health care facilities. It is not always possible to identify patients with MERS-CoV infection 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 for health care workers to apply standard precautions consistently with all patients, regardless of their diagnosis, in all work practices all of the time. Droplet precautions should be added to the standard precautions when providing care to any patient with symptoms of acute respiratory infection. Airborne precautions should be used where any aerosol generating procedures are carried out.

Health care facilities that provide care for patients suspected of 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 facility workers (medical and service personnel) 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. Health care workers should be informed to be infected with MERS-CoV should take appropriate precautions 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-CoV, people at high risk of developing severe disease (any person who is above 60 years, has diabetes, renal failure, chronic lung disease, or is immunocompromised), should take precautions when visiting farms or markets where dromedary camels are present or engage in any activity involving close contact with dromedary camels (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.

Studies in the Arabian Peninsula and in countries in West and North, as well as in the Horn of Africa indicate that people handling or working with dromedary camels 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 before and after every contact with an animal. Workers should wear facial protection where feasible; and protective clothing and boots, which 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, at a race track or in a 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. Sick dromedary camels should never be slaughtered for consumption; dead dromedary camels should be safely buried or destroyed.

Unless wearing adequate personal protective equipment, people should avoid contact with any dromedary camel that has had a recent positive MERS-CoV infection until subsequent tests have confirmed that the animal is free of infection.

Health officials in countries outside of the affected regions 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-CoV nor does it currently recommend the application of any travel or trade restrictions.

WHO guidelines and tools on epidemiologic investigations can be found on the [WHO MERS-CoV website](https://www.who.int).