

Middle East respiratory syndrome coronavirus (MERS-CoV) summary and literature update—as of 9 May 2014

Since April 2012, 536 laboratory-confirmed cases of human infection with Middle East respiratory syndrome coronavirus (MERS-CoV) have been reported to WHO, including 145 deaths (Figure 1). To date, the affected countries in the Middle East include Jordan, Kuwait, Oman, Qatar, Saudi Arabia (KSA), United Arab Emirates (UAE) and Yemen; in Africa: Egypt and Tunisia; in Europe: France, Germany, Greece, Italy and the United Kingdom; in Asia: Malaysia and Philippines; and in North America: the United States of America (USA). All of the cases recently reported outside the Middle East (Egypt, Greece, Malaysia, the Philippines and the USA) recently travelled from countries inside of the Middle East (KSA or UAE). Overall, 65.6% of cases are male and the median age is 49 years old (range 9 months-94 years old).

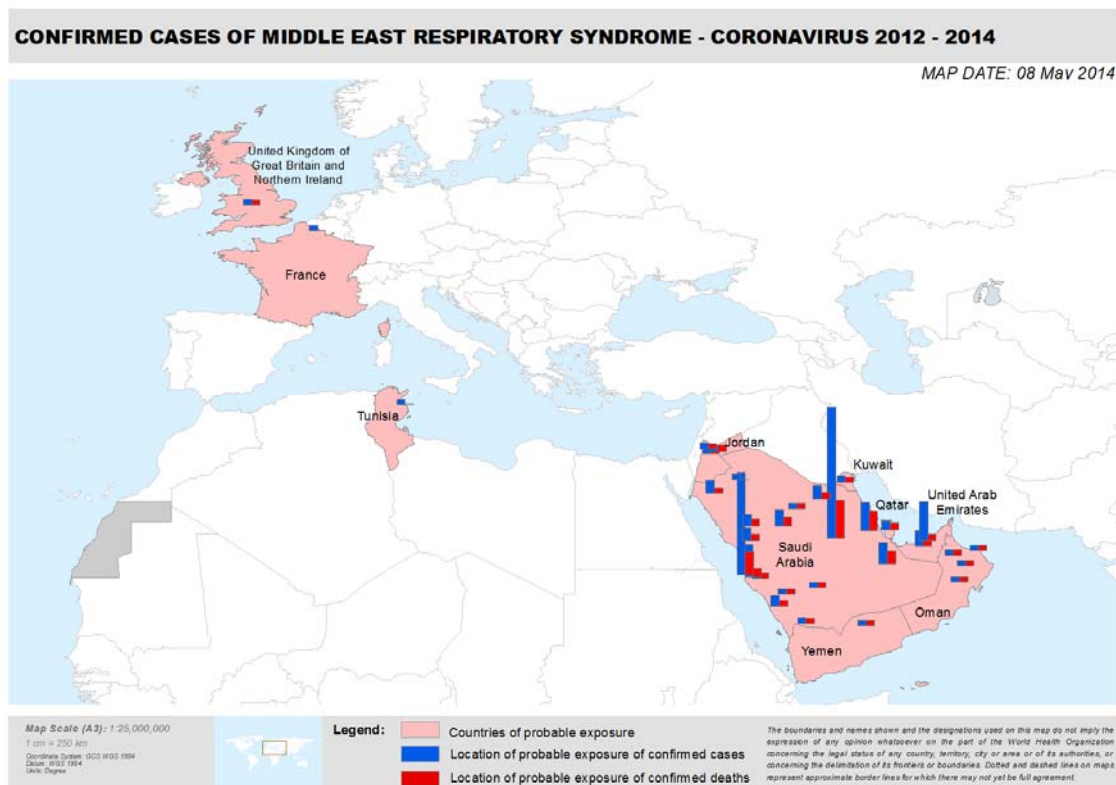


Figure 1. Location of the laboratory-confirmed cases of MERS-CoV infection by country of presumed exposure, March 2012-8 May 2014

Since the last update of 27 March 2014, 330 laboratory-confirmed cases, including 59 deaths, were reported to WHO. These include 290 cases infected in KSA, 37 cases from UAE, 1 case from Yemen and 2 cases from Jordan. These include one case each from Egypt, Greece, Jordan, Malaysia, USA and the Philippines who were infected in the Middle East. No further transmission has been documented so far from the recent exported cases.

The number of laboratory-confirmed MERS-CoV cases reported to WHO has sharply increased since mid-March 2014, essentially in KSA and UAE, where important healthcare-associated outbreaks are occurring (Figure 2). The number of cases who acquired the infection presumably from non-human sources has also increased since mid-March (shown as primary cases in Figure 3). These cases have not reported contacts with other laboratory-confirmed cases, and some have reported contacts with animals, including camels. Although camels are suspected to be the primary source of infection for humans, the routes of direct or indirect transmission remain unknown and investigations are ongoing.

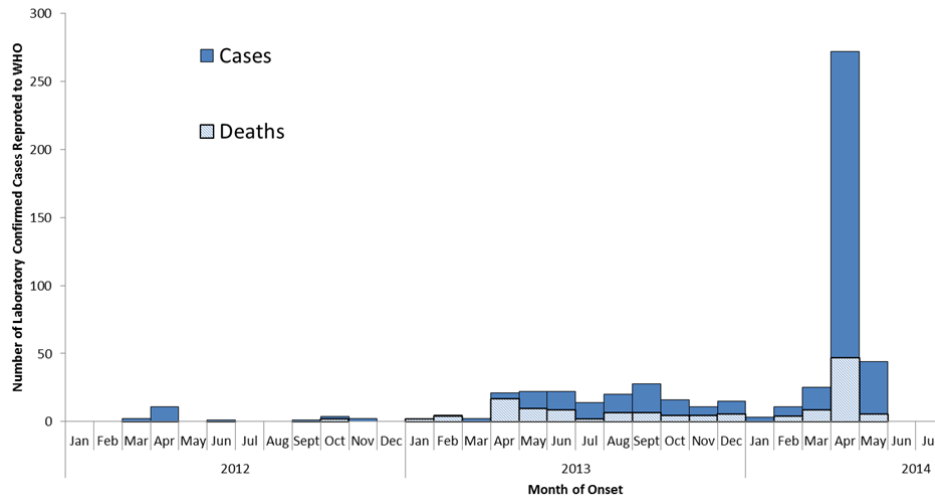


Figure 2. Epidemic curve of 536 laboratory-confirmed cases MERS-CoV cases by outcome (as of 8 May 2014)

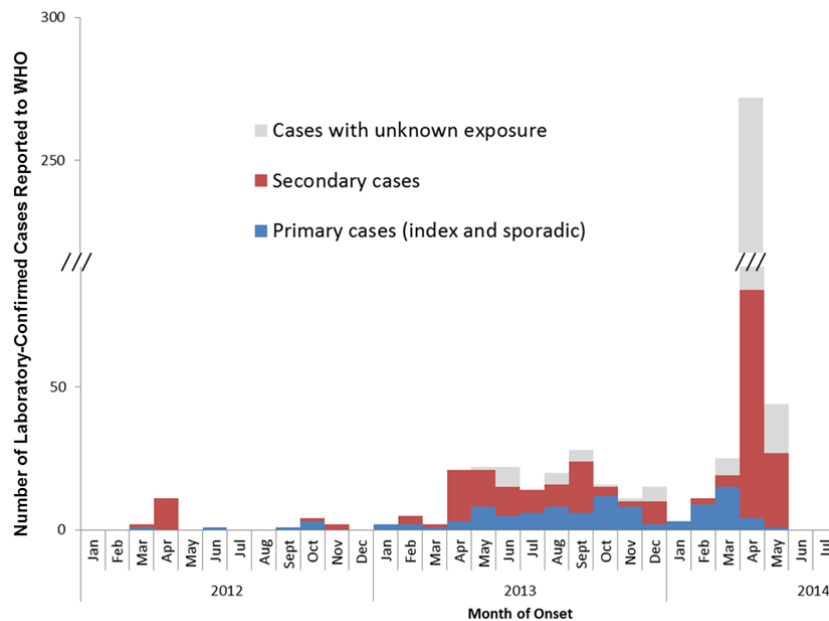


Figure 3. Epidemic Curve of 536 laboratory-confirmed MERS-CoV patients by case type (primary vs secondary; as of 8 May 2014)

Saudi Arabia cases

Since WHO's last summary update on 27 March 2014, Saudi Arabia has reported 290 cases from Jeddah, Mecca, Riyadh, Tabuk, Madinah, and Najran. WHO is currently working with the Ministry of Health of Saudi Arabia to understand the upsurge in cases.

Jeddah, Saudi Arabia, Hospital Outbreak

In late April, health authorities in KSA invited WHO to send a risk-assessment mission to review the current situation related to the upsurge in cases in Jeddah. The WHO mission took place 28 April– 5 May 2014.

The mission team, working with local authorities, analysed 128 laboratory-confirmed cases who had symptom onset between 17 February and 26 April 2014 and who were treated in 14 hospitals in Jeddah. Most hospitals treated 1-2 patients; however, one hospital reported 45 cases during this time period. Approximately one-third of these Jeddah cases are considered to be primary cases, although investigations are currently ongoing to determine whether these patients had contact with another confirmed case (these cases are not reflected as primary cases [in blue] in Figure 3 as investigations are ongoing). More than 60% of the 128 cases are presumed to have acquired infection in a hospital setting, including 39 health care workers.

The majority of the 128 Jeddah cases were male and the median age was 48.5 years. The health care workers who tested positive for MERS CoV were more likely to be younger, female, and exhibit mild or no symptoms when compared with primary cases. However, 15% of the health care workers who tested positive presented with severe disease (resulting in admission to an intensive care unit) or died. Household contacts of infected cases were screened for MERS-CoV and seven of 554 household contacts were PCR positive for MERS-CoV (secondary attack rate=1.3%).

An additional 35 cases have been reported to WHO from Mecca and this outbreak is still ongoing.

More details of the WHO Mission to KSA can be found here:

<http://www.emro.who.int/media/news/mers-cov-mission-saudi-arabia.html>

Outside Jeddah and Mecca, Saudi Arabia

Since mid-March, KSA reported 127 cases from outside Jeddah and Mecca, including 86 cases from Riyadh, 10 cases from Tabuk, 15 cases from Medina, 3 cases in Najran and 13 cases without a location specified.

Among these 127 cases, 26 were reported as health care workers. The 10 cases reported from Tabuk involve one hospital and seven health care workers. Among the 76 cases reported from Riyadh, 15 were health care workers. One health care worker was also reported from Medina. Three health care workers did not have a location specified. Investigations into all of these cases are currently ongoing.

UAE hospital outbreak

Since the last summary update, 37 laboratory confirmed cases of MERS-CoV have been reported from UAE. All have been reported from Abu Dhabi Emirate; 70.3% are male and the median age of cases is 41 (range 4-73) years. More than two-thirds were health care workers (including ambulance staff). Only one experienced severe disease; the rest were reported mild or no symptoms.

Twenty-eight cases were identified in a hospital cluster in Al Ain City in the Emirate of Abu Dhabi. The first case reported in this cluster was a 45-year-old male shopkeeper who died in UAE on 10 April 2014. He had no recent travel history or contact with animals, and the source of his infection is currently unknown. Contact tracing identified an additional 27 cases who were health care workers and social contacts residing in UAE. It is unclear whether transmission occurred from the index case or from non-human sources. Investigations in UAE are ongoing. One of those contacts, a male nurse, travelled to the Philippines on 15 April 2014. Contact tracing on his flights and in the Philippines identified no additional cases.

The remaining five cases include two sporadic cases, one 2-person family (mother and daughter) cluster and a non-related four-year old child who tested positive. The mother of the four-year-old child had recently performed Umrah in Saudi Arabia, but was never tested for MERS-CoV.

An additional four cases were reported from Abu Dhabi on 8 May 2014, but it is unclear whether these are linked with the Al Ain City cluster.

Newly affected country: Yemen

Yemen reported its first laboratory-confirmed MERS-CoV case on 15 April 2014. The case was a 44-year-old male residing in Shibam, Yemen. He developed symptoms on 17 March 2014 and died on 31 March. Preliminary investigations found that the case had no contact with other MERS-CoV cases and no recent history of travel outside of Yemen, but had made weekly visits to a camel farm where he reported drinking fresh camel milk. No additional cases were identified during contact tracing.

WHO MERS-CoV related activities and upcoming guidance

- WHO will convene a meeting of laboratory experts in June in Lyon, France, to finalize updated recommendations on laboratory testing for MERS-CoV. The recommendations will take into account the latest information on serological testing which will become more important as the number of asymptomatic and mildly ill cases increases.
- On 28 April 2014, WHO published guidelines for *Infection prevention and control of epidemic- and pandemic prone acute respiratory infections in health care*. These updated guidelines are fully applicable to MERS-CoV and were developed following the process established in the *WHO handbook for guideline development*, 2010. This involved the active participation of a WHO Steering Group and members of the Global Infection Prevention and Control Network (GIPCN). The resulting recommendations were peer reviewed by internal and external experts and can be found here: http://www.who.int/csr/bioriskreduction/infection_control/publication/en/
- WHO has updated Frequently Asked Questions on MERS-CoV: http://www.who.int/csr/disease/coronavirus_infections/faq/en/

Selected MERS-CoV Literature

- A team from USA and King Saud University isolated MERS-CoV from nasal swabs of dromedary camels in Saudi Arabia and demonstrated that whole-genome sequences of humans and camels are indistinguishable. They also reported that camels can be infected simultaneously with more than one MERS-CoV.

Citation: Briese et al. 2014. Middle East respiratory syndrome coronavirus quasispecies that include homologues of human isolates revealed through whole-genome analysis and virus cultured from dromedary camels in Saudi Arabia. mBio 5(3):e01146-14.

doi:10.1128/mBio.01146-14. Available at: <http://mbio.asm.org/content/5/3/e01146-14>

- An experimental study evaluated the stability of MERS CoV in milk from camels, goats and cows, before and after pasteurization. Results demonstrated that MERS-CoV could survive for prolonged periods in milk but viable virus was not detectable after pasteurization. Further study is needed to determine whether MERS-CoV is excreted into the milk of infected dromedary camels and, if so, whether handling or consuming contaminated raw milk is associated with MERS-CoV infection in humans.

Citation: van Doremalen N, et al Stability of Middle East respiratory syndrome coronavirus in milk [letter]. Emerg Infect Dis [Internet]. 2014 Jul. <http://dx.doi.org/10.3201/eid2007.140500>

- A paper summarizing the geographic distribution of serologic evidence for MERS-CoV or MERS-like CoV in dromedaries in Africa and the Arabian Peninsula has been published by Reusken et al. The authors note there is evidence of circulation covering a wide geographic area, including Canary Islands, Egypt, Tunisia, Nigeria, Sudan and Ethiopia in Africa and Jordan, Oman, Qatar, KSA, and UAE in the Middle East. They reported differences in seropositivity between adult and juvenile (<3 years of age) camels.

Citation: Reusken CBEM, et al. Geographic distribution of MERS coronavirus among dromedary camels, Africa. Emerg Infect Dis. 2014 Jul [early pub]. <http://dx.doi.org/10.3201/eid2007.140590>

- Researchers from Oman and Vienna reported on a nationwide survey of MERS-CoV in dromedary camels conducted in December 2013 in Oman. They found MERS-CoV nucleic acid in 5 of 76 camels sampled. The Omani camel sequences were compared with available human MERS-CoV sequences and camel MERS-CoV sequences from Qatar and Egypt. The camel sequences were closely related to human MERS-CoV sequences from the same geographic areas, suggesting that local transmission from camels to humans had occurred.

Citation: Nowotny N, Kolodziejek J. Middle East respiratory syndrome coronavirus (MERS-CoV) in dromedary camels, Oman, 2013. Euro Surveill. 2014;19(16):pii=20781. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20781>

- An experimental study evaluated the stability of MERS-CoV using combinations of temperature and humidity. MERS-CoV was more stable at low temperature/low humidity conditions (20°C--40% relative humidity and could still be recovered after 48 hours. During aerosolisation of MERS-CoV, no decrease in stability was observed at 20°C/40% relative humidity, suggesting the potential of MERS-CoV to be transmitted via contact or fomite transmission owing to prolonged presence in the environment.

Citation: van Doremalen N, et al. Stability of Middle East respiratory syndrome coronavirus (MERS-CoV) under different environmental conditions. Euro Surveill. 2013;18(38):pii=20590. Available at: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20590>

- Two studies reported the results of PCR screening for MERS-CoV in 2013 Hajj pilgrims. The first study (Memish et al., 2014) reported results from nasopharyngeal samples from pilgrims from 22 countries taken before (n=3210) and after (n=2025) the Hajj. The second (Gautret et al., 2014) reported results from pre- and post-Hajj nasal swabs from 129 French pilgrims. Neither found any evidence of MERS-CoV infection among subjects.

Citations: Memish ZA, et al. Prevalence of MERS-CoV Nasal Carriage and Compliance with the Saudi Health Recommendations Among Pilgrims Attending the 2013 Hajj. J Infect Dis. 2014 Apr 15. [Epub ahead of print] and Gautret P, et al. Lack of MERS coronavirus but prevalence of influenza virus in French pilgrims after 2013 Hajj. Emerg Infect Dis. 2014 Apr;20(4):728-30.

Summary and Risk Assessment

WHO is currently working with the Ministries of Health in Saudi Arabia and other affected countries and international partners to better understand the reasons for the increase in cases reported since March 2014. From preliminary investigations in KSA, it is clear that cases continue to be reported in a number of locations across the country. Importantly, health care workers have been infected across the country, including in Jeddah, Riyadh, Tabuk, Asir and Medina in recent weeks.

The large number of the recently reported cases from KSA reflects infection acquired through transmission in health care settings. The large outbreaks in Jeddah and Riyadh, and the reports of smaller hospital-associated cases in other parts of the country, emphasise the importance of infection control strategies and practices, not only when caring for suspected MERS-CoV patients but also – and most importantly - when caring for patients in all circumstances. It is therefore important to emphasize the implementation of standard precautions at all levels and also to apply additional precautions according to the risk assessment.

The WHO mission found that the upsurge in cases in Jeddah is explained by an increase in the number of primary cases, amplified by several hospital-acquired outbreaks that resulted from a lack of systematic implementation of infection prevention and control measures. The apparent seasonal increase in primary cases occurring for unknown reasons may be related to the weaning of young camels from their mothers in the spring of each year. Recent phylogenetic analysis using three human sequences from Jeddah suggests that the virus has not changed from previously recovered strains.

Based on available information from recent cases in KSA, in particular, from Jeddah, and from all recently affected countries, there is currently no evidence of sustained human-to-human transmission in the community. The overall transmission patterns previously observed remain unchanged. WHO bases this assessment on the evidence that:

- I. The clinical picture appears to be similar to what was observed previously; secondary cases tend to present with a 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 asymptomatic;
- II. The recently exported cases to Greece, Malaysia, the Philippines and the USA have not resulted in onward transmission to persons in close contact with these cases on airplanes or in the respective countries outside the Middle East (contact tracing is still ongoing);
- III. Intensive screening of MERS-CoV contacts revealed very few instances of household transmission; and
- IV. There has been no increase in the size or number of observed household clusters.

The increase in the community cases might reflect a seasonal increase in zoonotic infections from an animal population such as dromedary camels. Alternatively, as many of the community cases had no reported animal exposures, it is also possible that such cases reflected either person-to-person transmission or exposure to another source. Further epidemiological investigations are urgently needed to confirm or refute these hypotheses.

WHO expects that additional cases of MERS-CoV infection will be reported from the Middle East, and that it is likely that cases will continue to be exported to other countries by tourists, travellers, guest workers or pilgrims who might acquire infection following exposure to an animal (for example, while visiting farms or markets) or human source (possibly in a health care setting). Until more is understood about the exposures to non-human sources in the community, or human or environmental exposures in health care settings and implementation of preventive measures, cases will continue to be reported.

Urgent investigations are required to better understand the transmission patterns of this virus. The most urgent needs include detailed outbreak investigations, understanding how humans become infected from animal or environmental source(s) through case-control studies, identifying risk factors for infection in health care settings, and enhancing community studies and surveillance for community-acquired pneumonia. Collaboration between human and animal health sectors is essential to understand the risk of transmission between animals and humans. WHO guidelines and tools on investigations can be found here:

- [WHO guidelines for investigation of cases of human infection with Middle East Respiratory Syndrome Coronavirus \(MERS-CoV\) pdf, 359kb](#)
- [Middle East Respiratory Syndrome Coronavirus \(MERS-CoV\) Initial Interview Questionnaire of Cases pdf, 114kb](#)
- [Case-control study to assess potential risk factors related to human illness caused by Middle East Respiratory Syndrome Coronavirus \(MERS-CoV\) pdf, 257kb](#)

- [Seroepidemiological Investigation of Contacts of Middle East Respiratory Syndrome Coronavirus \(MERS-CoV\) Patients](#)

Enhancing infection prevention and control awareness and implementation measures is critical to prevent the possible spread of MERS-CoV in health care facilities. Health care facilities that provide care for patients suspected or confirmed to be infected with MERS-CoV infection 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. It is not always possible to identify patients with MERS-CoV early because some have mild or unusual symptoms. For this reason, it is 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. Contact precautions and eye protection should be added when caring for probable or confirmed cases of MERS-CoV infection. Airborne precautions should be applied when performing aerosol-generating procedures.

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

Camel farm and slaughterhouse workers should practice good personal and hand hygiene, with frequent hand washing after touching animals, facial protection where feasible and the wearing of protective clothing, which should be removed after work and washed daily. Workers should also avoid exposing family members to soiled work clothing, shoes, or other items that may have come into contact with camels or camel excretions. Sick animals should never be slaughtered for consumption; in cases where a particular animal has been tested and confirmed positive for MERS-CoV, people should avoid direct contact with such animals.

Countries outside the affected region should maintain a high level of vigilance, especially those with large numbers of travellers or guest workers returning from the Middle East. Surveillance should continue to be enhanced in these countries according to WHO guidelines, along with infection 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 this event nor does it currently recommend the application of any travel or trade restrictions.