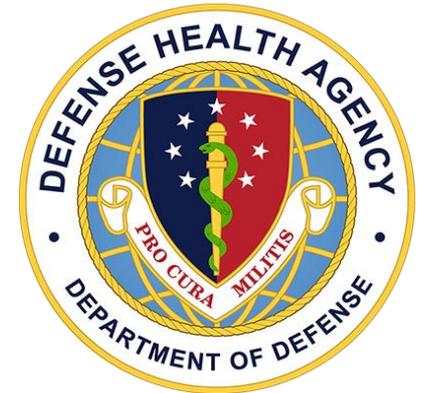


Department of Defense
Armed Forces Health Surveillance
Global MERS-CoV Surveillance Summary
(18 NOV 2015)



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18 NOV 2015 (next Summary 2 DEC 2015)



CASE REPORT: As of 18 NOV 2015, 1,699 (+1) cases of Middle East respiratory syndrome coronavirus (MERS-CoV) have been reported including 638 (+2) deaths in the Kingdom of Saudi Arabia (KSA), Jordan, Qatar, United Arab Emirates (UAE), United Kingdom (UK), France, Germany, Tunisia, Italy, Oman, Kuwait, Yemen, Malaysia, Greece, Philippines, Egypt, Lebanon, Netherlands, Iran, Algeria, Austria, Turkey, Republic of Korea (ROK), China, Thailand, and the U.S. Historically, increases in MERS-CoV cases in the Arabian Peninsula have occurred in the spring.

ROK CASE REPORT: On 1 OCT, the last South Korean patient (#186) previously diagnosed with MERS-CoV tested negative for the virus; however, this individual relapsed and tested positive for the virus on 12 OCT. The total case count continues to be 186 cases, 4 suspect cases and 37 deaths in ROK reported by the MOHW. As a result, an official declaration of the end of the outbreak will be delayed until 28 days after the last MERS-CoV patient recovers and is discharged. A recent study by the ROK MOHW found that there may be sequelae associated with MERS-CoV. Of the 112 MERS-CoV survivors in ROK that were surveyed, the MOHW found that 40% experience anxiety and that 37% also complain of fatigue, headaches, and indigestion.

Transmission during the ROK outbreak was attributed to delayed diagnosis and isolation of the index case, lapses in infection control, and care of patients by family members rather than HCWs. This interpretation was supported by WHO, which announced no mutations linked to transmissibility or pathogenesis were found in virus sequences obtained in ROK or China. On 25 OCT, the KCDC reported that 83% of MERS-CoV transmissions were linked to five super-spreaders (cases 1, 14, 15, 16, and 76) during the ROK outbreak. KCDC defines a super-spreader as a case that transmitted the virus to at least four other people. These five cases, all of whom had pneumonia, transmitted the virus to 153 of the 184 cases detected between 20 MAY and 13 JUL 2015 (two of the total 186 cases were excluded as their transmission routes remain unclear).

A study presented at the 2015 Infectious Disease Week found that most of the “touchable environments” in MERS-CoV units in ROK were contaminated by patients and HCWs. The study also found that viable MERS-CoV virus could be shed through respiratory secretions of patients who had clinically fully recovered and were conventional-PCR negative. While it was previously known that MERS-CoV could survive on surfaces for long periods of time, the extent of persistent contamination and the period of prolonged viral shedding observed during the MERS-CoV outbreak in ROK is significant for hygiene and infection control practices. A recent study by the KCDC found that the strains from the ROK outbreak were similar to strains found in Riyadh, KSA, with some strain-specific variations.

On 16 OCT, the ROK MOHW hosted a signing ceremony for a letter of intent (LOI) on collaborative research in precision medicine and MERS-CoV research between the U.S. NIH and the Korean NIH. This LOI is a follow up measure to the MOU between the HHS and ROK MOHW signed on 22 JUN detailing precision medicine and the Global Health Security Agenda as areas of bilateral collaboration. On 13 NOV, GeneOne Life Science, Inovio Pharmaceuticals, and Walter Reed Army Institute of Research (WRAIR) announced a partnership to create a MERS-CoV vaccine. The Deputy Commander of Operations at WRAIR voiced his support for this partnership as “U.S. military personnel could be at risk in the event of a large scale MERS-CoV outbreak” and noted the clinical trials will be conducted at the WRAIR Clinical Trials Center.

DIAGNOSTICS: Clinical diagnostic testing is available at BAACH, NAMRU-3, LPMC, MAMC, NHRC, USAFSAM, SAMMC, WBAMC, WRNMMC, and NIDDL (NMRC). Tripler AMC (TAMC) will have clinical diagnostic testing once validation is completed. Surveillance testing capability is available at NHRC, AFRIMS, NAMRU-2, NAMRU-3, NAMRU-6, USAMRU-K, and Camp Arifjan. All 50 state health laboratories and the NYC DOHMH were offered clinical testing kits. On 16 JUL, AFHS updated [MERS-CoV testing guidelines](#) for DoD components, which are aimed at capturing mild cases that may present in healthier populations such as DoD personnel.

Text updated from the previous report will be printed in red; items in (+xx) represent the change in number from the previous Summary (4 NOV 2015). All information has been verified unless noted otherwise. Sources include USFK, ROK MOHW, KCDC, U.S. CDC, WHO, EMRO, KSA MOH, ECDC, and Vaccine News Daily. For questions or comments, please contact: dha.ncr.health-surv.list.afhs-ib-alert-response@mail.mil

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BACKGROUND: In SEP 2012, [WHO reported two cases of a novel coronavirus](#) (now known as MERS-CoV) from separate individuals - one with travel history to the KSA and Qatar and one a KSA citizen. This was the sixth strain of human coronavirus identified (including SARS). Limited human-to-human transmission has been identified in at least 35 spatial clusters predominately involving close contacts. Limited camel-to-human transmission of MERS-CoV has been proven to occur, and [studies suggest](#) camels infected with MERS-CoV may appear asymptomatic but are able to shed large quantities of the virus from the upper respiratory tract. A [study](#) published in the Annals of Saudi Medicine found that the wave of MERS-CoV cases observed from MAR-JUN 2014 in the Makkah region was likely a result of nosocomial transmission. This springtime spike in cases was previously attributed to camel breeding season. Another recent [study](#) in the International Journal of Infectious Diseases found that three waves of MERS-CoV transmission appeared to follow waves of influenza A in the Middle East during the 1 MAY 2012 to 31 MAY 2015 time period. While the connection between these two diseases is not yet clear, both present a significant health care burden and possibly share seasonality. A joint [publication](#) by the U.S. CDC, KSA MOH, and a number of affected hospitals in KSA, analyzed risk factors in contracting MERS-CoV. The study found that among 'primary' MERS-CoV cases reported in KSA from MAR-NOV 2014, direct exposure to dromedary camels during the two weeks before illness onset, as well as diabetes mellitus, heart disease, and smoking, were each independently associated with MERS-CoV illness. On 10 OCT, local media [reported](#) that 33% of MERS-CoV cases in KSA over the past four years occurred within hospitals and that 13% resulted from exposure to ill persons inside the home. **A case-control study published by the KSA MOH found that during the 14 days before symptom onset, cases were more likely to have had direct exposure to dromedary camels (in or around the home or recent travel to a farm with camels) than the control population.**

The most recent known date of symptom onset is **24 OCT 2015**; however at least 40% of symptomatic cases have been reported without onset date. Due to inconsistencies in reporting, it is difficult to determine a cumulative breakdown by gender; however AFHS is aware of at least 490 cases in females to date. CDC reports 287 of the total cases have been identified as healthcare workers (HCWs). Of these, 178 were from KSA, 31 from UAE, 7 from Jordan, 2 from Iran, 1 from Tunisia, and 29 from ROK. Characteristics of reported cases are limited, however, CDC reports among 287 HCW cases with available information: 11 died; 55 were asymptomatic; 20 had comorbidities; and 15 presented with only mild symptoms. On 8 OCT, researchers at the University of North Carolina [announced](#) that they had successfully genetically engineered a mouse to be infected with MERS-CoV. Mice are not naturally susceptible to the MERS-CoV virus so this engineered mouse model can be used as a vehicle for animal trials of MERS-CoV drugs and vaccines. On 20 OCT, Margaret Chan, director-general of the WHO, [announced](#) that the U.S. and KSA are in discussions to prepare a vaccine for MERS-CoV ahead of the next outbreak of the disease.

INTERAGENCY/GLOBAL ACTIONS: WHO convened the [Tenth International Health Regulations \(IHR\) Emergency Committee](#) on 2 SEP and concluded the conditions for a Public Health Emergency of International Concern (PHEIC) have not yet been met. However, the Committee also emphasized that they have a heightened sense of concern as transmission from camels to humans continues in some countries and instances of human-to-human transmission continue to occur in health care settings. The Committee further noted that its advice has not been completely followed as asymptomatic cases that have tested positive for the virus are not always being reported as required. On 13 SEP, the WHO Regional Office for the Eastern Mediterranean (EMRO) concluded [an assessment of the outbreak in Riyadh](#). The EMRO mission identified that most of the nosocomial cases reported where the outbreak is currently ongoing involved patient-to-patient transmission. The mission also identified overcrowding as well as breaches in infection control as being causative. CDC maintains their [Travel Alert Level 2](#) for MERS-CoV in the Arabian Peninsula, which includes specific precautions for the Hajj pilgrimage. CDC is maintaining their travel notice for MERS-CoV in the ROK at a [Travel Watch Level 1](#).

The KSA MOH hosted a MERS-CoV Vaccine Development Workshop over 14-15 NOV in Riyadh, KSA. At this event, an international anti-coronavirus vaccine consortium was formed between the KSA MOH, WHO, U.S. NIH, American Institute of Health Research, and the International Vaccine Institute (IVI). Additionally, a memorandum of understanding (MOU) was signed between the KSA MOH, KSA Ministry of Agriculture (MOA), and the King Abdul Aziz City for Science and Technology (KACST) for joint cooperation that supports research related to MERS-CoV.

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All information has been verified unless noted otherwise. Sources include WHO, [KSA MOH](#), UNC, Ann of Saudi Med, IJID, MD Magazine, Reuters, and CDC.

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MEDICAL COUNTERMEASURES IN DEVELOPMENT

RESEARCH GROUP	TYPE OF COUNTERMEASURE	STAGE OF DEVELOPMENT
ROK MOHW	Plasma Treatment	Clinical Trials Stage
Inovio Pharmaceuticals, GeneOne Life Sciences, and Walter Reed Army Institute of Research (WRAIR)	DNA-based Vaccine (GLS-5300)	Clinical Trials Stage
Novavax and University of Maryland School of Medicine	Recombinant Nanoparticle Vaccine	Preclinical Testing Phase
U.S. NIH and Fudan University	M336 Antibody Treatment	Preclinical Testing Phase
Greffex	Treatment	Not yet announced
Abviro	Treatment	Not yet announced
Shanghai Kaibao	Treatment	Not yet announced
Nanovirivide	Treatment	Not yet announced
Purdue University	Enzyme Inhibition Treatment	Not yet announced
Ludwig-Maximilians-Universitaet (LMU) in Munich	Modified Vaccinia virus Ankara (MVA) vaccine	Phase 1 Clinical Trials
Institute for Research in Biomedicine, Universita della Svizzera italiana	Antibody Therapy (LCA60)	Preclinical Testing Phase
The University of Pennsylvania, NIAID, and Inovio Pharmaceuticals	Vaccine	Preclinical Testing Phase
China MOH and China CDC	Recombinant Receptor-Binding Domain (rRBD)	Preclinical Testing Phase
Medizone International, Inc.	Hospital Disinfection System (AsepticSure®)	Purchased by Al-Hidaya International Medical Services Company in KSA
University of Southampton	Antimicrobial Copper	Not yet announced

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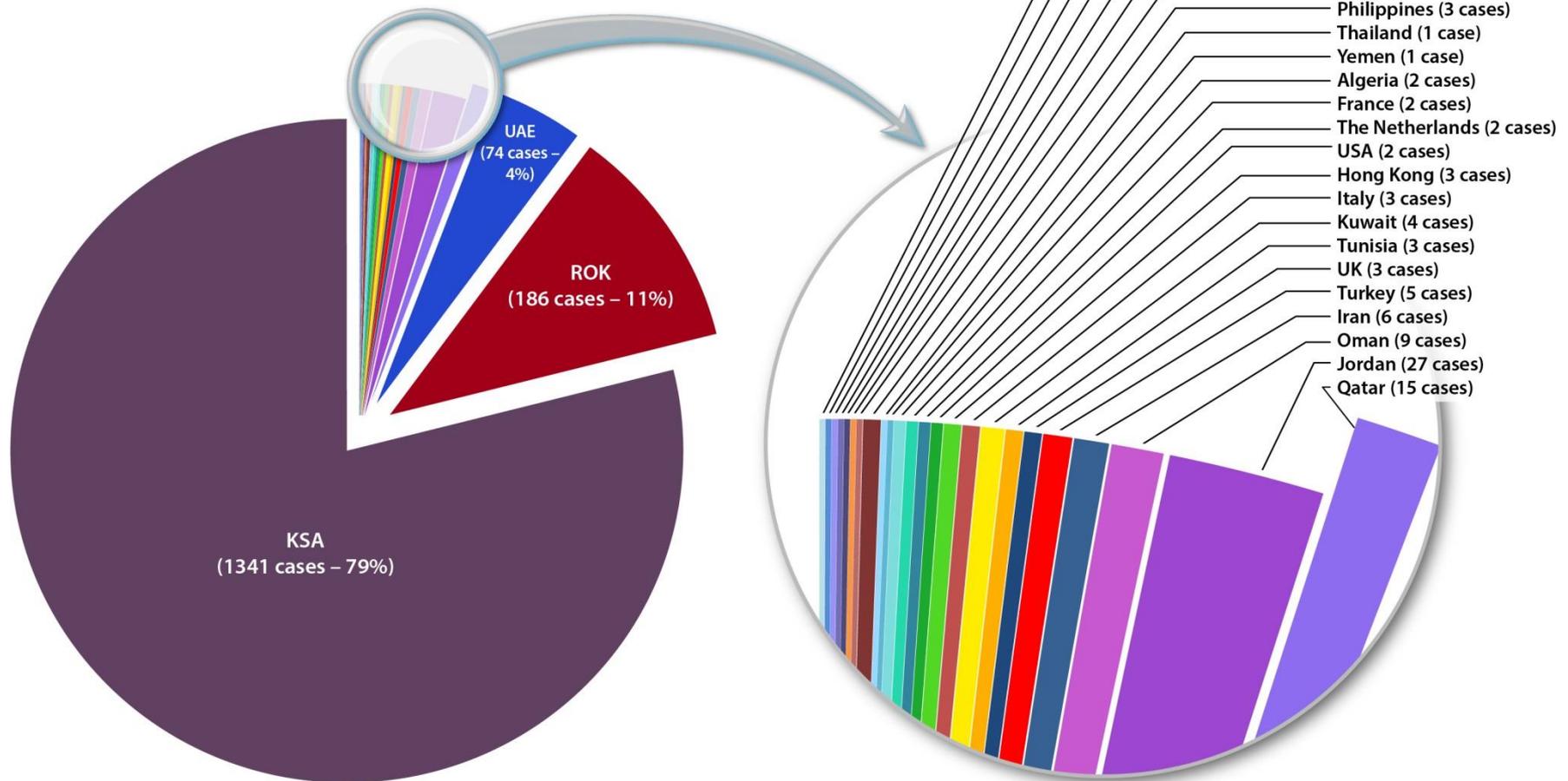
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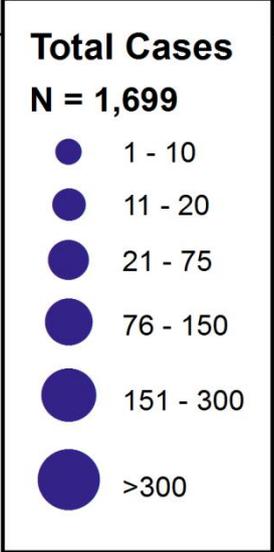
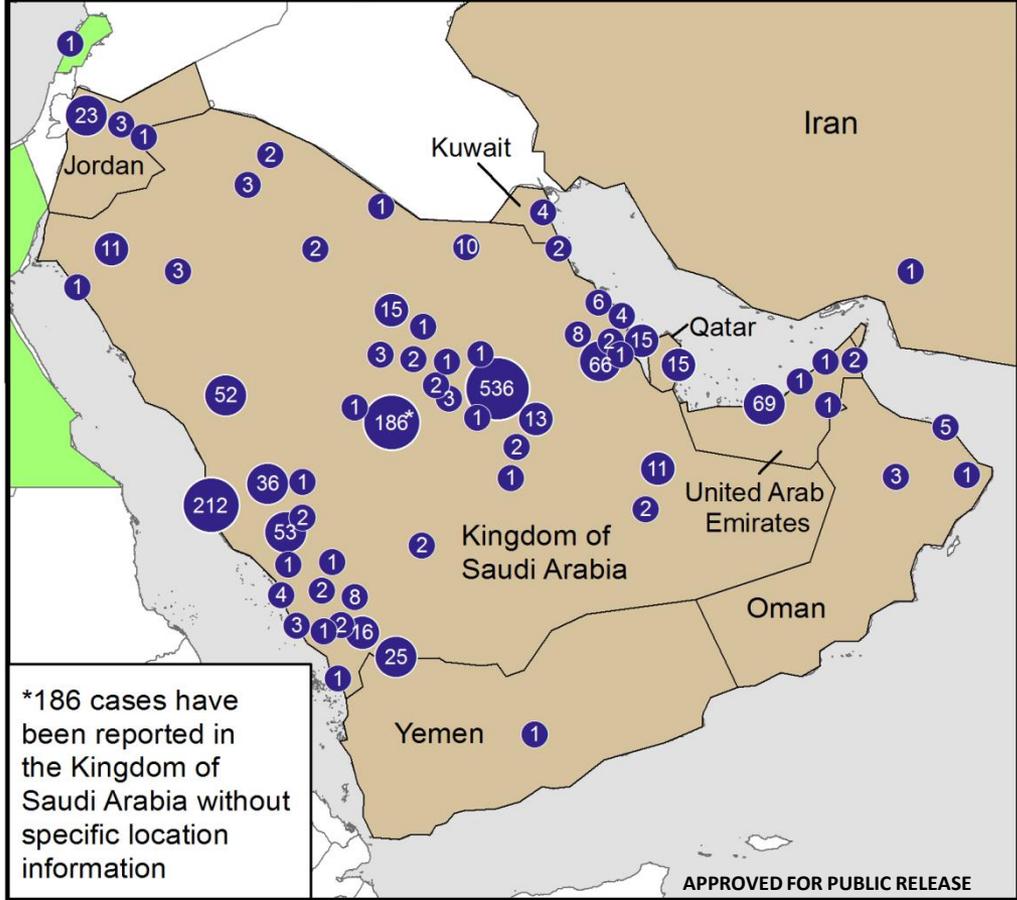
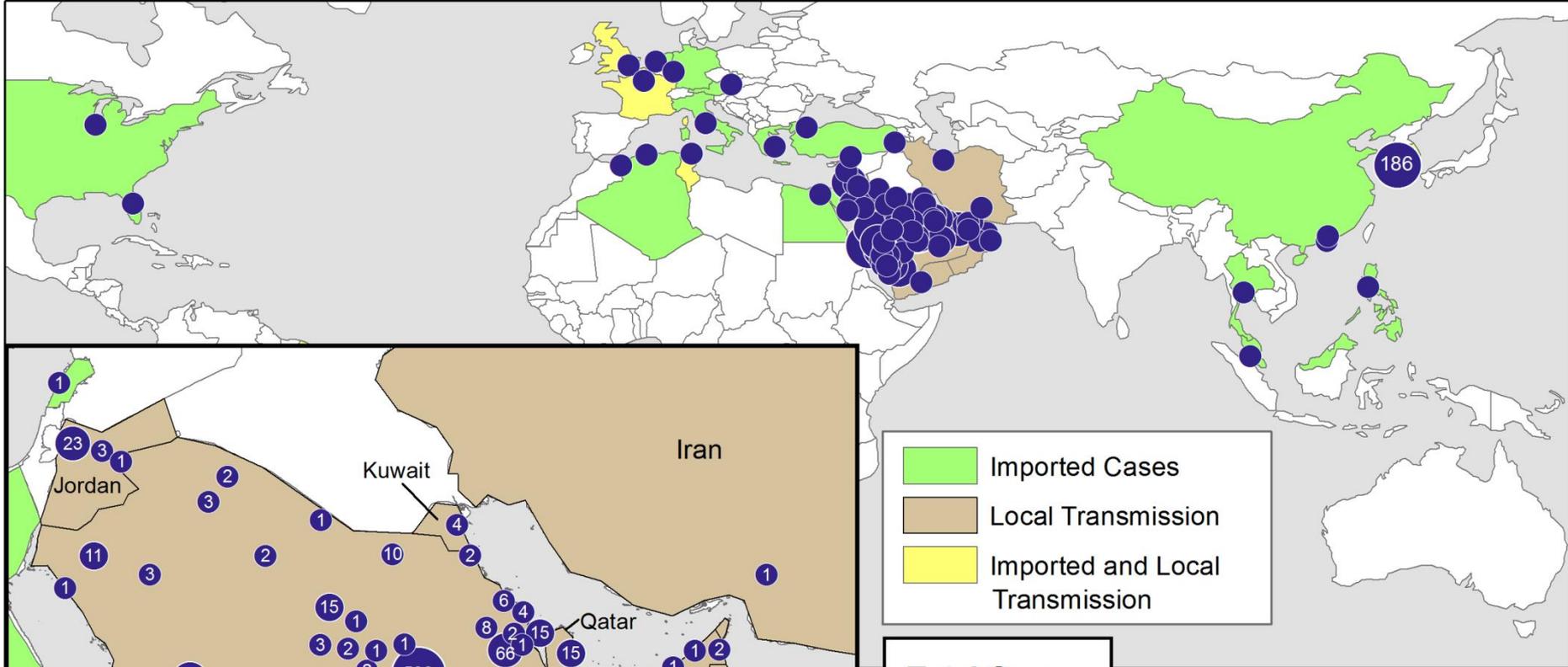
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Global Distribution of Reported MERS-CoV Cases* (SEP 2012 – NOV 2015)



*Data includes confirmed, suspect and probable cases reported by WHO, CDC, and various country MOHs



Geographic Distribution of MERS-CoV Cases
1 APR 2012 - 18 NOV 2015



*186 cases have been reported in the Kingdom of Saudi Arabia without specific location information

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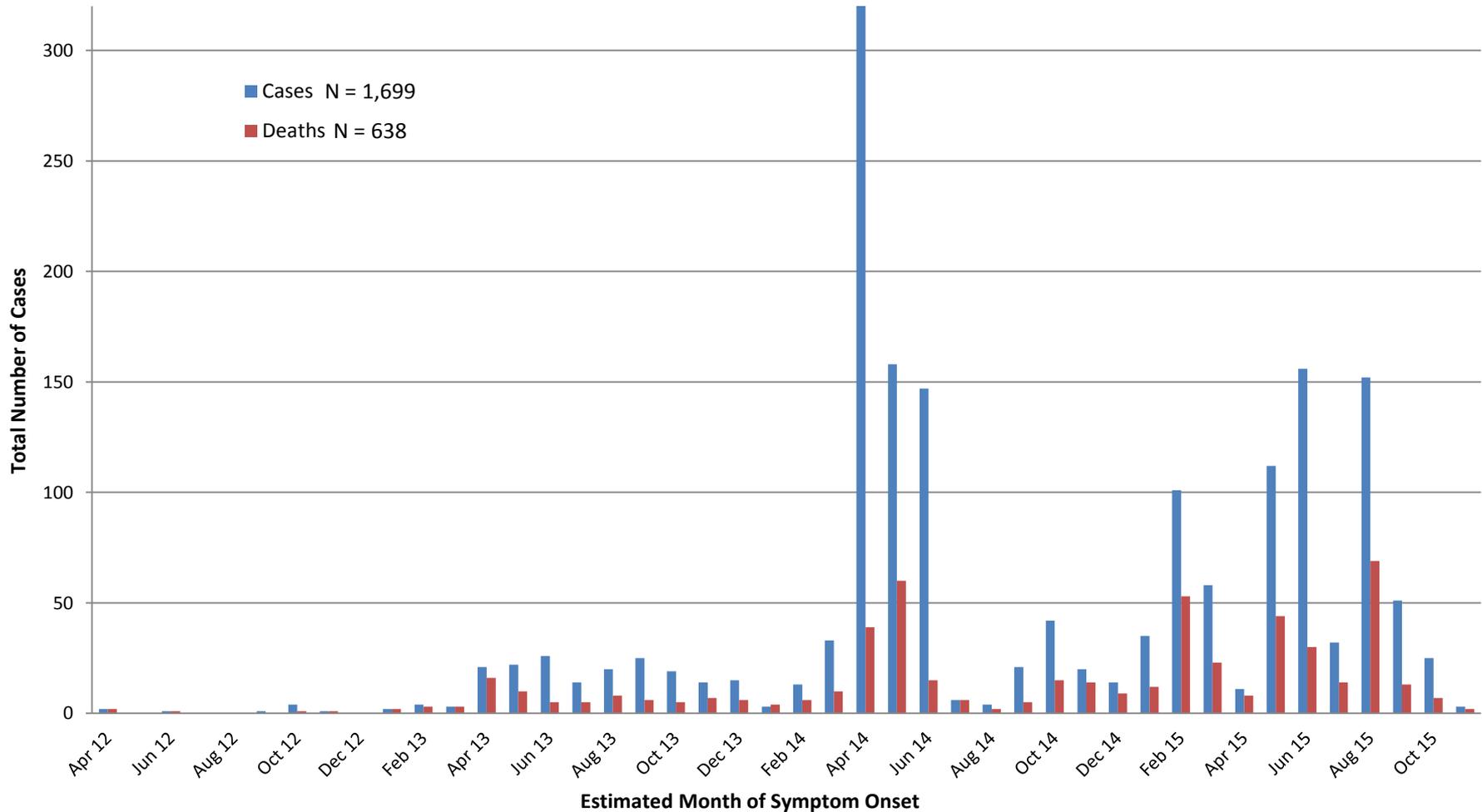
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Global MERS-CoV Epidemiological Curve - 18 NOV 2015



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GLOBAL MERS-CoV NUMBERS AT A GLANCE

	Total in 2012	Total in 2013	Total in 2014	Total in 2015	Cumulative Total (2012-2015)
Cases	9	171	777	742 cases (+1)	1,699 cases (+1)
Deaths*	6 deaths	72 deaths	277 deaths	283 deaths (+2)	at least 638 deaths (+2)
Case-Fatality Proportion	66%	42%	36%	38%	38%
Mean Age	45 years	51 years	49 years	55 years	52 years
Gender Breakdown*	1 female	at least 58 females	at least 175 females	256 females	at least 490 females
# of Healthcare Workers (HCWs) reported*	at least 2 HCWs	at least 31 HCWs	at least 87 HCWs	108 HCWs	at least 287 HCWs

***Disclaimer:** Data reported on MERS-CoV cases are limited and adapted from multiple sources including various Ministries of Health, CDC, and WHO. Consequently, yearly information may not equate to the cumulative totals provided by WHO and CDC.

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MERS-CoV Web Sites

- [WHO](#)
- [WHO Lab Testing Guidance](#)
- [WHO Travel Advice for Pilgrimages](#)
- [WHO 10th IHR Meeting Press Release](#)
- [CDC](#)
- [CDC Travel Advisory for the Arabian Peninsula](#)
- [CDC Travel Advisory for ROK](#)
- [CDC MMWR](#)
- [ECDC](#)
- [AFHS Detecting and Reporting Guidelines for MERS-CoV](#)

Information and News

- [Funding committee formed for manufacture of MERS vaccine](#) (Arab News, 18 NOV)
- [Latest WHO DON on MERS-CoV in the Arabian Peninsula](#) (WHO, 13 NOV)
- [Army enters partnership to create MERS vaccine](#) (Vaccine News Daily, 13 NOV)
- [Riyadh home to 87 scientists to discuss the vaccine virus](#) (Corona) (KSA MOH, 12 NOV)
- [Human Coronavirus 229E Remains Infectious on Common Touch Surface Materials](#) (mBio, 10 NOV)
- [KSA MOH MERS CoV General Public Infographic Video](#) (KSA MOH, 2 JUL)
- [Multifacility Outbreak of Middle East Respiratory Syndrome in Taif, Saudi Arabia](#) (CDC EIDJ, JAN 2016)
- [Risk Factors for Primary Middle East Respiratory Syndrome Coronavirus Illness in Humans, Saudi Arabia, 2014](#) (CDC EIDJ, JAN 2016)
- [Variations in Spike Glycoprotein Gene of MERS-CoV, South Korea, 2015](#) (CDC EIDJ, JAN 2016)
- [83% of Korean MERS cases stemmed from 5 patients](#) (Korea Herald, 25 OCT)
- [40% of Recovered MERS Patients Experience Anxiety](#) (KBS, 17 OCT)
- [33% MERS infections occurred in hospitals](#) (Arab News, 10 OCT)
- [Persistent environmental contamination and prolonged viral shedding in MERS patients during MERS-CoV outbreak in South Korea](#) (IDSA, 10 OCT)
- [Researchers Create a Mouse that Can Get MERS](#) (MD Magazine, 8 OCT)
- [Differences in the seasonality of MERS-CoV and influenza in the Middle East](#) (IJID, SEP 2015)
- [Association of Higher MERS-CoV Virus Load with Severe Disease and Death, Saudi Arabia, 2014](#) (CDC EIDJ, SEP/NOV 2015)
- [Asymptomatic MERS-CoV Infection in Humans Possibly Linked to Infected Camels Imported from Oman to United Arab Emirates, May 2015](#) (CDC EIDJ, 10 AUG)
- [MERS coronavirus: Candidate vaccine gears up for clinical](#) (EurekAlert, 22 JUN)
- [Presence of Middle East respiratory syndrome coronavirus antibodies in Saudi Arabia: a nationwide, cross-sectional, serological study](#) (Lancet, 5 MAY)
- [WHO DON on first novel coronavirus infection](#) (WHO, 23 SEP 2012)