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## Short Communication

# New episode of Middle East Respiratory Syndrome Coronavirus outbreak in Saudi Arabia: an emerging public health threat



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Over the last five years, Middle East respiratory syndrome coronavirus (MERS-CoV) infection has emerged as a devastating public health menace.<sup>1</sup> The causative agent of infection is a newly defined, positive-sense, single-stranded RNA virus of the genus *Betacoronavirus*. Major signs and symptoms of MERS-related illness include fever, cough, shortness of breath, and respiratory complications. The first report of this novel viral infection came from Saudi Arabia in 2012.<sup>1</sup> The United Arab Emirates, Jordan, Oman, Qatar, and South Korea currently top the list of nations with verified incidence of disease.<sup>2</sup> All but the last of these is a constituent country of the Arabian Peninsula that shares a land border with Saudi Arabia. However, global commerce and international travel have facilitated the spread of the virus to what are now at least 27 countries that span Africa, Asia, Europe, and North America.<sup>2</sup>

The origins of transmission to humans are regarded as zoonotic, the dromedary (also known as the Arabian camel,

*Camelus dromedarius*) being considered as the putative natural reservoir host. A landmark study providing evidence of zoonosis was published in June 2014.<sup>3</sup> This demonstrated the successful isolation and genetic sequencing of MERS-CoV from an infected Saudi camel herder, a 43-year-old previously healthy male, and one of his nine animals, with which he came into intimate contact daily. Phylogenetic analysis of both isolates revealed their identical nature. The serological data collected from nasal swabs, blood, milk, urine, and rectal swabs confirmed this MERS-CoV isolate to be present in the sick camel but not in the other, healthy members of the herd nor was the virus detected in blood and nasal samples from the patient's family and friends prior to the onset of his illness. Further confirmatory studies utilizing subgenomic fragments of MERS-CoV for phylogenetic comparison indicated the similarity of the coronaviruses isolated from camels and from humans exposed to camels.<sup>4,5</sup> A few months prior to recognition of transmission to humans, dromedaries were identified as the reservoir host of MERS-CoV.<sup>6</sup> Other ungulates, as well as goats, sheep, and wild birds, were tested for neutralizing antibodies to MERS-CoV, but none have yet been detected.<sup>6</sup>

Together with camel-to-human transmission, once the virus is in the human community, infection may be acquired through person-to-person transmission, especially by household contacts<sup>7,8</sup> and in healthcare settings.<sup>8,9</sup> The respiratory symptoms of secondary infections are generally milder, and many cases are asymptomatic.<sup>7,9</sup> A delayed or

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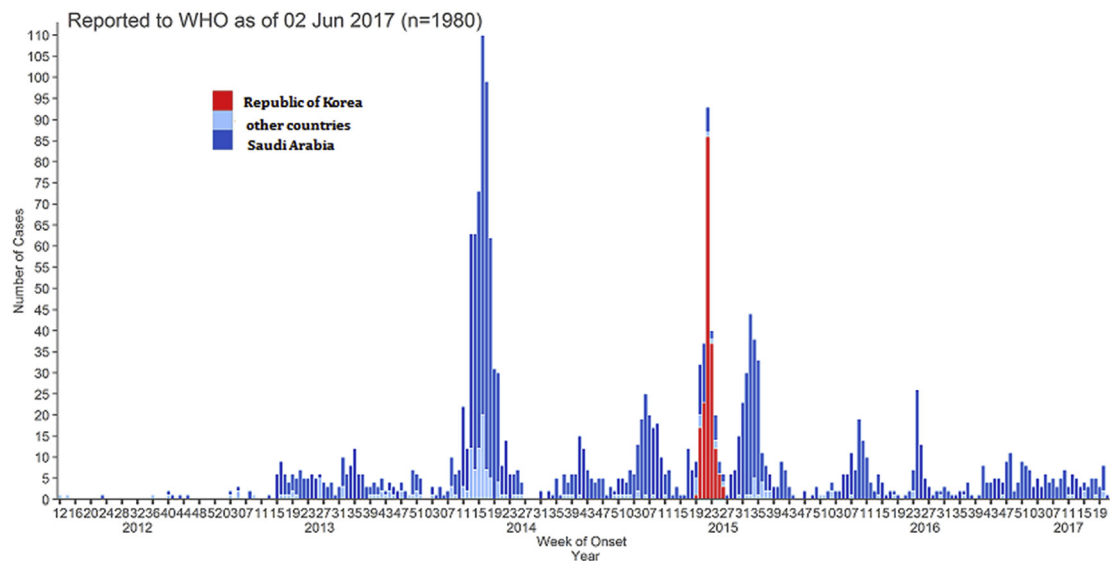
incorrect diagnosis of primary infection as a consequence of the asymptomatic nature of secondary exposure may be a contributory factor in disease progression. Although there is limited understanding of the mode by which the virus spreads between people, close contact enabling inhalation of respiratory aerosols is thought to be the most probable means of interpersonal transmission.<sup>10</sup> A report describing infection among healthcare workers<sup>10</sup> highlighted that a high proportion of infected individuals were associated with practices which generated aerosols, including intubation (71.4%), airway suctioning (57.0%), and sputum induction (28.6%). Based on statistics from the Saudi Health Ministry for MERS incidence since January 2015 that relate to the probable source of infection, 45% of cases are regarded as being of a primary nature, i.e. contracted from camels, 39% are healthcare-acquired, 12% are household contact-acquired, and in 4% of cases, the source remains unclassified.<sup>11</sup> These findings emphasize that alongside zoonosis, MERS-CoV has substantial capability to be disseminated between humans via close social contact.

Saudi Arabia remains endemic for the virus, and sporadic outbreaks of infection have been reported.<sup>1,12,13</sup> The most recent outbreak occurred in November 2016 when six people were hospitalized with MERS-related illnesses in four separate regions of the country.<sup>14</sup> From November 2016 to the end of February 2017, a total of 35 clinical cases were registered, with the highest mortality rate of 33.3% during January 2017.<sup>13</sup> Although it is thought that a person of any age can contract MERS, to date the 50–59 age group has been most affected,<sup>13</sup> which is perhaps a reflection of possible increased exposure to camels and camel products by farmers, abattoir workers, and market stall holders. According to the World Health Organization (WHO), from initial reports in 2012 until the present (WHO latest available data, June 2, 2017), 1980 MERS-CoV laboratory confirmed cases have been recorded worldwide,<sup>15</sup> resulting in 703 associated deaths.<sup>2</sup> The major share of both morbidity and mortality (>80%) is traced solely to Saudi Arabia (Fig. 1). The proliferation of outbreaks in this Arab sovereign state might be

attributed to progressive changes in camel husbandry that have resulted in the farming of a growing camel population in the increasingly close vicinity of expanding residential areas.

Currently, no suitable antiviral therapy exists for MERS-CoV; therefore the treatment is merely through supportive medication to alleviate symptoms of upper respiratory tract infection. Development of possible drug prophylaxis is progressing, and a candidate vaccine is anticipated in the near future.<sup>16</sup> Nevertheless, being a novel and hence under-researched human pathogen, to achieve vaccine efficacy in a short time presents a significant challenge. As around one in every three people who contract MERS dies as a result of acute febrile respiratory illness,<sup>2</sup> prevention is considered the sole control strategy. Low-technical measures include avoiding contact with camels at slaughter houses and recreational camel ride stations and the implementation of regular hand washing and other appropriate hygiene practices for whenever interaction with dromedaries cannot be reasonably avoided. The consumption of unpasteurized, raw or undercooked camel products such as milk, meat, and urine should be discouraged as per Centers for Disease Control and Prevention recommendations.<sup>12</sup> Healthcare workers should remain especially vigilant as a nosocomial outbreak might also prove to be deadly. Furthermore, as the symptoms of infection with MERS-CoV overlap with those of other respiratory disorders, notably the similarly coronavirus-caused zoonosis severe acute respiratory syndrome (SARS), earlier diagnosis, and prompt quarantine measures would serve as critical factors in the successful confinement of infected individuals.

Among the key challenges in combating MERS-CoV that need immediate attention are: a better understanding of the route of transmission from animals and the means of spread within a human population; assessment of possible risk factors for infection directly from humans or indirectly from the environment in occupational and healthcare settings; an integrated management approach involving collaboration between the public health and veterinary health sectors in affected regions



and in liaison with global health agencies in order to instigate improved management networks to implement effective infection control in humans and animals; and development of efficient and sensitive screening methods, especially of asymptomatic infection conditions, to ensure timely detection.

Being in a profession that greatly increases the risk of exposure to the virus, healthcare workers should adopt stringent precautionary measures when dealing with patients, performing waste management and cleansing duties, and when undertaking procedures that may generate aerosols. In the interest of restraining the potentially worldwide dissemination of infection, emphasis should be placed on global travel surveillance and epidemiological monitoring. Genome sequence analysis of virus isolates from the 2016 Jordanian outbreak indicated similarity with samples collected contemporaneously in neighboring Saudi Arabia.<sup>2</sup> Similarly, South Korea faced a massive outbreak when a contagious air traveler imported the virus from Saudi Arabia.<sup>2</sup> It is apparent that Saudi Arabia is the current hotspot for MERS, and control strategies at its land, sea, and air terminals are imperative to curtail the spread of the coronavirus to other regions. The present situation is of considerable importance in the context of foreign visitors to Saudi Arabia, since millions of Muslims from all over the world undertake pilgrimages to offer religious rituals at sacred Islamic sites, notably during the annual Hajj event. An integral part of such religious events is the distribution among the pilgrims and locals of meat prepared from abattoir-slaughtered livestock animals, including camels. It is therefore essential to ensure that the supplied animals are free of infection by subjecting them to scrupulous disinfection procedures, preferably under veterinary supervision.

As a disease of humans, MERS is in its early emergent period, and thus, effective and timely control measures would yield a high pay off. However, further spread of MERS-CoV beyond its primary focus in the Arabian Peninsula would pose a serious global public health threat, which could potentially escalate into a worldwide pandemic. As an essentially novel virus to which the general public has not been exposed, the full range of available news and social media initiatives should be exploited to raise community awareness regarding the dynamics of infection and to increase knowledge of prevention strategies. Specialist training initiatives should be organized to educate caregivers on how to adhere to a high standard of personal hygiene and healthcare workers on how to follow best practice in microbiological safety during patient handling and monitoring. As there is currently limited understanding of MERS-CoV infection pathogenesis and immunity, research on these aspects of disease pathology should be prioritized to gain deeper insights into the virus infection biology which will aid development of effective therapeutics.

## Author statements

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