

## Emerging Problems in Infectious Diseases

### Lessons to learn from MERS-CoV outbreak in South Korea

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#### Abstract

Since the first identification of Middle Eastern Respiratory Syndrome coronavirus (MERS-CoV) in 2012 the virus has infected 1289 humans with approximately 40% mortalities. Currently South Korea is experiencing the hospital-associated outbreak of MER-CoV that has infected 126 human cases and 13 deaths, as of 12 June 2015, following the return of a MERS infected patient from Middle East. The episode is characterized unique being the largest cluster of patients linked to the single introduction of virus that involves three generations of virus transmission. Human-to-human transmission though was observed on several occasions in past, it is documented as non-sustainable event. The recent outbreak including the healthcare workers, index case's roommates and their caregivers, raises several concerns about the infection control practices and timely diagnosis of MERS

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#### Introduction

Since Korean health officials on 20 May, 2015, reported the first imported case of Middle Eastern Respiratory Syndrome coronavirus (MERS-CoV) of the country [1] that further led to the largest transmission cluster of the disease worldwide involving 126 human cases and 13 deaths as of June 12, 2015, there has been great concern that whether this is beginning of new epidemic like SARS. The index patient of this outbreak was a 68-year old man who had a travel history of Saudi Arabia, Bahrain and Qatar before returning to South Korea on 4 May. Korean health authorities stated that the patient, initially asymptomatic, sought medical attention at four different local healthcare facilities with developing fever and cough after one week of his arrival from 11 to 20 May. He provided range of exposures to his family members, hospital roommates or ward mates and their caregivers as well as to the healthcare workers that resulted into nosocomial disease outbreak [1,2]. Another five facilities where

secondary cases were transferred provided platform for further disease transmission and appearance of tertiary cases (Figure 1). One of the secondary infected cases also travelled to Guangdong province of China via Hong Kong despite strict travel restrictions imposed by the treating physicians in Korea. The exposure times ranged from 5 minutes to few hours while incubation period ranged from 5 to 18 days, according to the data available by the World Health Organization (WHO) [3]. The outbreak is growing as tertiary cases started appearing from 1 June 2015 (Figure 2), more than 3000 people remain under quarantine and there has been closure of 700 schools located in nearby areas, as per local and international news resources [4]. The outbreak listed South Korea as the third most MERS affected country after Saudi Arabia and the United Arab Emirates [5].

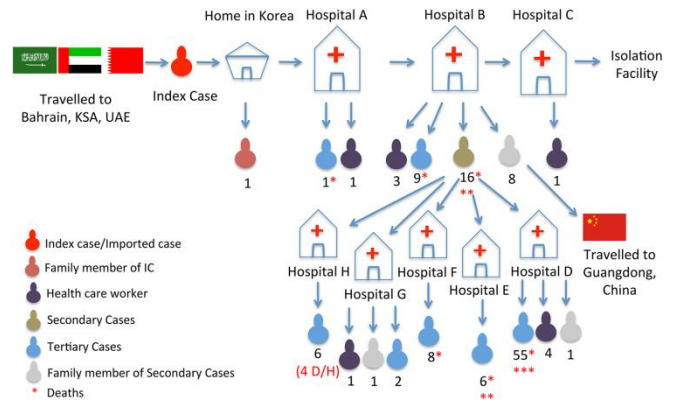
MERS-CoV was first identified in Saudi Arabia in June 2012 [6] and since then there have been 1289 infected cases with 40% mortalities [1,7]. The disease primarily epicentered in Arabian Peninsula has linked

to 23 countries via imported cases. The initial clinical signs include cough and mild fever that further develop into pneumonia, severe acute respiratory syndrome (ARDS), hypoxemic failure and multiple organ dysfunction (MOD), however mild cases are also observed [8]. MERS is a zoonotic origin disease might be transmitted to humans by dromedary camels who themselves remain asymptomatic [9].

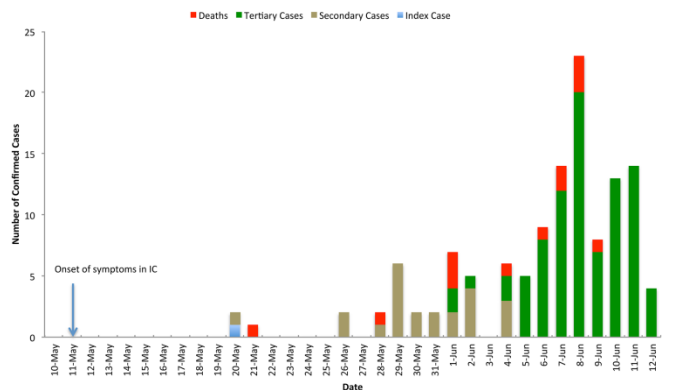
What we know about the disease transmission of MERS so far is that the virus is able to transmit among humans in limited fashion as secondary transmission has been observed in few households [10,11] and healthcare facilities [12-14]. Fortunately there is no sustained human-to-human transmission evidenced. Current South Korean outbreak raises few concerns about the disease transmission, as until now this is largest MERS cluster seen globally and the only one reported outside of Arabian Peninsula. In 2014, Jeddah region in Saudi Arabia reported marked increase in MERS cases which were further explained as secondary human-to-human transmission and healthcare associated amplifications but these cases did not follow the single introduction to the community [14] like what is observed in South Korea. In addition, the ongoing outbreak involves a number of healthcare-associated tertiary cases including ten deaths representing the three generations of transmission that is increasing over the period of time (Figure 2). In the past, tertiary transmission was observed on few occasions in Saudi Arabia, however their count remained low [14]. In South Korean outbreak, although tertiary cases are epidemiologically linked with secondary cases showing the evidence of direct contact between them, the risk of sustainable human-to-human transmission could not be ruled out.

The wide spectrum of MERS outbreak following the single introduction of human case in the community also raises the speculations about the superspreading events. Nonetheless the term is not new for MERS-CoV since cluster of 23 human cases following single introduction of virus has already been reported from Saudi Arabia [15]. Interestingly, tertiary cases also followed the single introduction of viral infected patient in these facilities suggest that these secondary cases also acted as superspreaders. One of the common features observed in MERS patients is the presence of mild cases [16] while the highest proportion of fatalities are observed among those with underlying comorbidities [17]. As of 12 June 2015, 13 deaths have been reported in South Korea after contacting with this virus. All of these patients were roommates or ward mates of index case or secondary

**Figure 1:** Transmission map of MERS-CoV outbreak in South Korea. According to Korean ministry of health, the hospitals are identified as Hosp A\_ Asan Medical center, Hosp B\_ St. Mary’s Hospital in Pyeontaek, Hosp C\_ 365 Yeol Lin Hospital, Hosp D\_ Samsung Seoul Hospital, Hosp E\_Kon Yang University Hospital, Hosp F\_Daejeon Dae Cheong Hospital, Hosp G\_Sacred Heart Hospital, Hallym University Dongtan, Hosp H\_Good Morning Hospital in Pyeongtaek.



**Figure 2:** Epidemiologic plot of confirmed cases linked to MERS-CoV outbreak in South Korea, May 20-June 12, 2015



cases and they had underlying diseases such as asthma, COPD, cardiovascular disease etc. while none of healthcare staff or patient caregiver is reported to be dead or severely ill. In addition, ratio of virus infection among apparently healthy people such as healthcare staff or caregivers was less than ill patients. It should be noted that severe cases were also not observed among healthcare staff in previous reports from Saudi Arabia [18]. Ten of the deaths are reported among tertiary case indicating the sustained infectivity and pathogenicity pattern of the virus despite multiple generations of infection.

The fact that most of secondary and tertiary cases of this outbreak are linked with different healthcare facilities, suggests inappropriate infection control measures and behavioral risk factors by the patients,

their caregivers and hospital staff that expose them to the infection. The situation raises two serious issues; firstly the key at this point is the timely identification of suspect cases. In this case, index case sought medical attention in four different healthcare facilities that failed to diagnose the disease on time. This gives us a lesson that window from the presence of a suspect case in community or healthcare facility to case confirmation play crucial role in disease spread. The larger the window is, the greater the spread will be. Secondly, we have seen that unfortunately medical evacuation in these hospitals right after identification of index case was delayed and did not help enough to halt further spread that indicates grave concern over the healthcare and infection control practices. This is the era of deadly respiratory viral infections where human being are at the forefront of dealing with the viruses such as MERS, avian influenza H5N1 and H7N9. Therefore infection control measures especially in those healthcare facilities that routinely deal with respiratory diseases such as respiratory, infectious diseases or emergency departments, should be revisited by healthcare watchdogs at national and international levels.

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