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Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Commentary

Middle East respiratory syndrome coronavirus infection control:
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Since the initial occurrence of Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012,^{1,2} the disease had caused 837 cases, with a case fatality rate of 34.7%.³ As with any emerging infectious diseases of pandemic potential there is a concern of the global spread of the disease. It is therefore the first priority of the global public health community to develop and implement the required infection control practices to prevent the dissemination of these emerging organisms within health care facilities (HCFs) and worldwide based on the best available evidence and previous experience with similar or related groups of pathogens. The World Health Organization (WHO) through its expert technical committees was prompt in developing its first infection control guidelines based on available knowledge on the new emerging virus, but it mostly drew on experience from a similar virus, severe acute respiratory syndrome coronavirus (SARS). These guidelines were updated based on accumulating experience from reports of MERS-CoV cases and clusters in the community and HCFs in affected countries and regions. This became particularly important with the third and largest wave of HCF-associated MERS-CoV cases reported from the Kingdom of Saudi Arabia and United Arab Emirates in April-May 2014.⁴ The initial cases were reported in hospital A in Jeddah with subsequent appearance of cases in 3 other hospitals. During the initial Jeddah outbreak, there were 5 involved hospitals: A-E. Hospital A had 3 cases: a community case and 2 health care workers (HCWs) assumed to have been infected from the first case. Hospital B had 2 community-acquired infections. Hospital C reported 1 community-acquired case. Hospital D had 1 fatal case in an HCW. The source of infection was believed to be the community; however, hospital-acquired infection could not be ruled out. Hospital E was where the main nosocomial cluster occurred. Hospital E is a large and busy referral teaching hospital where staff share accommodation. The emergency room is busy with an occupancy rate

of 578% for the 76 emergency beds. There were initially 4 community cases reported. Extensive screening of their contacts among HCWs and family members identified 26 laboratory-confirmed cases among HCWs (19 were asymptomatic), 1 family member, and 6 patient contacts. Careful review of the recent increase in the number of cases revealed that about 25% were among HCWs.⁴ Of the initial 128 recent MERS-CoV infected patients in Jeddah, Kingdom of Saudi Arabia, most (60%) were infected in the health care setting. Of those, 39 were HCWs.^{5,6} These 128 cases occurred between February 17, 2014, and April 26, 2014,⁶ and were treated in 14 hospitals in Jeddah. Most hospitals had 1 or 2 patients, and hospital E had 45 cases.⁶ Of these cases, 33% were primary cases.⁶ Of the 128 cases, 60% (including 39 HCWs) were from health care-acquired infection.⁶ An extensive screening of contacts showed that 7 of 554 household contacts (1.3%) were polymerase chain reaction positive for MERS-CoV⁶ compared with 3.03% of 462 family contacts screened during 2012-2013.⁷

Because the largest percentage of secondary human-to-human transmission occurs in HCFs,⁸ the critical question remains of whether the recent large multi-HCF clustering in 2014 was caused by failure of the evidence-based recommended infection control measures outlined by the WHO or failure of its strict application in the affected facilities. The WHO continues to stress 3 different approaches to infection control: contact precautions, droplet precautions, and airborne isolation.⁹ The use of contact precautions is thought to be needed because of the presence of diarrhea and vomiting in approximately 30% of cases.^{2,10,11} Although, there was no documented transmission of MERS-CoV through this route, the virus was isolated from stool in a few patients.¹² In addition, studies investigating environmental stability of MERS-CoV have revealed that MERS-CoV was stable at different temperature and humidity conditions and could still be recovered after 48 hours, which supports the potential of MERS-CoV to be transmitted via contact or fomite transmission because of prolonged environmental presence.¹³ Drawing on data from similar viruses, the potential transmission of viral respiratory infections by contacts was highlighted previously.¹⁴ Because MERS-CoV is similar to SARS in many aspects, patients with SARS had high virus concentrations and prolonged virus excretion in stools.¹⁵⁻¹⁷ Assessment of infection control

DOI of original article: <http://dx.doi.org/10.1016/j.ajic.2014.06.019>

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Conflicts of interest: None to report.

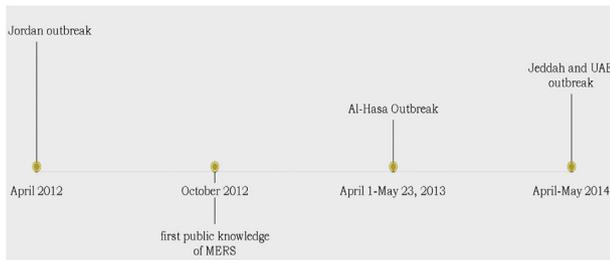


Fig 1. Timeline showing the occurrence of the 3 major health care-associated outbreaks.

practices applied in the affected HCFs during the peak of the outbreak conducted by local and international agencies concluded that the Jeddah outbreak was related to poor compliance with the recommended basic infection control measures.¹⁸ The finding is supported by similar observations from SARS. During the SARS outbreak, the infection in health care settings was further exaggerated by overcrowding, short distance between patient beds, inadequate ventilation, use of aerosol-generating techniques, and during cardiopulmonary resuscitation.^{19,20} The WHO report on infection control measures for severe acute respiratory infections also elucidated the major risks associated with high-risk aerosol-generating procedures.⁹ The recommendations to use droplet precautions for all patients admitted with confirmed or suspected MERS-CoV, except in aerosol-generating procedures, come from the understanding of the Al-Hasa outbreak.² During that outbreak, a total of 23 patients were recorded across 4 health care settings. The outbreak was controlled with implementation of the basic infection control measures without airborne isolation.^{2,21} The recommendation also relies on the fact that viral respiratory tract infections (eg, SARS) spread by large ($\geq 10 \mu\text{m}$ in diameter) respiratory droplets.²² There is a clear seasonal disease activity because the Zarqa, Jordan, outbreak was in April 2012, the Al-Hasa outbreak was in April–May 2013, and the Jeddah and United Arab Emirates outbreak was in April–May 2014 (Fig 1). Therefore, exposure of HCWs is more likely during these months because of increased community cases.^{23,24}

Airborne infection isolation (AII) precautions should be applied during any aerosol-generating procedures as recommended by the WHO.^{21,25} During the SARS outbreak, aerosol-generating procedures associated with increased risk of transmission of SARS were intubation, tracheotomy, and manual ventilation.²⁶ Indeed, in the only study addressing the risk of MERS-CoV transmission among HCWs, the reported staff were involved in at least 1 of the following high-risk procedures: intubation, airway suctioning, and sputum induction.²⁷ The Centers for Disease Control and Prevention in the United States and European Centre for Disease Prevention and Control continue to recommend the application of AII precautions when caring for patients with MERS-CoV.²⁸ These recommendations and the recommendations from other experts rely on the fear of the disease and high case fatality rate.²⁹ In a recently published debate, the presented evidence supported the use of droplet precautions, not aerosol-generating procedures.²⁹ A recent study showed that MERS-CoV RNA was isolated from the barn of camels linked to a human MERS-CoV case suggesting possible aerosolization of MERS-CoV.³⁰ The study had several limitations, including the following: it was only 1 positive sample; there was a lack of internationally acceptable sampling strategies of the air, and the sequences are all 100% identical to all other sequences from the patient, camel, and laboratory, which suggests contamination; there was a lack of proof of the causation of aerosol dissemination of the virus; and finally, the viral load in the air sample was higher than the viral load in the camel's nose.³⁰ In addition, there are no established methods for sampling airborne exposures.³¹

For the transmission of SARS, and this is likely true with MERS-CoV, multiple factors play a role in the propagation of infection in a health care setting. These factors include the following: lax basic infection control procedures, aerosol-generating procedures, improper use of personal protective equipment, and mouth exposure to patients' body fluids and excretions.^{32–38} Teasing out the most important factors contributing to HCW infection of SARS, MERS-CoV, or emerging respiratory viruses is of paramount importance. In addition, the utilization of maximum respiratory protection is easily applied when there are a few cases, but this strategy puts a burden on any health care system when the number of cases increases substantially. When resources are available, using AII precautions in conjunction with contact precautions would provide the best protection for HCWs.

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