Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Transmission among healthcare worker contacts with a Middle East respiratory syndrome patient in a single Korean centre

T. Kim[1], J. Jung[1], S.-M. Kim[1], D.-W. Seo[2], Y. S. Lee[2], W. Y. Kim[2], K. S. Lim[2], H. Sung[3], M.-N. Kim[3], Y. P. Chong[1], S.-O. Lee[1], S.-H. Choi[1], Y. S. Kim[1], J. H. Woo[1] and S.-H. Kim[1]

1) *Department of Infectious Diseases,* 2) *Department of Emergency Medicine and* 3) *Department of Laboratory Medicine, Asan Medical Centre, University of Ulsan College of Medicine, Seoul, Republic of Korea*

Original Submission: 2 September 2015; **Accepted:** 7 September 2015

Editor: D. Raoult

Article published online: 15 September 2015

Corresponding author: S.-H. Kim, Department of Infectious Diseases, Asan Medical Centre, University of Ulsan College of Medicine, 88 Olymphic-ro-43-gil, Songpa-Gu, Seoul, 138-736, Republic of Korea
E-mail: kimsunghanmd@hotmail.com

Middle East respiratory syndrome (MERS) is mainly transmitted via droplet and contact routes [1]. Therefore, only close contact within 3–6 feet from an infected patient for a long time has been believed to be needed for transmission, except in the case of aerosol-generating procedures [2]. However, data on the minimal requirements regarding close contact and length of contact are limited. We describe an investigation of the nosocomial transmission of MERS among healthcare workers (HCWs) exposed to a fatally ill index patient with MERS during his 27-min stay in the emergency department.

On 26 May 2015, a severely ill patient who had not been classified as a close contact with the first MERS-confirmed patient was transferred from a hospital in Gyeonggi Province, the first epidemiological hot spot hospital in the South Korea outbreak, to the emergency department of a tertiary-care centre in Seoul, South Korea. Because of overcrowding in the emergency department on that day, he remained there for 27 min, without there being any suspicion of MERS, and was then, upon his own request and after cancelling his hospital registration, moved to another hospital, where he was identified as the sixth confirmed MERS case in South Korea on 28 May [3]. Then, he was transferred to the MERS-designated hospital, and he finally died on 3 June 2015. On 28 May 2015, we received a report from the Korea Centres for Disease Control and Prevention (KCDC) that this index patient was positive for RT-PCR for MERS coronavirus (MERS-CoV). At that point, we were concerned about possible nosocomial transmission from the patient. An epidemiological investigation of all HCWs who had been in contact with the patient was immediately initiated via emergency department security closed circuit television to identify all HCWs who had been in contact with the index patient. We identified a total of 31 HCWs in the emergency department during his 27-min stay. Of these 31 HCWs, nine were classified as having been within 3–6 feet of the patient. These nine HCWs were quarantined at home and monitored for 14 days. If fever or respiratory symptoms developed, RT-PCR for MERS was immediately performed by the KCDC. One individual became symptomatic. Sera were collected from the other eight HCWs approximately 3 weeks after their exposure to the index patient. Serum from the symptomatic HCW, who was finally diagnosed with MERS by RT-PCR performed in the KCDC, was collected approximately 6 weeks after his exposure to the index patient upon his recovery from MERS.

To investigate subclinical MERS infection, serum specimens collected 3–6 weeks after exposure were screened for MERS-CoV-specific IgG with a recombinant nucleocapsid-based ELISA (Alpha Diagnostic International, San Antonio, TX, USA). Sera were considered to be positive when the optical density (OD) values were at or above a 0.28 cut-off value (mean absorbance at 450 nm of sera from individuals not exposed to MERS-CoV plus three standard deviations) [4].

A total of nine HCWs were in contact within 3–6 feet of the index patient in the emergency department during his 27-min stay (Fig. 1). Detailed demographic, duty and exposure information is given in Table S1. One doctor in the triage area wore an N95 respirator, six HCWs wore surgical masks, and the remaining two HCWs wore neither N95 respirators nor surgical masks (Fig. 1). None of the HCWs used goggles and gloves. One security guard complained of fever on the 13th day after exposure, and was diagnosed with MERS pneumonia by positive real-time RT-PCR. Detailed closed circuit television analysis revealed that he had remained within 3–6 feet of the index patient without any personal protective equipment for 10 min, and had talked with him for 2 min; there was no evidence that he had touched the patient or the devices around him in the emergency department (Fig. 1). His convalescent serum gave a positive ELISA result (OD value of 3.22). No subclinical infection was detected among the remaining eight HCWs by serology for MERS; the cut-off OD value was 0.28, and the ODs of the eight HCWs were <0.28 (mean 0.07 ± standard deviation 0.05).

The KCDC guidelines define close contact as being within approximately 6 feet of the patient, or within the room or care area, 'for a long time' [2]. However, this time definition is

http://dx.doi.org/10.1016/j.cmi.2015.09.007

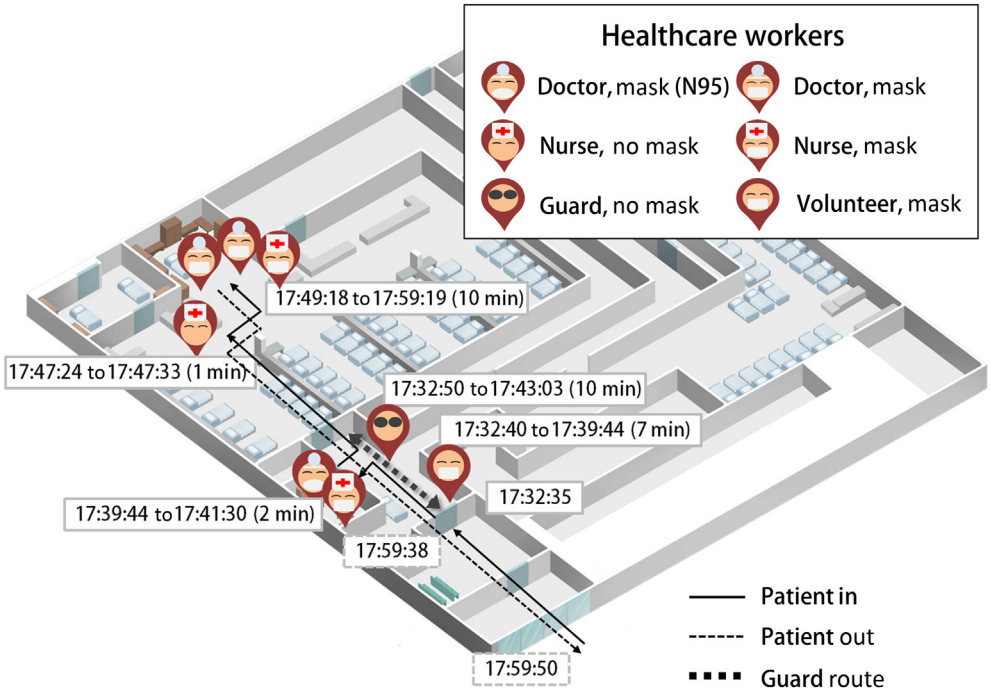

FIG. 1. Floor plan of the index patient's movements during his stay in the emergency department. Numbers indicate hours/minutes/seconds recorded on close circuit television in the emergency department.

somewhat vague. Actually, the initial KCDC MERS control guidelines described close contact as staying within 6 feet of the patient for >1 h [5]. This time period of 1 h is rather arbitrary, but the government released this figure for practical reasons. However, data on the minimal requirements for defining close contact and length of contact are limited. We show that a 10-min stay and 2 min of talking within 3–6 feet of a severely ill patient with MERS is enough for the transmission of MERS-CoV. We assume that the initial idea that a 'relatively long time period' was required for the transmission of MERS-CoV, which guided the initial investigation of close contacts of the first case imported into South Korea, may have been responsible for the initial failure of contact-tracing in the KCDC response. Our data for the minimal duration of contact with HCWs for the transmission of MERS-CoV will be important for developing guidelines describing more specific behaviours and times for the definition of close contact.

Some argue that the security guard who acquired MERS-CoV could have been infected from some other unknown source. A relatively long incubation period (13 days) may increase this possibility. However, he did not work on 28 May, owing to being off-duty, and he was quarantined at home from 29 May, and so had no opportunity for contact with other sources. Actually, two patients experienced transmission from the index patient (sixth confirmed patient); one is the security guard in our hospital and the other is a family member [3]. This family member also had the same incubation period (13 days). This suggests that low viral shedding from the index patient might result in a long incubation period.

Transparency declaration

There are no potential conflicts of interest for any authors.

Acknowledgements

This work was supported by grants from the Asan Institute for Life Sciences (2015-0193).

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.cmi.2015.09.007.

References

[1] Chan JF, Lau SK, To KK, Cheng VC, Woo PC, Yuen KY. Middle East respiratory syndrome coronavirus: another zoonotic betacoronavirus causing SARS-like disease. Clin Microbiol Rev 2015;28:465–522.

[2] Centers for Disease Control and Prevention. MERS. Intrim guidance for healthcare professionals. Available at: http://www.cdc.gov/coronavirus/mers/interim-guidance.html [accessed 20.08.15].
[3] Ki M. MERS outbreak in Korea: hospital-to-hospital transmission. Epidemiol Health 2015;37:e2015033.
[4] Al-Abdallat MM, Payne DC, Alqasrawi S, Rha B, Tohme RA, Abedi GR, et al. Hospital-associated outbreak of Middle East respiratory syndrome coronavirus: a serologic, epidemiologic, and clinical description. Clin Infect Dis 2014;59:1225–33.
[5] Korea Centers for Diseases Control and Preventions. Guidance for MERS, 2nd edn. Available at: http://www.cdc.go.kr/CDC/info/CdcKrHealth0295.jsp?menuIds=HOME001-MNU1132-MNU1013-MNU1509-MNU1915&cid= [accessed 20.08.15].