**SUPPLEMENTARY MATERIALS**

**Description of HCP and the screening strategy in the hospital-associated outbreak**

On May 17, the first case of MERS in Korea (Patient A) visited our hospital and 27 HCP were quarantined due to unprotected close exposure to the patient. Ten days later, a secondary case (Patient B) who was infected with MERS-CoV from Patient A while staying at the same hospital was admitted at our ED. As he had remained in our ED for three days prior to recognition of his contact history, the exposure was extensive. This exposure generated 82 tertiary cases including eight HCP, making it the most extensive super-spreading event during the 2015 Korean MERS outbreak. 89 HCP were quarantined from this exposure, and additional 716 HCP were quarantined from exposure to part of the 82 tertiary cases. In the late phase of the outbreak, two tertiary cases who were managed in our hospital (Patient C and D) transmitted MERS-CoV to seven HCP caring for MERS patients despite application of standard PPE, and additional 205 HCP were quarantined from exposure to these seven quaternary cases. Quarantined HCP were monitored for two weeks from exposure, and those who experience any MERS-like symptom were tested sputum rRT-PCR repeatedly with 48-hr interval till symptom resolution. Thereafter, all quarantined HCP were additionally tested a screening rRT-PCR assay before returning to general patient care. Among the 45 MERS-CoV infected patients managed in our hospital, only four of them additionally transmitted MERS-CoV to others (Patient A, B, C, and D) and were considered as highly infective MERS patients. 59 out of 189 HCP (31.2%) closely exposed to these highly infective patients consented to this study for serologic investigation. Although enrolled HCP were younger than refused HCP, proportion of male sex, exposure duration, and MERS-like symptom experience were not statistically different between enrolled and refused HCP (Supplementary Table 1).

In managing MERS patients, HCP were cohorted such that those assigned to MERS patient care would not care for general patients. Assigned HCP were monitored and symptomatic HCP were isolated and tested rRT-PCR as the same way with exposed HCP. After the development of MERS-CoV infection in four assigned HCP despite application of PPE, one-point screening rRT-PCR was performed in all assigned HCP which detected three additional asymptomatic infections. After the end of MERS patient care, assigned HCP were quarantined at home for two weeks and rRT-PCR tested twice before being allowed to care for general patients. After the outbreak, among these 247 HCP assigned to MERS patient care, 130 HCP (52.6%) consented to the study. Demographics, ICU patient care, and MERS-like symptom experience were not statistically different between enrolled and refused HCP (Supplementary Table 1).

**Supplementary Table 1. Demographics, exposure risks, and MERS-like symptom experience of HCP who were enrolled and refused to participate in the study**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** |  | **Exposed HCP (n=189)** | | |  |  | **Assigned HCP (n=247)** | | |  |
| **Enrolled**  (n=59) | | **Refused**  (n=130) | ***P* value** | | **Enrolled**  (n=130) | | **Refused**  (n=117) | ***P* value** | |
| Age | 30.2 ± 6.1 | | 33.3 ± 8.6 | 0.005 | | 29.7 ± 5.8 | | 30.0 ± 6.3 | 0.759 | |
| Male sex | 18 (30.5%) | | 47 (36.4%) | 0.428 | | 18 (13.8%) | | 23 (19.7%) | 0.220 | |
| Exposure duration, days | 1 (1-2) | | 1 (1-2) | 0.139 | | N/A | | N/A | N/A | |
| ICU patient care | N/A | | N/A | N/A | | 72 (55.4%) | | 79 (67.5%) | 0.051 | |
| Symptoms within 2wks. | 15 (25.4%) | | 18 (13.5%) | 0.063 | | 27 (20.8%) | | 25 (21.4%) | 0.908 | |

Data are expressed as the number (%) of patients, mean ± SD, or median (IQR).

Abbreviations: MERS, Middle East respiratory syndrome; HCP, healthcare personnel; N/A, not available; ICU, intensive care unit

**Supplementary Table 2. Characteristics and antibody response of HCP exposed to four highly infective MERS patients**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Total** (n=59) | **HCP exposed to** | | | |
| Patient A (n=3) | Patient B (n=38) | Patient C (n=8) | Patient D (n=10) |
| **Patient factors** |  |  |  |  |  |
| Pneumonia |  | Yes | Yes | Yes | Yes |
| Cough and sputum |  | Yes | Yes | Yes | Yes |
| MERS transmission\* |  | 0 (27†) | 82 | 1 | 6 |
| Epidemiologic impact  on the outbreak |  | Index case of the outbreak | Infected 82 tertiary cases | The highest viral load | HCP transmission wearing PPE |
| Quarantined HCP | 189 | 27 | 89 | 37 | 36 |
| **HCP factors** |  |  |  |  |  |
| Enrollment percent | 31.2% | 11.1% | 42.7% | 21.6% | 27.8% |
| Age | 30.2 ± 6.1 | 33.0 ± 3.5 | 30.4 ± 6.6 | 30.8 ± 6.3 | 28.0 ± 3.8 |
| Male sex | 18 (30.5%) | 0 (0.0%) | 18 (47.4%) | 0 (0.0%) | 0 (0.0%) |
| Underlying comorbidity | 5 (8.5%) | 0 (0.0%) | 2 (5.3%) | 1 (12.5%) | 2 (20.0%) |
| Exposure duration, days | 1 (1-2) | 1 (1-N/A) | 1 (1-2) | 1 (1-2) | 2 (1-2) |
| Symptoms within 2wks. | 15 (25.4%) | 1 (33.3%) | 10 (26.3%) | 0 (0.0%) | 4 (40.0%) |
| Fever/myalgia | 9 (56.2%) | 1 (100%) | 6 (54.5%) | N/A | 2 (50.0%) |
| Headache | 1 (6.2%) | 0 (0.0%) | 0 (0.0%) | N/A | 1 (25.0%) |
| Cough/sputum | 3 (18.8%) | 0 (0.0%) | 2 (18.2%) | N/A | 1 (25.0%) |
| Sore throat/rhinorrhea | 4 (26.7%) | 1 (100%) | 2 (18.2%) | N/A | 1 (25.0%) |
| Diarrhea | 5 (31.2%) | 0 (0.0%) | 3 (27.3%) | N/A | 2 (50.0%) |
| Symptom duration, days | 3 (2-5) | 5 | 3 (2-8) | N/A | 3 (2-3) |
| **MERS-CoV Ab test** |  |  |  |  |  |
| Days from exposure | 76 (72-29) | 104 (95-N/A ) | 76 (72-79) | 85 (82-86) | 68 (66-69) |
| ELISA IgG OD ratio |  |  |  |  |  |
| Mean ± SD | 0.09 ± 0.05 | 0.10 ± 0.01 | 0.10 ± 0.05 | 0.08 ± 0.02 | 0.07 ± 0.01 |
| Median, IQR | 0.08, (0.06-0.10) | 0.10, (0.09-N/A) | 0.07, (0.06-0.11) | 0.07, (0.06-0.10) | 0.06, (0.05-0.08) |
| OD ratio ≥ 0.2 | 3 (5.1%) | 0 (0.0%) | 3 (7.9%) | 0 (0.0%) | 0 (0.0%) |
| Confirmatory tests‡ |  |  |  |  |  |
| Positive IFA | 0 (0.0%) | N/A | 0 (0.0%) | N/A | N/A |
| Positive PRNT | 0 (0.0%) | N/A | 0 (0.0%) | N/A | N/A |

Data are expressed as the number (%) of patients, mean ± SD, or median (IQR). \*In-hospital transmission in our hospital. †Transmission from Patient A occurred exclusively outside of our hospital. ‡Samples with an ELISA OD ratio ≥ 0.2 were selected for confirmatory tests, which is approximately three-fold of the median (0.06) value of control samples of the present study.

Abbreviations: MERS, Middle East respiratory syndrome; HCP, healthcare personnel; PPE, personal protective equipment; PCR, polymerase chain reaction; Ab, antibody; N/A, not applicable; ELISA, enzyme linked immunosorbent assay; OD, optical density; SD, standard deviation; IQR, interquartile range; IFA, immunofluorescence assay; PRNT, plaque reduction neutralization test

**SUPPLEMENTARY FIGURE LEGENDS**

**Supplementary Figure 1. Comparison of anti-MERS-CoV IgG ELISA OD ratios of the controls, exposed HCP, and assigned HCP**

Although statistical difference of ELISA OD ratios between the three categories was observed (*P* < 0.001), none of tested sera confirmed to be positive by IFA and PRNT.

Abbreviation: MERS-CoV, Middle East respiratory syndrome coronavirus; ELISA, enzyme linked immunosorbent assay; OD, optical density; HCP, healthcare personnel; IFA, immunofluorescence assay; PRNT, plaque reduction neutralization test

**Supplementary Figure 2. Anti-MERS-CoV IgG ELISA OD ratios presented according to age of tested individuals**

Although median of ELISA OD ratio were higher in HCP and two false-positive results were observed in old ages, there were no statistical relationship between age and OD ratios in both negative controls and HCP (*P* = 0.178 and *P* = 0.416, respectively).

Abbreviation: MERS-CoV, Middle East respiratory syndrome coronavirus; ELISA, enzyme linked immunosorbent assay; OD, optical density; HCP, healthcare personnel