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Letter to the Editor

Investigation of a nosocomial outbreak of coronavirus disease 2019 in a paediatric ward in South Korea: successful control by early detection and extensive contact tracing with testing

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To the Editor

The containment of nosocomial transmission of coronavirus disease 2019 (COVID-19) poses a particularly difficult challenge [1]. We recently experienced a nosocomial outbreak in a paediatric ward in a tertiary care hospital in Seoul, South Korea, which was a transmission case from a child to an adult. The index patient was a previously healthy 9-year-old girl. On 25 March 2020, the patient presented to the emergency room of Hospital X in Gyeonggi-do, South Korea (located 30 km northwest of our hospital) with a 1-day history of headache. She underwent brain CT, which showed intracerebral and intraventricular haemorrhage. She stayed with another patient (patient A) in the same multi-patient room for 1 day between 25 and 26 March. Patient A was diagnosed with COVID-19 later.

On 26 March, the index patient was referred to our paediatric emergency room. She did not have respiratory symptoms or pneumonia. The child developed a fever (38.1°C). On 27 March she was admitted to a single room in the paediatric general ward in our hospital. The initial PCR result for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a nasopharyngeal swab

specimen was negative, so she was moved to a six-patient room. She did not receive any aerosol-generating procedure. Closed-circuit television footage revealed that the index patient did not wear masks most of the time.

On 31 March, the Korea Centre for Disease Control and Prevention notified of a nosocomial outbreak at Hospital X through a daily press release. We therefore immediately screened all inpatients who had recently visited that hospital, including the index patient. The patient's second SARS-CoV-2 PCR results were positive (Ct value for *E* gene, 14.35) on 31 March. She was still asymptomatic without any evidence of pneumonia on chest CT.

The index patient was promptly admitted to a negative-pressure isolation room and the paediatric wards were put under cohort isolation. The method used for contact-tracing is described in the Supplementary material (Appendix S1). Upon thorough contact tracing, we identified a total of 1206 close and casual contacts (219 inpatients with guardians, 81 discharged patients with guardians, 48 visitors and 858 health-care workers); among them, 81 were close contacts (see Supplementary material, Fig. S1). Except for 54 discharged patients and their guardians, 1152 (96%) contacts underwent SARS-CoV-2 PCR tests at our hospital.

The results were negative for all of the close and casual contacts including the index patient's parents and a total of 18 patients and caregivers staying in the six-patient room with the index patient except for one—on 4 April, a 40-year-old mother of a hospitalized infant (22 days after birth) who shared the six-patient room directly across from the index patient (approximately 3-m distance) showed positive results in her nasopharyngeal swab specimen (Ct value for *E* gene, 19.28). This mother (patient B) had spent 2 hours in the six-patient room on 28 March and 20 hours from 30 to 31 March (Fig. 1, and see Supplementary material, Fig. S2). Patient B had gone home before the index patient was diagnosed with COVID-19. Eventually, she returned to the cohort ward on 3 April to care for her infant. The infant had negative SARS-CoV-2 PCR results. Patient B was initially asymptomatic but developed anosmia and hypogeusia 3 days after the diagnosis without pneumonia on chest CT. Closed-circuit television monitoring for contact-tracing of

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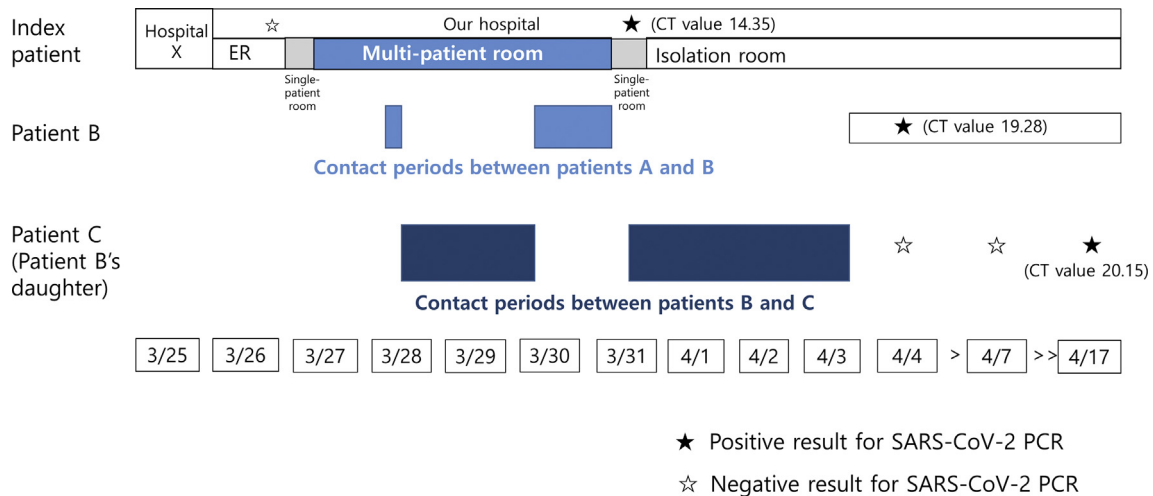


Fig. 1. Chronology of the three individuals with COVID-19 including contact history and SARS-CoV-2 PCR results.

patient B in our hospital revealed eight additional close contacts with patient B.

We performed SARS-CoV-2 PCR for all inpatients and their guardians in the cohort isolation wards every 3 days and whenever a symptom developed. Among health-care workers of contacts, close contacts tested for SARS-CoV-2 initially, 2 weeks after isolation, and at symptom onset. All showed negative results in a total 2639 tests and were released from isolation on 15 April.

On 17 April, the 2-year-old daughter of patient B (patient C) who had contact with patient B at home and quarantined showed a positive PCR result. Her previous PCR tests performed on 4 and 7 April were both negative. Patient C was asymptomatic and her chest X-ray showed no signs of pneumonia.

Our prevention measures for the transmission of COVID-19 included early isolation of index patients with cohort isolation and meticulous investigation of contacts with PCR tests. These may be helpful in restricting the number of secondary transmissions in a multi-patient room. However, some balancing between isolation period and the extent of cohort isolation is needed based on the accumulative nosocomial outbreak data of SARS-CoV-2 infection.

There have been limited reports of transmission from a child to adult in family [2]. A recent survey of the literature could not provide any evidence of transmission from children to adults [3]. One Chinese language paper reported the possibility that a 3-month-old infant transmitted SARS-CoV-2 to her father and mother [4]. It is worth noting that our index patient underwent a SARS-CoV-2 PCR test at admission due to fever (might be caused by intracerebral haemorrhage), but this was negative as she was in the incubation period. The cost-effectiveness of universal screening at admission in areas with various COVID-19 activities is not known. However, if patients are in the incubation period after exposure, as in our case, then they may be negative at the admission screening test. Careful interpretation of negative results of screening at admission is needed.

In conclusion, our data indicate that transmission from asymptomatic children with COVID-19 to adults can occur. Early detection of an asymptomatic case based on an epidemiological link followed by extensive contact-tracing and testing for SARS-CoV-2 appears to be important in effectively containing a nosocomial outbreak of COVID-19.

Transparency declaration

The authors have disclosed no conflicts of interest.

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Research ethics

This study was approved by the Institutional Review Board of our hospital with waiver of consent (IRB no. 2020-0653).

Authors' contribution

JJ, EOK and SHK contributed to conceptualization and methodology; the investigation was by JJ, MJH, EOK, JL and M-NK. Writing of the original draft and visualization was by JJ and SHK; and review and editing were by JJ, MJH, EOK, JL, MNK and SHK.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cmi.2020.06.021>.

References

- [1] Vanhems P. Fast nosocomial spread of SARS-CoV2 in a French geriatric unit Lyon Study Group on Covid-19 infection. *Infect Control Hosp Epidemiol* 2020;41:866–7. <https://doi.org/10.1017/ice.2020.99>.
- [2] Yang ZD, Zhou GJ, Jin RM, Liu ZS, Dong ZQ, Xie X, et al. Clinical and transmission dynamics characteristics of 406 children with coronavirus disease 2019 in China: a review. *J Infect* 2020. <https://doi.org/10.1016/j.jinf.2020.04.030>. Epub ahead of print.
- [3] Boast A, Munro A, Goldstein H. An evidence summary of paediatric COVID-19 literature. Don't forget the Bubbles; 2020. <https://doi.org/10.31440/DFTB.24063>. Available at: .
- [4] Zhang Y, Lin D, Xiao M, Wang J, Wei Y, Lei Z, et al. 2019 novel coronavirus infection in a three-month-old baby. *Chin J Pediatr* 2020;58:182–4 (Chinese language).