Role of super-spreader phenomenon in a Covid-19 cluster among healthcare workers in a Primary Care Hospital

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Letter to the Editor

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We read with great interest the recent publication of Majra et al.[1] focusing on "societal" superspreading events (SSE) as a major risk factor for epidemic spread.

We report another situation of SSE with a nosocomial cluster amongst healthcare workers (HCW) in Tenon Hospital, Paris, France, a middle-sized hospital of 525 beds, between February 21 and March 6, following the admission of our first confirmed COVID-19 case.

A suspected COVID-19 case was someone exhibiting compatible symptoms who had been in direct or indirect contact with the index case. A confirmed case was a suspected case with laboratory confirmation through real time reverse transcriptase polymerase chain reaction (RT-PCR) performed on a nasopharyngeal swab.

We classified contacts according to their level of exposure. Moderate/high-risk HCW self-isolated at home for 14 days after their last exposure and monitored their symptoms. Confirmed cases self-isolated for 14 days or at least for 7 days, and 48 h after resolution of their symptoms. They were contacted every 48 h. French General Data Protection Regulation approved data analysis (CNIL: N°2,217,729).

COVID-PRESTO® is an IgG/IgM rapid test with 100% sensitivity 15 days after symptom onset and 100% specificity in RT-PCR negative patients[2].

Our index case was an 83-year-old man coming back from Algeria. He came to the emergency room (ER) on February 21, 5:53pm. Exhibiting asthenia, fever, and shortness of breath since February 19, he had to wear a surgical mask upon his arrival. The blood work showed an acute renal failure KDIGO III on stage IV chronic kidney disease (CKD), associated with atypical immune-

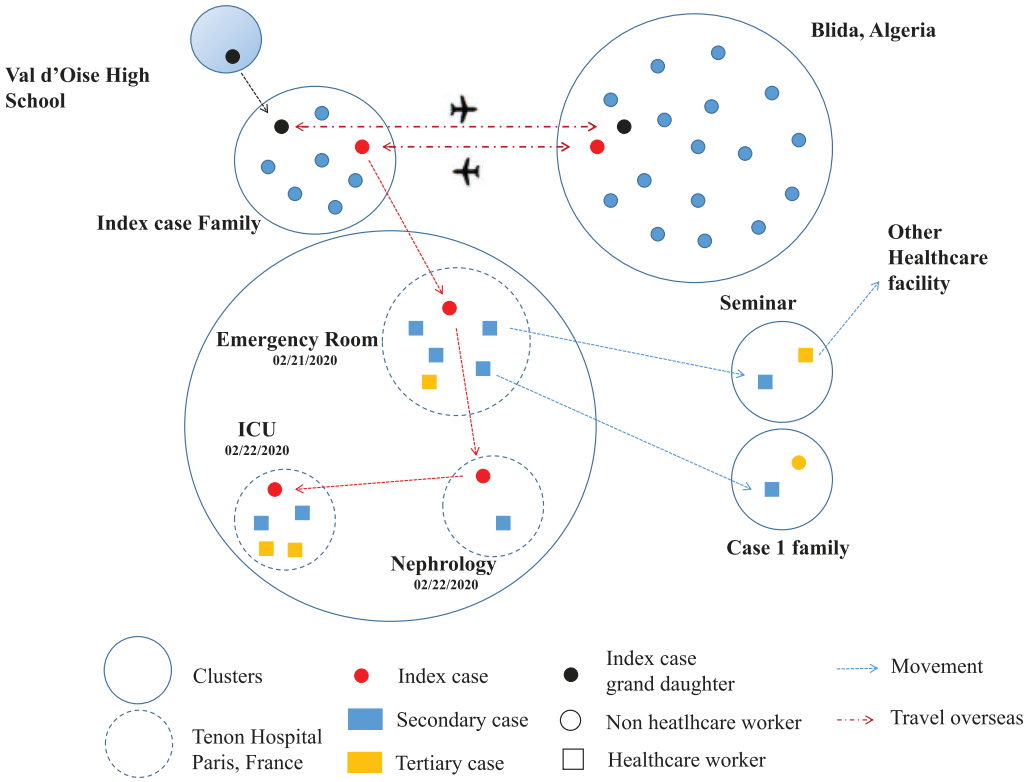
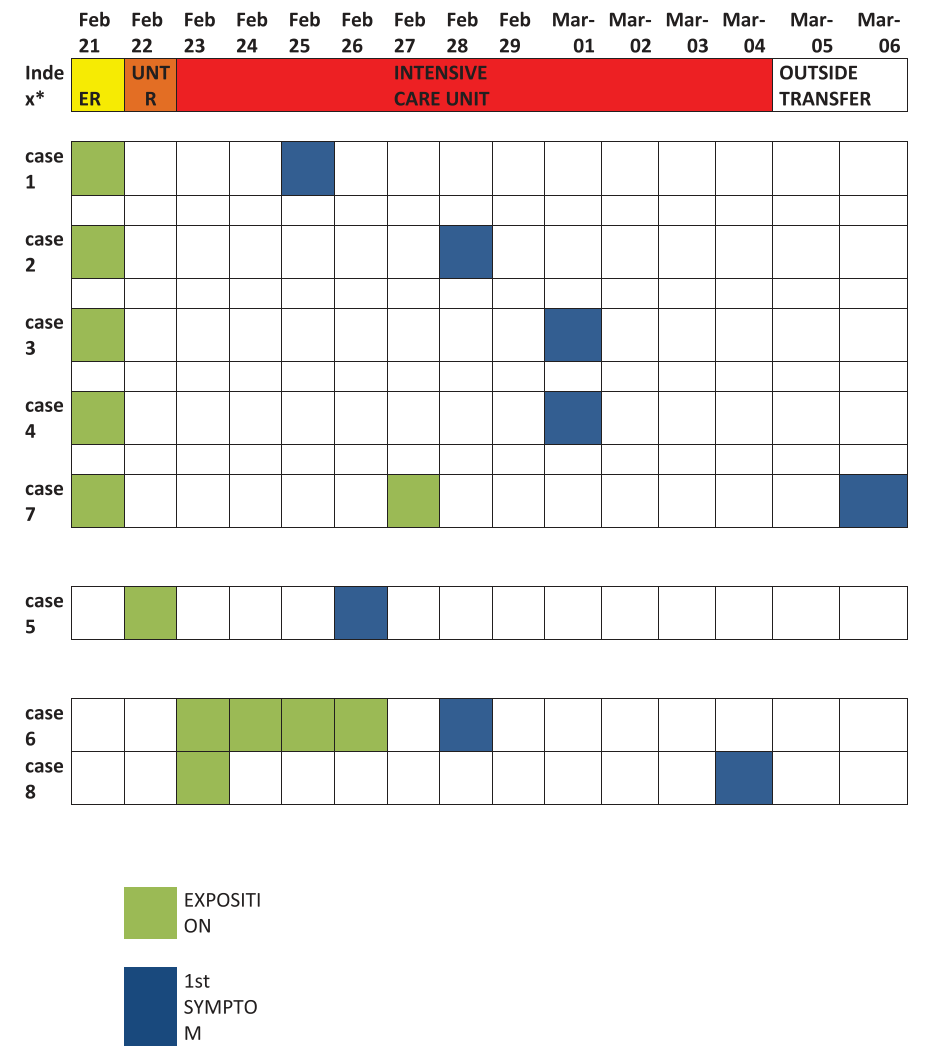


Fig. 1. summarizes secondary cases. In the ER, ten staff members were considered moderate/high-risk. Contact with the patient occurred on February 21. Two nurse's aides (cases 1–2) and two student nurses (cases 3–4) tested positive with symptom onset ranging from February 25 to March 1. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 1
Secondary cases timeline.



* Hospital ward transfers of the Index Patient; ER: Emergency Room; UNTR: NephrologyIntensive Care

related glomerulonephritis treated two years before by rituximab and corticosteroids. He was admitted to the nephrology ward on February 22, 11:17am for its possible recurrence. Airborne precautions were implemented 30 min later for a potential influenza. He was transferred to the intensive care unit (ICU) the same day at 10:12pm. After a night of high-flow nasal oxygen therapy (HFNO), he underwent closed-circuit intubation on February 23, 10:30am. As he was returning from a foreign country, contact precautions were maintained throughout his stay regarding a potential multidrug resistant bacteria carriage.

On February 26, COVID-19 national testing guidelines were extended to every unexplained ARDS. The diagnosis was confirmed on February 27, after detection of SARS-CoV-2 RNA on nasopharyngeal swab and bronchoaspiration, with high viral loads (cycle threshold (Ct) values of 19·55 and 18·34).

In the nephrology ward, one nurse tested positive (Case 5). Exposed on February 22, she became symptomatic on February 26.

In the ICU, one nurse (Case 6), symptomatic since February 28, tested positive. The doctor (Case 8) who intubated (without videolaryngoscopy, with preoxygenation with HFNO and non-invasive ventilation) exhibited fever, dry cough, and myalgia ten days after exposure. Negative for COVID-19 by RT-PCR, she tested positive for IgM and IgG antibodies by COVID-PRESTO®.

Five women and two men, 23 to 49 years old, were confirmed as secondary cases, none severe.

Five tertiary cases were identified. The 11-year-old daughter of Case 1 and a colleague he attended a seminar with tested positive. An ICU male nurse in close contact with Case 6 as well. Briefly exposed to the index case, an ER nurse (Case 7) in close contact with Case 2 on February 27, exhibited symptoms on March 6, making him more likely a tertiary case. The ICU doctor sharing the office of Case 8, symptomatic on March 26, tested negative by RT-PCR but positive for IgM and IgG by COVID-PRESTO®.

The spread of any contagious disease is linked to the R_0 of its pathogen, but not every patient is equally infectious. In previous viral outbreaks the existence of SSE has been key to the speed and magnitude of the virus spread. Among coronaviruses, their existence is known[3,4].

We report here seven secondary cases among HCW and five tertiary cases. Most secondary cases occurred before complete precautions were implemented and all before our patient's diagnosis. Among them, the ER desk clerk (case 1) spoke to the patient through a glass window for less than 5 min and put his identification bracelet on, advocating for contact transmission. Our index case contaminated five HCW in 18 h despite wearing a surgi-

cal mask. Such a number of secondary cases in this short period suggests a SSE.

What makes a super-spreader is still unclear. In COVID-19, older age is statistically associated with a higher viral load[5] and, as with influenza, its peak occurs early in the disease[6], when our index case was 83 and at day 2 of his symptoms. Advanced CKD, his underlying immune-related condition and its treatment could be additional factors.

HCW in close contact with COVID-19 patients are at high risk of contracting the virus. We report the occurrence of a nosocomial outbreak of moderate intensity compared to previously published ones[7,8]. Despite a delay of 6 days before diagnosis, the early implementation of precautions and the eviction of high-risk HCW limited the number of contacts and the viral transmission in the hospital. Despite the possibility of a SSE, proper precautions are highly effective.

Thanks to a proper case investigation, the chains of transmission were identified and links between clusters shown (Fig. 2). The patient's 15-year-old granddaughter, who travelled with him, was symptomatic prior to their trip and a pupil at the high[9] where worked the first French COVID-19 patient without any link to China. Seven more members of his family tested positive, as well as 16 guests of a wedding he attended in Algeria. As with other coronaviruses, the role of clusters in the spread of the epidemics advocates for early testing of any symptomatic individual and the need to isolate confirmed cases and high-risk contacts (Fig. 1).

The collection of data concerning similar events[10] emphasizes the risks of transmission in healthcare settings and its potential role in the spread of epidemics (Table 1).

Declaration of Competing Interest

We declare no competing interests regarding this study.

Funding

No funding

References

1. Majra D, Benson J, Pitts J, Stebbing J. SARS-CoV-2 (COVID-19) superspreader events. *J Infect* 25 nov 2020.
2. Prazuck T., Colin M., Giache S., Gubavu C., Seve A., Rzepecki V., et al. Evaluation of performance of two SARS-CoV-2 Rapid whole-blood finger-stick IgM-IgG Combined Antibody Tests [Internet]. Infectious Diseases (except HIV/AIDS); 2020 mai [cité 1 juin 2020]. Disponible sur: http://medrxiv.org/lookup/doi/10.1101/2020.05.27.20112888
3. Cowling BJ, Park M, Fang VJ, Wu P, Leung GM, Wu JT. Preliminary epidemiological assessment of MERS-CoV outbreak in South Korea, May to June 2015. *Euro Surveill Bull Eur Sur Mal Transm Eur Commun Dis Bull. 25 juin* 2015;**20**(25):7–13.
4. Riley S. Transmission Dynamics of the Etiological Agent of SARS in Hong Kong: impact of Public Health Interventions. *Science. 20 juin* 2003;**300**(5627):1961–6.
5. To KK-W, Tsang OT-Y, Leung W-S, Tam AR, Wu T-C, Lung DC, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. *Lancet Infect Dis* 23 mars 2020.
6. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, et al. SARS-CoV-2 Viral load in upper respiratory specimens of infected patients. *N Engl J Med* 19 mars 2020;**382**(12):1177–9.
7. Assiri A, McGeer A, Perl TM, Price CS, Al Rabeeah AA, Cummings DAT, et al. Hospital outbreak of middle east respiratory syndrome coronavirus. *N Engl J Med. août* 2013;**369**(5):407–16.
8. Lee SS, Wong NS. Probable transmission chains of Middle East respiratory syndrome coronavirus and the multiple generations of secondary infection in South Korea. *Int J Infect Dis. sept* 2015;**38**:65–7.
9. Fontanet A, Tondeur L, Madec Y, Grant R, Besombes C, Jolly N, et al. Cluster of COVID-19 in northern France: a retrospective closed cohort study [Internet]. *Infect Dis (except HIV/AIDS)* 2020. avr [cité 10 mai 2020]. Disponible sur http://medrxiv.org/lookup/doi/10.1101/2020.04.18.20071134 .
10. Lau MSY, Grenfell B, Thomas M, Bryan M, Nelson K, Lopman B. Characterizing superspreading events and age-specific infectiousness of SARS-CoV-2 transmission in Georgia, USA. *Proc Natl Acad Sci U S A* 8 sept 2020;**117**(36):22430–5.

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