# High-risk exposure without personal protective equipment and infection with SARS-CoV-2 in-hospital workers - The CoV-CONTACT cohort

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## High-risk exposure without personal protective equipment and infection with SARS-CoV-2 in-hospital workers - The CoV-CONTACT cohort

*Dear Editor,*

Two recent studies published in this journal focused on SARS-CoV-2 infection among hospital workers (HWs), the first one reported the prevalence of SARS-CoV-2 carriage among HWs and the second, the clinical presentation of symptomatic HWs in order to identify new cases as early as possible and to stop nosocomial transmission[1,2]. The objective of the present study was to estimate within the hospital, the risk of in-hospital HWs infection following a high-risk exposure to SARS-CoV-2-infected subject without personal protective equipment.

We conducted the CoV-CONTACT study, a prospective cohort which included HWs, hereafter referred to as "contacts" with an high risk exposure to an SARS-CoV-2-infected person (either a patient or a colleague) hereafter referred to as "index", in the 1000 bed Bichat Claude Bernard University Hospital (Paris, France) between March, 3rd 2020 and April, 27th 2020[3]. Exposure was considered to be at high-risk of SARS-CoV-2 transmission if it occurred i) face-to-face, within one meter and without protective surgical or FFP2/N95 mask, and ii) during a discussion or while the index had an episode of coughing or sneezing, and iii) in the 72 h prior to, or following the virological diagnosis, or during the symptomatic period of the index.

Following exposure and upon written informed consent, daily symptoms were self-reported for 30 days; nasopharyngeal swabs for SARS-CoV-2 RT-PCR were performed at inclusion and at days 3, 5, 7 and 12; SARS-CoV-2 IgG serology (LuLISA N and EuroIMMUN[4,5]) was assessed at inclusion and at day 30. Confirmed infection was defined by positive RT-PCR or seroconversion, and possible infection by one general and one specific symptom for two consecutive days. SARS-CoV-2 seroconversion was defined as the apparition of a positive SARS-CoV-2 serology at the D30 visit, or as an at least two-fold increase of the LuLISA signal or EuroIMMUN ratio between inclusion and day 30. The primary endpoint was confirmed or possible SARS-CoV-2 infection, hereafter referred to as "SARS-CoV-2 infection".

The 146 analysed contacts were exposed to 42 COVID-19 index. No contacts worked in a front-line COVID-19 unit (Table 1). Exposure to patient decreased from 67.4% (56/83) before March, 18th (the date of the widespread use of masks in the hospital) to 15.9% (10/63) after March, 18th.

Overall, 24 /146 contact subjects (16.4%, 95%CI [11.0%–23.7%]) had at least one SARS-CoV-2-positive nasopharyngeal swab; 16/146 contact subjects (10.9%) had positive serology at inclusion which did not respond to the seroconversion definition, revealing a pre-existing infection and 31 additional contact subjects (21.2%, 95%CI [15.1%–28.9%]) exhibited a seroconversion at D30. Based on self-administered questionnaires, 59/146 contact subjects (40.4%, 95%CI [32.5%–48.9%]) met the definition of a clinical infection Fig. 1. Seven out of 24 subjects with positive SARS-CoV-2 nasopharyngeal RT-PCR had a positive RT-PCR before the symptoms onset; the first positive nasopharyngeal RT-PCR was observed as early as six days before symptoms onset. At day 30, 63/146 contacts (43.2%, 95%CI [35.1%–51.6%]) had SARS-CoV-2 infection (confirmed in 35 (23.9%, 95%CI [17.5%; 31.9%]), and possible in 28 (19.2%, 95%CI [13.3%; 26.7%])). In the multivariable analysis, the variables associated with SARS-CoV-2 infection were being a non-caregiver HW (aOR = 4.1, 95%CI [1.4; 12.2], $p = 0.010$) and being exposed to a SARS-CoV-2-infected patient (aOR = 2.6, 95%CI [1.2; 5.7], $p = 0.013$) rather to an infected colleague (Table 1).

Following universal masking for HWs on March, 18th in our hospital, high-risk exposure to SARS-CoV-2-positive patients dropped by 4 and high-risk exposure to SARS-CoV-2-positive colleagues became predominant, making colleagues-to-colleagues transmission a potentially major route of infection[6]. Of note, none of the exposures between a HW and a SARS-CoV-2 infected patient occurred in the front-line services where the mask was worn by all caregivers from the beginning of the epidemic. These exposures occurred, prior to universal masking, in second-line services in which patients had not been previously identified as COVID-19. The profession of the contact subjects was associated with infection, but we did not find any association with the type of activities of the HWs.

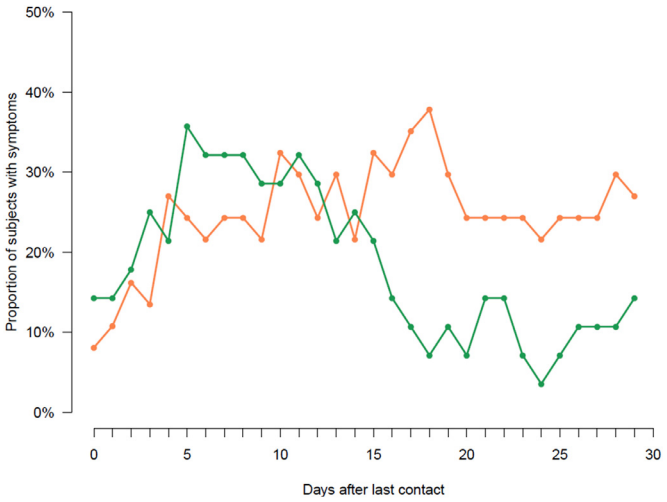


**Fig. 1.** Proportions of symptomatic contact subjects among the 146 contacts of the CoV-CONTACT cohort. The orange curve corresponds to contacts subjects with confirmed SARS-CoV-2 infection (*i.e.*, virologically- or immunologically-proven, $n = 35$). The green curve corresponds to contacts subjects with possible SARS-CoV-2 infection (*i.e.*, clinically-suspected without viro-immunological confirmation, $n = 28$).

The 10.9% rate of HWs with SARS-Cov-2 antibodies at inclusion revealing a pre-existing infection while they were not working in front-line services, is close to the seroprevalence of 8.8% reported in the Paris area in the general population during this period[7,8]. In addition to these HWs already infected at inclusion, 31 others (21.2% of the total population) seroconverted at day 30.

We cannot state with certainty that contacts meeting the definition of confirmed infection acquired their infection as a result of the exposure leading to their inclusion in the study. There are several arguments in favor of the link between exposure and infection: the RT-PCR positivity within 12 days after contact, the chronology of symptom onset after contact, and the seroconversion rate observed within the 30 days following the exposure, which is much higher than that observed in the community between March and May 2020[7, 8]. In addition, the subjects included were counseled to strictly adhere to protective measures to avoid any chain of transmission during the D0-D30 period, limiting the risk of further exposure.

All together, the rate of transmission observed in HWs after high-risk exposure, which could be as large as 43%, and close to a recent report[9], strengthens the conclusion that universal masking of HW, both during contacts with patients and colleagues, and at all times, as soon as the epidemic has been identified, is essential to prevent HWs infection and maintain hospital capacities during outbreaks[10].

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**Table 1**
Characteristics of the 146 contacts with high-risk exposure to SARS-CoV-2 included in the CoV-CONTACT cohort, according to the infection status at D30.

| Variable | All contacts ($N = 146$) | Contacts with SARS-CoV-2 infection ($N = 63$) | Contacts with no SARS-CoV-2 infection ($N = 83$) | OR [95%CI] | *p*-value | aOR [95%CI] | *p*-value |
|---|---|---|---|---|---|---|---|
| Contact characteristics | | | | | | | |
| Age (year) | 35 [29;46] ($N = 146$) | 35 [28.5;45.5] ($N = 63$) | 35 [30;47] ($N = 83$) | 0.99 [0.96;1.02] | 0.46 | | |
| Male gender | 35/146 (24%) | 11/63 (17.5%) | 24/83 (28.9%) | 0.52 [0.23;1.14] | 0.11 | | |
| HW functions | | | | | | | |
| Medical doctor / Resident / Midwife | 49/146 (33.6%) | 14/63 (22.2%) | 35/83 (42.2%) | 1 (ref) | – | 1 (ref) | – |
| Registered nurse / Certified nurse assistant /Physiotherapists / Hospital Students | 74/146 (50.7%) | 36/63 (57.1%) | 38/83 (45.8%) | 2.37 [1.11;5.22] | 0.028 | 1.76 [0.78;4.03] | 0.18 |
| Non-caregiver HWs | 23/146 (15.8%) | 13/63 (20.6%) | 10/83 (12%) | 3.25 [1.17;9.36] | 0.025 | 4.06 [1.42;12.18] | 0.010 |
| Coexisting conditions | | | | | | | |
| Obesity (BMI > 30 Kg/m²) | 27/146 (18.5%) | 13/63 (20.6%) | 14/83 (16.9%) | 1.28 [0.55;2.98] | 0.56 | | |
| Tobacco use | 36/146 (24.7%) | 17/63 (27%) | 19/83 (22.9%) | 1.24 [0.58;2.66] | 0.57 | | |
| Cardiopathy | 8/146 (5.5%) | 5/63 (7.9%) | 3/83 (3.6%) | 2.3 [0.54;11.57] | 0.27 | | |
| Chronic respiratory disease | 21/146 (14.4%) | 7/63 (11.1%) | 14/83 (16.9%) | 0.62 [0.22;1.59] | 0.33 | | |
| Chronic kidney disease | 2/146 (1.4%) | 2/63 (3.2%) | 0/83 (0%) | NE | 0.99 | | |
| Diabete | 1/146 (0.7%) | 0/63 (0%) | 1/83 (1.2%) | NE | 0.99 | | |
| Immusuppressive therapy | 7/146 (4.8%) | 4/63 (6.3%) | 3/83 (3.6%) | 1.81 [0.38;9.47] | 0.45 | | |
| Current pregnancy | 1/111 (0.9%) | 0/52 (0%) | 1/59 (1.7%) | NE | 0.99 | | |
| Type of exposition | | | | | | | |
| Contact with > 1 index | 26/146 (17.8%) | 13/63 (20.6%) | 13/83 (15.7%) | 1.4 [0.59 ;3.3] | 0.44 | | |
| Types of index subject | | | | | | | |
| Contacts with infected HW(s) only | 80/146 (54.8%) | 27/63 (42.9%) | 53/83 (63.9%) | 1 (ref) | – | 1 (ref) | – |
| Contacts with infected patient | 66/146 (45.2%) | 36/63 (57.1%) | 30/83 (36.1%) | 2.36 [1.21;4.65] | 0.01 | 2.62 [1.24;5.71] | 0.013 |
| Maximal SARS-CoV-2 viral load in the index subject | 9.3 [7.5;10.8] ($N = 145$) | 10 [7.6;10.8] ($N = 62$) | 8.7 [7.5;10.8] ($N = 83$) | 1.1 [0.93;1.31] | 0.25 | | |
| Cumulated length of exposure > 30 min | 98/143 (68.5%) | 38/61 (62.3%) | 60/82 (73.2%) | 0.61 [0.3;1.23] | 0.17 | | |
| Exposure to infected patient ($N = 66$) | | | | | | | |
| Care during an aerosol-generating procedure | 6/66 (9.1%) | 3/36 (8.3%) | 3/30 (10%) | 0.82 [0.14;4.73] | 0.81 | | |
| Care without aerosol-generating procedure | 55/66 (83.3%) | 30/36 (83.3%) | 25/30 (83.3%) | 1 [0.26;3.7] | 1 | | |
| Presence in the patient's room during an aerosol-generating procedure | 22/66 (33.3%) | 13/36 (36.1%) | 9/30 (30%) | 1.32 [0.47;3.8] | 0.6 | | |
| Other type of contact | 12/66 (18.2%) | 10/36 (27.8%) | 2/30 (6.7%) | 5.38 [1.27;37.23] | 0.04 | | |
| Exposure to a SARS-CoV-2-infected HCW ($N = 92$) | | | | | | | |
| Face-to-Face discussion | 86/92 (93.5%) | 31/34 (91.2%) | 55/58 (94.8%) | 0.56 [0.1;3.2] | 0.5 | | |
| Participation in a joint meeting | 25/92 (27.2%) | 9/34 (26.5%) | 16/58 (27.6%) | 0.95 [0.35;2.43] | 0.91 | | |
| Lunch sharing | 20/92 (21.7%) | 6/34 (17.6%) | 14/58 (24.1%) | 0.67 [0.22;1.89] | 0.47 | | |
| Other type of contact | 9/92 (9.8%) | 3/34 (8.8%) | 6/58 (10.3%) | 0.84 [0.17;3.42] | 0.81 | | |

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## Side effect of a 6 p.m curfew for preventing the spread of SARS-CoV-2: A modeling study from Toulouse, France

*Dear Editor,*

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that emerged in Wuhan, China in December 2019 spreads mainly by sustained human-to-human transmission[1]. This spread has been so rapid that the WHO declared the resulting disease a pandemic[2]. After a first lockdown in March 2020, SARS-CoV-2 resumed its rampage in Europe, including France, at the end of the summer. We have used data from the measures to limit virus transmission, mask wearing, restricted access to public spaces and curfews, taken by several large cities to quantify their impact on virus proliferation[3]. The French authorities declared a new lockdown from October 29 to November 28, followed by a gradual release with a 8 p.m curfew from December 15, 2020. This curfew has shown its effectiveness in restricting the spread of the virus in France[3]. A recent study published in this journal assessed the impact of community-wide mask-wearing on the spread of SARS-CoV-2 in the Hong Kong population during the first phase of the epidemic, March 2020[4]. The efficacy of these public health measures has been widely questioned despite the fact that of they have all helped to restrict the spread of the virus[3,5]. We have examined the impact of the 6 p.m. curfew imposed by the French government from January 16, 2021 on the resumed proliferation of the virus after the New Year celebrations using data for the city of Toulouse, France.

Our model is a discretized version of a susceptible infectious and recovered (SIR)-type model[6]. These compartmental models are well suited to studies of the spread of SARS-CoV-2 in different populations[7,8]. Our model[3,5,9] includes a diffusion/transmission coefficient $R_0$ that varies with the likelihood of contagion, and a reduction coefficient $\widehat{c}$ that accounts for the impact of public health measures on virus transmission in the French city of Toulouse. The model predicts how the SARS-CoV-2 virus would have evolved and projects the daily percentage of new positive cases. We estimated $\hat{c}$ by correcting the values predicted by the model with observed data so that predictions and observations coincide over a given period. This model was then used to measure the influence of each individual public health measure on the dynamics of the SARS-CoV-2 infection. We focused on two periods: January 1–January 15, 2021, when an 8 p.m curfew was in force immediately after the New Year, and January 20–January 24, 2021, when the curfew was lowered to 6 p.m.

The January 1–January 15, 2021 period makes it possible to assess adherence to the curfew during the end-of-year holidays. The circulation of the virus among Toulouse inhabitants was reduced by 38% by the 8 pm curfew[5]. There should have been a 7–8% increase in positive RT-PCR tests between January 10 and 15 if the curfew had been strict adhered to. Instead, it was closer to 8.5–9%, which corresponds to less constraint of 37%. Using these data, the percentage of new positive cases per day would increase to 15.4% at the end of May 2021 and only then decrease to 10% of positive