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Increased risks of SARS-CoV-2 Nosocomial Acquisition in high-risk COVID-19 units justify personal Protective Equipment : a cross sectional study

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We read with great interest the studies by Martin and colleagues on the dynamics of SARS-CoV-2 RT-PCR positivy and seroprevalence among high risk healthcare workers and hospital staff (1), and Zheng and colleagues on characterisitics and transmission dynamics of COVID-19 in healthcare workers at a London teaching hospital (2). Taken together, these two studies underscored the efficacy of personal protective equipment (PPE), the acquisition of infections predominantly around lockdown time, and possible extraprofessional exposures as the source of infections. We report here a seroprevalence study of differentially exposed healthcare workers and hospital personnel to COVID-19 patients, which showed similar results, but, in contrast, a significant increased risk of COVID-19 in staff working in high risk COVID-19 units.

With the expansion of infections in France, authorities implemented a national lockdown on March 17th which lasted till the 11th of May 2020. Measures implemented in our hospital and their timeline are detailed in figure 1. Between the 21st of April and the 3rd of June 2020, we included 647 healthcare and hospital personnel volunteers from highly, mildly and unexposed COVID-19 units who had physically been present during the lockdown. Highly exposed volunteers had worked in the medical, intensive care and screening COVID-19 units, mildly exposed in the non COVID-19 medical units, and unexposed personnel from the administration or laboratories. For highly and mildly exposed healthcare workers, eligibility implied being in contact with patients or their immediate environment (i.e. cleaning agents). After completing an investigator-led questionnaire, a blood sample for serological determination was collected, using the anti SARS-CoV-2 IgG antibobies with the ID Screen® SARS-CoV-2-N IgG Indirect assay (ID.Vet®). Highly exposed participants had a systematic concomitant nasopharyngeal swab for SARS-CoV-2 RT-PCR test, and in other groups only if seropositive. Seropositive participants were investigated by two specialists to determine whether SARS-CoV-2 acquisition was most likely professional or extraprofessional. We aimed to include at least 156 subjects per exposure group, and to compare rates in each group using an exact logistic regression adjusted on age, gender and profession (doctor/ resident, paramedical or other).

We included 261 highly and 227 mildly exposed (representing 70% and 93% of the corresponding eligible workforce respectively), and 159 unexposed volunteers. Mean age was 38.3 (SD ± 11.0), 496 (77 %) were women. Mean days of work in the highly exposed was 21.5 days (± 11.0). Thirteen personnel tested positive for SARS-CoV-2 NP IgG (prevalence rate of 2.01 % [95% Confidence Interval: 0.93-3.09]); ten people (3.91 % [1.53-6.28]) in the highly exposed group, two (0.8 % [0.0-2.1]) in the mildly exposed group and one (0.63 % [0.00-1.86]) in the unexposed group (p = 0.022). After adjustment, the odds ratio (OR) of being positive for SARS-CoV-2 in the highly exposed group was 4.43 (95% CI 1.15-17.06) *versus* mildly and unexposed groups (p = 0.031). One highly exposed

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healthcare worker had a positive SARS-CoV-RT- PCR at study entry, with a positive COVID-19 serology.

Seven seropositive cases had exposures prior or within 14 days of lockdown (figure 1). Extra professional exposure was deemed most probable for 6 cases. Four of the seven most probable professional acquisition occurred in workers who recalled unprotected contact with a COVID-19 case prior to full implementation of PPE in a non COVID-19 department, and in one worker from the medical COVID-19 department intermittently using a surgical mask in presence of colleagues. Two workers did not report any known specific exposure.

Despite an increased risk of acquiring COVID-19 in highly exposed personnal, seroprevalence was low, reflecting efficacy of PPE and barrier procedures, in line with two non-comparative studies carried out in highly exposed healthcare workers (3) (4). Most nosocomial COVID-19 infections occurred at the beginning of the lockdown, a period in which recommendations were being fully upgraded and implemented, and extraprofessional acquisition more probable due to the high community viral circulation. It was also a time in which medical and paramedical teams were still inexperienced and stressed, which could enhance mistakes when using new protective gears (5). Also, some data suggests possible airborne transmission of SARS-CoV-2 in enclosed environments, against which surgical masks may lack efficacy (6). Our findings contrast with a Chinese study of 420 heatlthcare professionals deployed to Wuhan for direct care of COVID-19 patients, for whom serology and SARS-CoV-2 RT-PCR of naso-pharyngal swabs on return revealed no infection (7). However, in this study, Liu and colleagues described full measures implemented prior to the professionnels' arrival, but also very strict extraprofessional rules which may be difficult to implement in other parts of the world and over an extended period.

In conclusion, SARS-CoV-2 nosocomial transmissions to healthcare workers occur in high risk settings, but PPE procedures are effective in reducing acquisition. Many cases were likely due to extraprofessional exposures and incomplete compliance to procedures. Following strict PPE procedures at work and outside are essential to reduce nosocomial acquisition of SARS-CoV-2.

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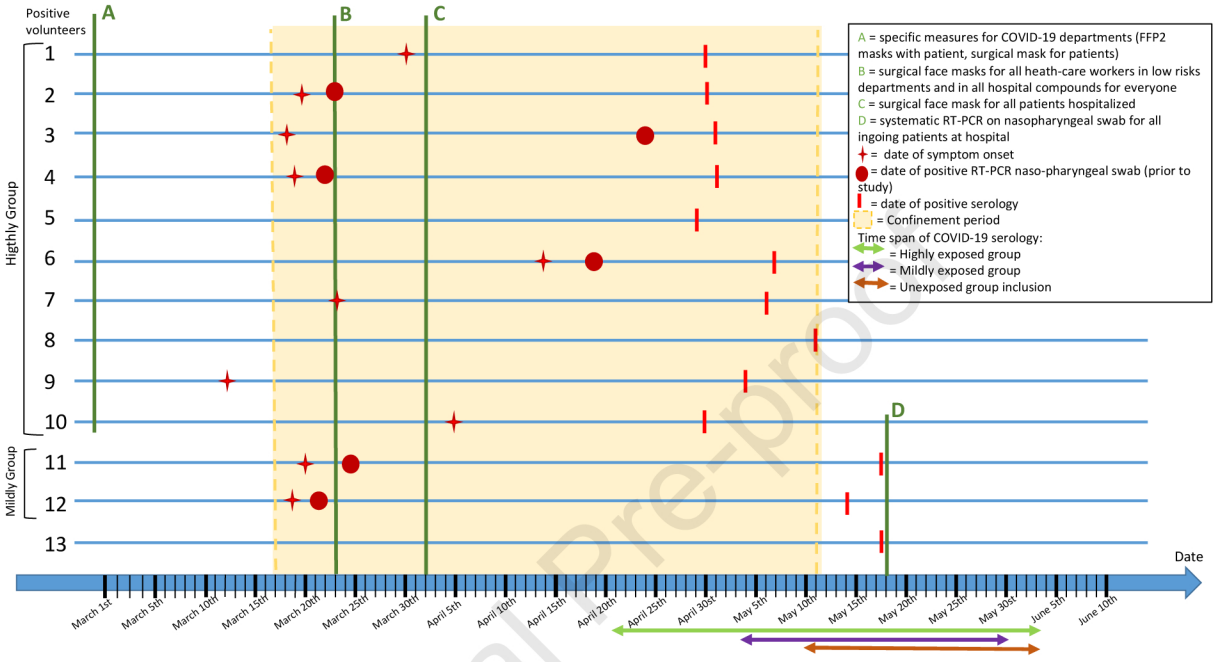
Figure 1: Timeline of clinical events according to implementation of barrier measures in the 13 serological positive volunteers. To better understand potential infectious dynamics, please read the time-dependant A, B, C measures in our hospital setting. In all units, physical presence of non-essential personnel, social distancing at work, systematic hand sanitizing, and virtual meetings were encouraged. Professionals exposed to COVID-19 patients were specifically trained to use and discard PPE, including protective suits, FFP2 masks, double pair of gloves, eye protective gears, shoe covers, mobcaps and gowns.



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Conflict of Interest Statement: the authors report no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, and no other relationships or activities that could appear to have influenced the submitted work. Contributorship statement: all authors contributed to the investigation, data analysis and interpretation, and final approval of article. MB and OV realized most of the investigation and the first draft of th article, FG, MCP, GM and AM conceived and planned the study.

The study protocol was reviewed and approved by the University Hospital of Montpellier Institutional Review board (RB ID: 202000465), and registered on clinicalTrials.gov under the ID: NCT04376944. All participants consented to the study procedures and objectives. The participants were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

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