Pandemic peak SARS-CoV-2 infection and seroconversion rates in London frontline health-care workers

Nosocomial transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a major public health concern. Health-care workers (HCWs) are at high risk of developing COVID-19, and may themselves contribute to transmission.[1]

To evaluate these risks, we enrolled 200 patient-facing HCWs between March 26 and April 8, 2020, in SARS-CoV-2 Acquisition in Frontline Healthcare Workers—Evaluation to inform Response (SAFER), a prospective cohort study in high-risk frontline HCWs in an acute National Health Service hospital trust in London. We collected nasopharyngeal swabs for RT-PCR twice per week, symptom data, and blood samples monthly for high-sensitivity serology assays (ELISA and flow cytometry for spike glycoprotein). Further methodology, study participant demographics, and the length of participation are described in the appendix.

87 (44%) of 200 HCWs had evidence of SARS-CoV-2 infection at any timepoint, detected either by serology or RT-PCR. Of the 200 HCWs, 181 gave a valid blood sample at two timepoints. On the basis of the composite ELISA and flow-cytometry serological results, 82 (45%) of 181 HCWs were seropositive after 1 month. 36 (20%) of 181 HCWs seroconverted during the study, and 46 (25%) of 181 HCWs were already seropositive at study entry. 42 (21%) of 200 HCWs tested positive for SARS-CoV-2 by RT-PCR in at least one swab.

The median age of study participants was 34 years (IQR 29–44). There was a trend towards a higher infection rate in participants younger than 30 years (31 [55%] of 56 positive) compared to those older than 50 years (ten [33%] of 30 positive), with a reduction in log odds of positivity by 0·035 per year (p=0·0199). The mean duration of detection of SARS-CoV-2 RNA by RT-PCR was 12·9 days (first positive to last positive swab; 95% CI 9·4-17·3). The longest observed duration of SARS-CoV-2 detection was 29 days.

Asymptomatic carriage is an important phenomenon associated with SARS-CoV-2 infection. Of the 42 HCWs that ever tested positive for SARS-CoV-2 by RT-PCR, 20 (48%) reported symptoms within 7 days of the positive test that were consistent with Public Health England's COVID-19 case definition,[2] and 16 (38%) did not report any symptoms in the same time frame. Six participants did not return symptom surveys within 7 days of their first positive PCR. The median time from first positive RT-PCR to first reported PHE case-definition symptom in 23 HCWs who reported symptoms at any timepoint during the study was 4 days (appendix). No participants required hospital admission.

We compared the risk of SARS-CoV-2 positive disease by RT-PCR detection in the 1 month of follow-up in those who tested negative by serology and RT-PCR at baseline (122 of 181 HCWs) with those who were positive by serology and negative by RT-PCR at baseline (33 of 181 HCWs). We excluded ten of the 122 HCWs who were negative by serology and RT-PCR at enrolment and seroconverted without having had a positive swab during follow-up (as these participants might represent seroconversions from infections acquired before the baseline sample, transient infection missed between swabs, or cross-reactivity from exposure to seasonal coronaviruses). Of the remaining 112 HCWs who were negative by RT-PCR and serology at enrolment, 98 remained negative by RT-PCR, 13 tested positive by RT-PCR and seroconverted, and one tested positive by RT-PCR but had not seroconverted by the second sampling timepoint (in a blood sample taken 17 days later).

This represents a 13% infection rate (ie, 14 of 112 HCWs) within the 1 month of follow-up in those with no evidence of antibodies or viral shedding at enrolment. By contrast, of 33 HCWs who tested positive by serology but tested negative by RT-PCR at enrolment, 32 remained negative by RT-PCR through follow-up, and one tested positive by RT-PCR on days 8 and 13 after enrolment.

Notwithstanding the short follow-up period, these results suggest a protective effect, correlating with the presence of spike protein-specific antibodies, on subsequent infection within a 1-month period in a high-risk setting. Of the 26 HCWs who tested positive by RT-PCR at enrolment, 13 already had antibodies at baseline, indicating an anti-viral immune response, whereas the remaining 13 HCWs seroconverted by the 1-month follow-up. All 46 HCWs testing positive for SARS-CoV-2 by serology at enrolment remained positive at follow-up approximately 1 month later.

Of the 36 HCWs who seroconverted during the study, 19 had SARS-CoV-2 RNA detected either at the time of enrolment or in the 7 days following enrolment. Of the remaining 17 HCWs who seroconverted, ten were staff in whom no SARS-CoV-2 was detected by RT-PCR during follow-up. Of the 99 HCWs who were seronegative at both timepoints, only one tested positive by RT-PCR (on a single swab taken 17 days before the second serology test).

In this cohort of HCWs, most infections occurred between March 30 and April 5, 2020, the week with the highest number of new cases in London (appendix). Personal protective equipment (PPE) for all patient interactions in England was introduced on April 1, 2020. Our results show that 25% of HCWs were already seropositive at enrolment and that a further 20% of HCWs became seropositive within the first month of follow-up.

Our finding that 44% of HCWs show evidence of SARS-CoV-2 infection either by RT-PCR or serology

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in a frontline setting is higher than reported by others in the UK and worldwide.[3] Differences with Chinese[3] and Dutch[4] data might be explained by the different study designs and the extent of implementation (or not) of both PPE and community lockdown measures. Evidence of infection in our central London HCWs was more than double that of the London population.[5]

These data highlight the urgent need to implement policies to better protect HCWs and for regular asymptomatic HCW surveillance in hospital settings that will protect both HCW staff and patients from nosocomial transmission through a potential SARS-CoV-2 second wave. Vaccines, if and when they become available, should initially be prioritised for HCWs.

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