

SYNOPSIS

Review of “FFP3 respirators protect healthcare workers against infection with SARS-CoV-2”

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One-minute summary

- A United Kingdom (UK)-based tertiary care hospital with 1,000 beds changed work practices for health care workers by replacing fluid-resistant surgical masks (Type IIR) with filtering face piece 3 (FFP3; equivalent to N99) respirators during routine care of patients on ‘red’ wards that contain confirmed coronavirus disease 2019 (COVID-19) patients.
- Health care workers continued the use of surgical masks on ‘green’ wards containing patients with negative tests for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and no clinical features of COVID-19.
- Using a mathematical model, the authors reported a 47.0-fold (confidence interval [CI], 7.92 to infinity) increased risk of occupational-based transmission of SARS-CoV-2 prior to implementing FFP3 use in red wards, compared to green wards. Following implementation of FFP3 use in red wards, the authors reported complete protection against occupational-based transmission of SARS-CoV-2 by (100%, CI, 31.3 – 100).
- The authors conclude that the precautionary principle should be used to support a revision of the respiratory protective equipment recommendations by upgrading to using FFP3 (N99) respirators instead of surgical masks for health care workers caring for patients with COVID-19 until more data becomes available.

Additional information

- Six hundred and nine SARS-CoV-2-infected health care workers were identified by polymerase chain reaction (PCR) tests conducted on swabs obtained during symptomatic testing as required; weekly or biweekly voluntary asymptomatic screening at the hospital; and from community testing data collected from November 2, 2020 to January 11, 2021.
- From the 609 SARS-CoV-2 positive tests, 27.8% (169/609) were included in the analysis.
- Eight weeks of data prior to implementing FFP3 use and three weeks after FFP3 implementation on December 22, 2020 were available for red wards, and 11 weeks of data were available for green wards.

- Six green wards were converted to red wards (seven total red wards) during the study period. Health care workers working in converted wards were included in the analysis and assigned to the colour of the ward in which they worked five days prior to their positive SARS-CoV-2 test.
- Green wards had fewer cases per ward day (mean 0.028 cases per ward day), compared to red wards (mean 0.167 cases per ward day), for seven of eight weeks in the period prior to FFP3 implementation ($P = 0.016$).
- There was no statistical difference between wards in the three weeks following FFP3 implementation in red wards (0.11 versus 0.134 cases per ward day in red and green wards, respectively, $P = 0.5$).
- A strong positive correlation with community incidence was reported between the number of cases per ward day in green wards ($R^2 = 0.80$, $P < 0.00005$), but not red wards ($R^2 = 0.01$, $P > 0.7$). The authors conclude that the rates in green wards are likely mostly driven by community-acquired infections. Also, in conjunction with modelling data, the rates in red wards were not correlated with community rates because most of the infections were occupationally-acquired, prior to implementing FFP3 respirators.
- The authors add that the use of FFP3 respirators was also successful for protecting against any associated increase in transmissibility of the variant of concern, B.1.1.7 (Alpha, first identified in the UK), because there was no increased transmission compared to green wards.
- Universal eye protection was instituted in all wards; however, the type of eye protection was not defined.
- Confidence intervals were defined as the region of parameter space in which the likelihood L was within 2 units of the maximum.
- Confounders considered by the authors were:
 - Rates of natural immunity were low as few health care workers had prior infection.
 - Vaccination was excluded as a confounder because vaccines were not widely available for health care workers until January 8, 2021 and it was not expected that the vaccine given on or after this date would have any appreciable effect by the end of the study period.
 - Frequency of screening was not attributed as a confounder based on the rationale that the proportion of symptomatic and asymptomatic infections detected by screening on red and green wards was similar.
 - Evaluation of compliance with specific infection prevention and control measures on either ward was not explicitly reported other than authors noting that the decision to implement FFP3 respirators was based on a lack of reduction of disparity of infections between red and green wards despite audits indicating good adherence to infection prevention and control measures consistent with Public Health England recommendations.

PHO reviewer's comments

- The study uses confirmed PCR-positive tests and an appropriate timeframe for disease transmission of SARS-CoV-2, which are both strengths of the study; however, a small proportion of positive tests were used in the final analysis.
- The authors used an approach to model and analyze data based on per ward days. This does not account for differences in the number of patients or the number of staff and hours per staff providing care to patients on a given ward. Therefore, the number of exposures is not accounted for in the analysis and it is not clear in which direction this could impact the results.
- The model used a fixed variable for incubation period, whereas it would be more appropriate to use a distribution to account for shorter and longer incubation periods.
- Additional epidemiological details would support understanding the nature of infections detected in health care workers. For example, if cases were related or not to an outbreak, linkage analysis of cases, and specific sources of infection. The lack of sequencing data does not allow for direct linkage of infection from patient to staff.
- Data was collected during the second wave of SARS-CoV-2 in the UK. This may have increased rates of infection on both wards including the risk of worker-to-worker transmission.
- Changes in testing protocols were implemented in red and green wards during the study period. These changes may lead to an increase in infections being detected; however, it would also make the estimate of the impact of the FFP3 respirators more conservative.
- The number of red ward days are relatively small in the first eight weeks of the study period compared to green ward days; thus, a single case in a red ward can dramatically affect the cases per ward day, which was reflected in the wide confidence intervals.
- For each ward, the types of procedures conducted were not reported, including relevant aerosol-generating medical procedures. By implementing continual use of FFP3 respirators, there may have been a reduction of high-risk exposures by eliminating opportunities for exposure to aerosol-generating medical procedures without adequate RPE.
- Additional considerations for multifactorial behavioural changes could explain in part some reduction of cases observed in red wards following the implementation of universal use of FFP3 respirators. For example, any additional health and safety training associated with FFP3 respirator use could improve donning and doffing technique as well as refresh knowledge and behaviour related to other infection prevention and control measures (e.g., hand hygiene).
- The authors note that there is existing evidence to support that health care workers who care for COVID-19-positive patients are at increased risk of SARS-CoV-2 infection compared to health care workers who do not. There is however, conflicting evidence for this, with some studies demonstrating a negative relationship (i.e., decreased risk). Therefore, the assumption that this is the case for all settings has not been consistently observed.^{1,2}
- Demographics of infected health care workers were not assessed for any trends or explanations for differences in infection rates.

- For generalization of these findings to other jurisdictions, it would be of benefit for the authors to have described the basic infection control practices that were implemented and provide descriptions of the wards and room types including features such as ventilation parameters.
- The study does not examine whether FFP3 masks should be used on all wards.
- The correlation coefficient of 0.80 abstracted from figure supplement 1 differed from the value of 0.88 in the body of the text. The error bears little effect on the interpretation of the data, but is noted as a discrepancy.
- This study is published as a pre-print, it has not been peer reviewed and as such the findings should be interpreted with caution.

Additional Cited Resources

1. Lai X, Wang M, Qin C, Tan L, Ran L, Chen D, et al. Coronavirus disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary hospital in Wuhan, China. *JAMA Netw Open*. 2020;3(5):e209666. Available from: <https://doi.org/10.1001/jamanetworkopen.2020.9666>
2. Vahidy FS, Bernard DW, Boom ML, Drews AL, Christensen P, Finkelstein J, et al. Prevalence of SARS-CoV-2 infection among asymptomatic health care workers in the greater Houston, Texas, area. *JAMA Netw Open*. 2020;3(7):e2016451. Available from: <https://doi.org/10.1001/jamanetworkopen.2020.16451>

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