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SYNOPSIS

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Review of "Evaluation of Healthcare Personnel Exposures to Patients with Severe Acute Respiratory Coronavirus Virus 2 (SARS-CoV-2) Associated with Personal Protective Equipment"

Article citation: Shah VP, Breeher LE, Hainy CM, Swift MD. Evaluation of healthcare personnel exposures to patients with severe acute respiratory coronavirus virus 2 (SARS-CoV-2) associated with personal protective equipment. Infect Control Hosp Epidemiol. 2021 May 12 [Epub ahead of print]. Available from: https://doi.org/10.1017/ice.2021.219

One-minute summary

- Authors performed a retrospective cohort study of health care workers (HCWs) with high-risk exposures to suspected or confirmed severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) patients in a tertiary-care medical center in Minnesota, United States from May 13, 2020 through November 30, 2020.
- 2.3% (8/345) of HCWs with high-risk exposures to Coronavirus Disease 2019 (COVID-19) patients tested positive for SARS-CoV-2:
    - Five HCWs did not wear eye protection during close contact with a COVID-19 positive patient who was not wearing a mask.
    - One HCW did not wear a respirator during an aerosol-generating procedure (AGP), but wore a surgical mask.
    - Two HCWs did not wear eye protection and a respirator during an AGP, but wore a surgical mask.
- Authors state that lack of eye protection was significantly associated with positive reverse-transcriptase polymerase chain reaction (RT-PCR) results during the 14-day post-exposure quarantine (relative risk [RR] 10.25; 95% confidence interval [CI] 1.28-82.39; P=0.009).
- Authors state that use of a surgical mask instead of a respirator was not associated with positive RT-PCR test results during the 14-day post-exposure quarantine (RR 0.99; 95% CI 0.96-1; P=1).
- Based on the analysis, the authors determined that a lack of eye protection correlated significantly with transmission of SARS-CoV-2. The authors concluded that the use of universal eye protection is critical in preventing transmission of SARS-CoV-2 from patient to healthcare worker.

Additional information

- Universal masking was instituted on April 1, 2020 and universal eye protection on May 13, 2020.
- Eye protection was defined as a face shield, protective wraparound eye wear, or a polycarbonate face shield or helmet.
- Three hundred and forty-eight of 581 HCWs (60%) met definitions of having had high-risk patient-to-HCW exposures; 345 of 348 HCWs (99%) had PCR testing during 14 day post-exposure quarantine and were included in the analysis. High-risk exposure was defined by the Centers for Disease Control and Prevention (CDC) criteria:
    - Lack of respiratory protective equipment and within 2 metres (m) for at least 5 minutes (min) of a patient with confirmed COVID-19.
    - Lack of eye protection and within 2 m for at least 5 min of a patient with confirmed COVID-19 patient while the patient was not wearing a mask.
    - Lack of a gown, gloves, eye protection and respirator while performing an AGP, entering the patient's room while an AGP was performed, or entering a room during the aerosol room clearance time.
        - Note that the authors classified exposures as high-risk even if the time of AGP-related exposure was less than 5 min.
- Registered nurses accounted for 58.8% (203/345) of HCW high-risk exposures, physicians accounted for another 15.9% (55/345), and respiratory therapists, patient care assistants, housekeepers, and other HCWs the remaining 25.3%.
- The majority of high-risk exposures occurred in non-COVID-19 units (66.4%; 229/345).
    - Lack of a respirator during an AGP was more common in COVID-19 units than regular units (72.4% vs 53.7%, RR 1.35; 95% CI 1.14-1.59, P=0.001).
    - Conversely, lack of eye protection was less common in COVID-19 than regular units (25.9% vs. 48.4%, RR 1.43; 95% CI 1.22-1.70; P<0.001).
    - Some HCWs had both a lack of eye protection and lack of respirator use, but were included in each category comparing lack of eye protection or lack of respirator use.
- Patients were screened on entry to the hospital and RT-PCR testing was conducted if admitted to hospital; positive screening and RT-PCR results were used to assign patients to COVID-19 units.
- Age, sex and occupation were not significantly different for the comparison of all high-risk exposures.
- Authors hypothesize that the lack of difference between respirator and surgical mask use during AGPs could be due to protection offered by surgical masks or that their inclusion of brief exposures less than 5 min while not wearing appropriate PPE could have included exposures with insufficient exposure times for infection; thus, biasing the findings to the null.
- The authors acknowledge the following limitations:
    - There were a small number of transmission events that occurred from the high-risk exposures.
    - The definitions used for classifying high-risk may have omitted some exposures that resulted in transmission.
    - Some lapses may not have been documented and thus not reviewed.
    - The study was not designed to evaluate airborne spread of SARS-CoV-2 outside lapses of PPE during AGPs.

PHO reviewer's comments

- Overall, there are a number of methodological and technical limitations in this report that makes interpretation of results challenging, and conclusions unsubstantiated.
- An exposure incident was not defined by the authors. One might deduce that authors used the CDC definition of a 'scenario' (Table 1); however, in the discussion, the authors acknowledge that for the AGP exposure group, the time component from the CDC scenario definition was ignored when classifying an exposure incident as high-risk. Additionally, superscript footnotes in the table are not defined.
- The study does not describe when information about the nature of the exposure and any PPE lapses was collected. If it is presumed that this was collected at the time of exposure (as it would be necessary to deem the HCW a high-risk contact), then as the authors have stated, there should be non-differential issues of recall bias and social desirability bias. But if further information about any PPE lapses was collected after the HCW became a case, there is the possibility of differential recall bias. In addition, exposures that occurred prior to the patient being recognized and/or declared as a case, particularly on non-COVID-19 units, also presents the possibility of a differential recall bias. There was also no description of potential risk of exposure through improper donning/doffing of PPE or impact of the nature of the type of healthcare worker-patient interaction on the exposure risk assessment.
- A major limitation of this study is the small number of outcomes on which to base their findings, and the limited information by which to confirm whether infection was actually due to patient-to-HCW transmission:
    - Due to very small event rates, some cells for Fisher exact tests would contain zero or very small values and; therefore, single events could drastically change the findings of the study, which can be observed in the very wide CIs in the RR calculations;
    - There is no description of whether the patient case was known to be a case at the time of exposure (only whether in a COVID-19 or non-COVID-19 unit), or their symptom status or infectiousness status (e.g., cycle threshold value) at the time of exposure;
    - There was no description of laboratory sequencing assessment of patient and HCW specimens to determine relatedness of patient and HCW infections;
    - There was no description of non-community (e.g., other co-worker/other patient contact) exposures for the HCW, or other potential routes of exposure.
- The inclusion criteria and resultant double-counting of individuals who did not wear eye protection and did not wear a respirator makes the associations calculated in the study difficult to interpret meaningfully given the non-independent risk factors. Overall, there was no specific comparison of 'only lacking eye wear' to 'followed all PPE protocols' presented in the results to be able to conclude that eye protection is an independent risk of acquisition. Similarly, there was no specific comparison of surgical mask with respirator in the context of eye protection, as those with a respirator may or may not have worn eye protection. Therefore, the authors' conclusions on universal eye protection and similar risks with respirators compared with surgical masks are not supported by their findings.
- There are a number of statistical analysis discrepancies that also make the presented results difficult to interpret, and do not accurately represent the outcomes of the analysis:
    - The RR calculation for "a lack of eye protection was also associated with transmission of SARS-CoV-2 (RR 14.1; 95% CI 1.3–150.1; P = .04)" is likely confounded by the fact that the only infections in this group were also infections related to individuals that did not wear a respirator during an AGP.

- The values in Table 4 under the significant exposure during AGP and tested negative do not sum appropriately to 222, and instead fall short by five. I.e., 'any lack of respirator during AGP' (n=203) plus 'any lack of eye protection' (n=26) subtracted by 'lack of respirator and eye protection during AGP' (n=12) is equal to 217. There may be an 'other reason for exposure' that was not reported that would make up for the missing 5 test-negatives, similar to 11 cases reported in Table 3; however, the authors have not specified this.
- RR was calculated for the statement "the use of a surgical face mask instead of a respirator during an AGP was not associated with transmission of SARS-CoV-2 (RR 0.99; 95% CI 0.96–1; P=1)", but should not be possible because there is a 0 incidence rate in the 'wore a respirator' category, which does not allow for a RR to be calculated. The 2x2 table for the Fisher exact test for which the P=1 value was calculated (see reviewer comment below about the inappropriate attribution of P values from the Fisher tests to the RR calculations) would be: exposed group (infected/non-infected) 3/203 and control group (infected/non-infected) 0/19.
- RR and Fisher's exact test calculated for the statement: "Conversely, a lack of eye protection was implicated in 30 (25.9%) of 116 exposures in COVID-19 units compared to 111 (48.4%) of 229 exposures in non-COVID-19 units (RR 1.43; 95% CI 1.22–1.70; P < .001)" does not appear to be correct. A recalculation of this value, using non-COVID-19 units as the reference value, returns a RR of 0.53 (95% CI 0.38-0.75; P=0.0002), or, using COVID-19 units as the reference value, a RR of 1.87 (95% CI 1.34-2.62; P=0.0002). Fisher's exact test P<0.001.
- The authors report the P values from Fisher exact tests rather than the P values from the relative risk calculations alongside the relative risk outcomes; thus, these P values should not be associated with the statistical significance of the relative risk calculations.

Citation

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