Short report

Coworkers are more likely than patients to transmit SARS-CoV-2 infection to healthcare personnel

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Received 9 February 2022
Accepted 11 July 2022

ABSTRACT

Objectives To compare the impact of occupational exposures to SARS-CoV-2 positive patients and SARS-CoV-2 positive coworkers, by comparing the frequency of occupational exposure incidents and the rate of healthcare personnel (HCP) who developed a positive PCR test for SARS-COV-2 after occupational exposure to the two different types of infectious individuals.

Methods A retrospective analysis of all confirmed higher risk occupational exposure incidents that occurred in HCP from 20 March 2020 to 31 December 2020 at a large multisite US academic medical centre. Comparisons between groups for source type were performed using unpaired Student's t-test for continuous variables and the χ^2 test for categorical variables, regression analysis was conducted to assess the associations between source type and risk of positive COVID-19 test after occupational exposure.

Results In total, 2253 confirmed medium or high-risk occupational exposures occurred during the study period. 57% were exposures from coworker sources. Each source individual exposed a mean of 2.6 (95% CI 2.3 to 2.9) HCP; during postexposure surveillance, 4.5% of exposed HCP tested positive within 14 days. A coworker source on average exposed 2.2 (95% CI 2.01 to 2.4) other HCP and infected 0.14 (95% CI 0.1 to 0.17) HCP, while patient sources exposed a mean of 3.4 (95% CI 2.6 to 4.2) HCP but only infected 0.07 (95% CI 0.04 to 0.11) HCP. The multivariate analysis demonstrated that exposure to a coworker source carried a higher risk of testing positive compared with exposure to a patient source (OR 3.22; 95% CI 1.72 to 6.04).

Conclusion Occupational exposures to coworker sources were not only more frequent but also associated with triple the risk of developing COVID-19 infection, compared with exposures to patient sources.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Healthcare personal (HCP) remains among the highest burdened occupational groups by the COVID-19 pandemic due to their increased risk of exposure and acquiring the infection from exposure to patients or other HCP. While several studies have examined the impact of occupational exposure in a healthcare setting, little is known about the infection risk of exposure to patients compared with coworkers.

WHAT THIS STUDY ADDS

⇒ In a large cohort of HCP, occupational exposures to coworker sources were more frequent and associated with triple the risk of developing COVID-19 infection compared with exposures to patient sources.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ In addition to the need to promote vaccination, HCP and hospital administrators should maintain vigilance using personal protective equipment and social distancing among coworkers, especially when the community prevalence of COVID-19 is high.

INTRODUCTION

Healthcare personal (HCP) remains among the highest burdened occupational groups by the COVID-19 pandemic due to their increased risk of exposure and acquiring the infection from exposure to patients or other HCP.[1–3] While several studies have examined the impact of occupational exposure in a healthcare setting, little is known about the infection risk of exposure to patients compared with coworkers.[4 5]

OBJECTIVES

To compare the impact of occupational exposures to SARS-CoV-2 positive patients and SARS-CoV-2 positive coworkers, by comparing the frequency of occupational exposure incidents and the rate of HCP who developed a positive PCR test for SARS-COV-2 after occupational exposure to the two different types of infectious individuals.

METHODS AND RESULTS

This is a retrospective analysis of all confirmed higher risk occupational exposure incidents that occurred from 20 March 2020 to 31 December 2020 at a large multisite US academic medical centre with facilities in four states (Arizona, Florida, Minnesota and Wisconsin). Exposure variables were collected in an occupational health service (OHS) COVID-19 database, including the exposure source type (patient, coworker), exposure dates, exposed HCP demographic and occupational data (age, gender, location and occupational category) and SARS-CoV-2 molecular assay results.

To cite: Farah W, Breeher L, Shah V, *et al*. *Occup Environ Med* Epub ahead of print: [please include Day Month Year]. doi:10.1136/oemed-2022-108276

Higher-risk exposures were defined as prolonged close contact with a communicable individual without recommended personal protective equipment (PPE) as defined by current Centers for Disease Control and Prevention (CDC) guidance at the time of the exposure. Medium (exposure for more than 15 min within 6 ft with either the source masked and the exposed HCP without a mask, or the source unmasked and the exposed HCP wearing a mask but no eye protection) and high-risk exposures (exposure for more than 15 min within 6 ft while both subjects were unmasked or any amount of exposure to source patients during an aerosol-generating procedures (AGP) without the appropriate PPE initially defined by the CDC were consistently documented throughout the study period even after the CDC ceased to distinguish between medium and high-risk exposures and renamed them 'higher-risk' exposures.[6] The source of COVID-19 exposure was categorised as patient if HCP sustained exposure while providing medical care to a COVID-19 patient, and as a coworker if the exposure occurred from an infected HCP while both parties were working at the time of the exposure. Postexposure testing was conducted for any symptoms during the 14-day postexposure period, and starting 30 April 2020, testing on day 12–14 postexposure was required for all medium and high-risk exposures.

Comparisons between groups for source of exposure were performed using unpaired Student's t-test for continuous variables and the χ^2 test for categorical variables. A two-level, random intercept, hierarchical logistic regression model was constructed to assess the associations between source type and risk of positive COVID-19 test after occupational exposure while accounting for unobserved difference among sources of exposure. The adjusted variables included exposed employee demographic characteristics (age, sex, state), occupational category (administrative staff, health professionals, nonclinical staff, nurses, providers and technician) and risk level of exposure.

During the study period, a total of 2253 confirmed medium or high-risk occupational exposures were reported. Fifty-seven per cent (1286) were exposures from coworker sources, 63.1% (1535) were high-risk exposures and each source individual exposed a mean of 2.6 (95% CI 2.3 to 2.9)) HCP. During postexposure surveillance, 4.5% (101) of exposed HCP tested positive within 14 days (table 1).

When exposures to coworker sources occurred, 81.3% were categorised as high (rather than medium) risk compared with 50.6% of exposures to patients being high risk (p<0.001). The multivariate analysis demonstrated that exposure to a coworker source carried a higher risk of testing positive compared with exposure to a patient source (OR 3.22; 95% CI 1.72 to 6.04, p<0.001). Each coworker source on average exposed 2.2 (95% CI 2.01 to 2.4; range: 1–18) other HCP and infected 0.14 (95% CI 0.1 to 0.17; range: 0–6) HCP, while patient sources exposed a mean of 3.4 (95% CI 2.6 to 4.2; range:1–58) HCP but only infected 0.07 (95% CI 0.04 to 0.11; range: 0–3) HCP (p<0.001) (table 1).

DISCUSSION

Over the last 2 years, the SARS-CoV-2 pandemic has placed extraordinary and excessive demands on the healthcare system and HCPs from increased risk of infection, staff shortage, loss of productivity and/or financial burden.[4 7 8] Our cohort illustrates the risk and impact of SARS-CoV-2 occupational exposure on HCP, particularly the risk posed by working alongside coworkers who may be working with an asymptomatic or presymptomatic infection themselves.

Similar to previously published studies,[2 3 8] our cohort demonstrated the increased risk of developing COVID-19 infection after occupational exposure to a patient or coworker source with an overall post exposure infection rate of 4.5%. While the occupational risk of SARS-CoV-2 infection in HCP has been well defined in other studies,[2 4] the difference in risk from occupational exposures to different source types has been inconsistent, with some studies reporting increased infection rates following exposures to patient sources[9 10] while others have found an increased occupational exposure risk from infected coworkers.[5 11 12] HCP in our study were three times more likely to test positive after an exposure to a coworker vs a patient, consistent with the previously reported result by Fell *et al* demonstrating a postexposure conversion rate of 3.8% when the source was a coworker compared with 1.3% for a patient source.[11]

In our analysis, we observed that more HCP were exposed when the source was a patient than a coworker (3.4 vs 2.2 HCP exposed per source, respectively), while the more significant exposures (high risk) were more common when the source was a coworker. This finding is consistent with the previously reported results by Emecen *et al* and Maltezou *et al*.[5 8]

The higher number of exposed HCP for each patient source is likely attributable to two common scenarios: lack of eyewear use by HCP caring for an inpatient not initially suspected of having COVID-19, and presence during or shortly after an AGP without the use of a respirator.[13] Delayed and/or incidentally discovered infections, potentially due to a preadmission exposure or an initial false negative test, occurred throughout the

Table 1 Occupational exposure outcomes by source type

Outcome	Exposures to patient sources (967)	Exposures to coworker sources (1286)	P value
Exposure incident risk level			<0.0001
Medium-risk exposure incidents	478 (49.4%)	240 (18.7%)	
High-risk exposure incidents	489 (50.6%)	1046 (81.3%)	
HCP postexposure PCR results			<0.0001
Positive	21 (2.2%)	80 (6.2%)	
Negative	946 (97.8%)	1206 (93.8%)	
No of HCP sustaining medium or high-risk exposure per source individual—mean (95% CI)	3.43 (2.6 to 4.2)	2.19 (2.01 to 2.4)	<0.0001
No of HCP with a positive post exposure SARS-CoV-2 test, per exposure incident—mean (95% CI)	0.07 (0.04 to 0.11)	0.14 (0.1 to 0.17)	<0.0001

Unpaired Student's t-test for continuous variables and $\chi 2$ test for categorical variables.
HCP, healthcare personnel; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

study period, despite routine admission testing for COVID-19 starting in April 2020. Prolonged or continuous AGPs such as continuous positive airway pressure, on inpatients not clinically suspected of having COVID-19 infection, tended to expose large numbers of HCP if the patient was subsequently identified as having COVID-19 infection. The lower number of exposed HCP per coworker source may reflect general adherence to precautions such as masking and social distancing, with isolated close contact during breaks with one or two individuals. The number of coworkers exposed could also have been underestimated, given the contact tracing process largely relies on the infected worker's recall of HCP with whom they had contact while communicable.

Most exposures to patient sources were medium risk while the vast majority of exposures to coworker were high risk. This discrepancy may be attributed to a difference in HCPs perceived risk when in close contact with patients compared with coworkers. HCP may use appropriate PPE when providing patient care but may be less diligent in PPE use in proximity to coworkers who are asymptomatic and appear healthy. In some work settings, masking and/or physical distancing may not be feasible such as in breakrooms and shared workspaces. Socialising with coworkers outside of work can also lead HCP to perceive coworkers as low risk at work, especially given the extended periods of time that HCP spend together.[14] Additionally, the increased awareness of transmission risk factors and improvements in infection prevention and control measures implemented in healthcare setting reduced the intensity of exposure to COVID-19 from patient sources.[12]

The increased frequency of high-risk exposures to coworkers is especially concerning given the higher risk of post exposure infection demonstrated in our cohort. The institutional impact of high-risk exposures in the setting of staff shortages can be profound when considering HCP absenteeism due to exposure-related quarantine and/or isolation, in addition to the loss of productivity associated with mortality and years lost due to disability from COVID-19 infection and post-COVID-19 sequalae.[7]

Our study is subject to limitations. First, the observation period predated the availability of COVID-19 vaccines. Despite widespread vaccine requirements for HCP, the relationships between exposure source, exposure intensity and occupational infection risk are likely to remain relevant. Although vaccines are highly effective, the potential remains for waning immunity and the emergence of vaccine-resistant new variants. The perceived risk of encountering an infection from coworkers among HCPs, especially vaccinated coworkers, may be underappreciated by HCP as immunity wanes. Second, the more accessible identification of all HCP potentially exposed to a patient through available features in the electronic medical record, compared with HCP exposure to a coworker source which is subject to recall bias toward HCP with the most intense exposure. Third, the data regarding the exposure history and allocation to occupational vs nonoccupational exposure after a positive COVID-19 test was obtained from the OHS staff's detailed interviews, however, we were not able to rule out non-occupational exposure that may have coincided with medium or high-risk exposures at work. The overall effect would be overestimating occupational exposure as the source of infection in healthcare workers. Fourth, during the first 6 weeks of the study, postexposure testing was only recommended for symptomatic individuals, which would limit the ability to identify infection in asymptomatic HCP in the initial 6 weeks of the study. Additionally, infected workers who are asymptomatic/presymptomatic and feel well enough to be at work are likely in the earliest, most infectious period of their illness, while hospitalised patients have primarily lower respiratory infection and may be less contagious.[15 16] Finally, the continual emergence of new variants coupled with widespread vaccination limit the generalisability of the infection risk estimates observed.

CONCLUSION

Occupational exposures to coworker sources, especially during social interactions at work, are more frequent and associated with triple the risk of developing COVID-19 infection when compared with exposures to patient sources. In addition to promoting vaccination, HCP and hospital administrators should maintain vigilance with use of PPE and social distancing among coworkers, especially when community prevalence of COVID-19 is high.

Acknowledgements We would like to acknowledge the Mayo Clinic Occupational Health Service Department for providing the database

Contributors WF contributed to the planning of the study, data collection, interpretation of data, manuscript writing, and submitted the study. LB contributed to the conception of the study protocol and IRB submission, data interpretation and manuscript writing. VS contributed to the study question, data collection, and manuscript writing. ZW analysed the data and revised the manuscript method and statistical section. CH contributed to the data collection and revised the manuscript critically for important intellectual content. MS contributed substantially to the study planning, conception of the study protocol and IRB submission, data interpretation and manuscript writing. WF, LB and MS had full access to all of the data in the study and takes responsibility as guarantors for the integrity and accuracy of the data and the overall content.

Funding This work was supported by the Division of Public Health, Infectious Diseases and Occupational Medicine at Mayo Clinic, Rochester.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Mayo Clinic Institutional Review Board (IRB application #20-007051).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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