

Elevated Risk of COVID-19 Infection for Hospital-Based Health Care Providers



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INTRODUCTION

There have been numerous reports of SARS-CoV-2 infection among health care workers (HCWs) across the globe. However, data is lacking on risk of hospital vs. community COVID-19 exposure faced by US providers. We report COVID-19 infection rates for physicians (MDs) and advance practice providers (APPs) in hospital medicine and critical care at a national acute care medical practice between March and December 2020.

METHODS

Setting and Subjects

Data for this study comes from a national medical group specializing in hospital medicine (HM), critical care (CCM), and emergency medicine. At most of the 200 community hospitals in 41 states staffed by the group, these staff are the only hospital medicine providers. It serves hospitals in states that were impacted by the early COVID-19 surge, including Washington, Michigan, Ohio, and New York. Human Resources collects daily data regarding COVID-19 testing on all payroll employees. Local hospital testing (with an FDA-approved RT-PCR test) is triggered by symptoms or exposure to an infected person without personal protective equipment (PPE).

We assembled daily cumulative counts of COVID-19 test-positive providers with at least 100 patient contacts March–December 2020. The number of COVID-19 patients in each hospital overall was used as a proxy for community COVID-19 exposure. We included data from the National Neighborhood Data Archive (NaNDA): Socioeconomic Status and Demographic Characteristics of ZIP Code Tabulation Areas, USA, 2008–2017 to control for demographics that could influence hospitalization.

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Analysis

We calculated cumulative provider infection rates overall, by provider type (APP or MD) and by specialty (HM or CCM). We used mixed-effects logistic regression with hospital treated as a random effect to explore the relationship between provider infection, characteristics of the providers, and the number of COVID-19 patients at the hospital and treated by the providers. In sensitivity analysis, we tested a hospital fixed effects model to obtain estimates of the within hospital effects of provider-specific exposure to COVID-19 patients. Since the point estimates were similar from both models, we report results of the mixed effects model.

RESULTS

This analysis includes 3108 W2 employed providers with at least 100 patient contacts March–December 2020. A total of 180 providers were tested; 88 were positive, 90 negative, and 2 pending. The provider cumulative infection rate was 2.8%, 2.3% for MDs and 3.9% for APPs ($p=0.069$). There were no statistically significant differences in provider infection by specialty (HM 2.6%, CCM 2.1%; $p=0.644$) (Table 1). The infection rate increased by the number of COVID-19 patients under direct care of the providers. The infection rate was 0.9% for providers who took care of <10 COVID-19 patients, 2.4% for providers caring for 10–49 COVID-19 patients (OR 2.7, 95%CI 1.1–6.8, $p=0.037$), and 4.1% for providers caring for 50+ COVID-19 patients (OR 4.8, 95%CI 1.8–12.9, $p=0.002$). The number of hospital COVID-19 patients was not associated with provider COVID-19 infections (<150 COVID-19 patients = 2.7% provider positive rate; 150–500 COVID-19 patients = 2.1% provider positive rate [OR 0.8, 95%CI 0.3–1.8, $p=0.532$]; >500 COVID-19 patients = 2.9% provider positive rate [OR 1.1, 95%CI 0.4–2.7, $p=0.851$]).

DISCUSSION

In this nationwide study of infection risk among 3108 hospital-based providers, staff caring for larger numbers of COVID-19 patients were at elevated risk for COVID-19 infection. The number of COVID-19 patients treated at each hospital was not associated with increased risk of infection. These findings suggest that it is not the total number of COVID-19 patients hospitalized, which may reflect the

Table 1 Relationship Between Provider Characteristics and Patient Volumes and COVID-19 Infection

Variable	Infection rate	95% confidence interval			p-value
		Odds ratio	Lower bound	Upper bound	
Provider COVID-19 contacts					
<10	3976 (0.9%)				
10–49	2104 (2.4%)	2.7	1.1	6.8	0.037
50+	1729 (4.1%)	4.8	1.8	12.9	0.002
Hospital COVID-19 contacts					
<150	2633 (2.3%)				
150–500	2498 (2.1%)	0.8	0.3	1.8	0.532
>500	2678 (2.9%)	1.1	0.4	2.7	0.861
Provider type					
MD	6730 (2.3%)				
APP	1079 (3.9%)	1.8	1.0	3.3	0.069
Service					
Hospital medicine	7134 (2.6%)				
Critical care	675 (1.9%)	0.8	0.3	2.1	0.644

number of COVID-19 patients in that hospital's community, but the number of COVID-19 patients that providers directly treat which increases the risk of virus transmission.

There is mixed evidence on provider transmission. Some suggest infections arise from the hospital and community,¹ some have pointed to community-acquired infection,^{2, 3} and others have shown higher in hospital transmission.^{4–6} In these studies, HCWs do tend toward higher seropositivity rate than people in the community.

Our study is limited by the approximation we used to estimate provider infection, as well as the fact that we could not measure provider incidence of infection over time. Overall, in our large nationwide study of provider infection risk, the number of COVID-19 patients treated was associated with increased provider infections. Given the possibility of increased risk of transmission, continued vigilance factors highly in protecting providers from occupational risk for COVID-19.

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REFERENCES

1. **Lai X, Wang M, Qin C, et al.** Coronavirus Disease 2019 (COVID-2019) Infection Among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China *AMA Netw Open* 2020;3:e209666.
2. **Sikkema RS, Pas SD, Nieuwenhuijse DF, et al.** COVID-19 in health-care workers in three hospitals in the south of the Netherlands: a cross-sectional study. *Lancet Infect Dis* 2020.
3. **Kluytmans-van den Bergh MFQ, Buiting AGM, Pas SD, et al.** Prevalence and Clinical Presentation of Health Care Workers With Symptoms of Coronavirus Disease 2019 in 2 Dutch Hospitals During an Early Phase of the Pandemic. *JAMA Netw Open* 2020;3:e209673.
4. **Murakami E, Ghatak-Roy A, Popova M, et al.** COVID-19 infection among emergency department healthcare providers in a large tertiary academic medical center following the peak of the pandemic. *Am J Emerg Med* 2021;40:27-31.
5. **Iversen K, Bundgaard H, Hasselbalch RB, et al.** Risk of COVID-19 in health-care workers in Denmark: an observational cohort study. *The Lancet Infectious diseases* 2020;20:1401-8.
6. **Nguyen LH, Drew DA, Joshi AD, et al.** Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study. medRxiv 2020.

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