Sick on the Frontlines:A Cross Sectional Study on COVID-19 Infection, Symptom Severity Amongst Emergency Medicine Residents and Fellows in Urban Academic Hospital Settings

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Abstract

Background: COVID-19, an illness caused by the novel coronavirus SARS-CoV-2, affected many aspects of healthcare worldwide in 2020. From March to May of 2020, New York City (NYC) experienced a large surge of cases.

Objective: The authors aimed to characterize the amount of illness experienced by residents and fellows in 2 NYC hospitals during this time period.

Methods: This was a cross-sectional observational study. An IRB-exempt survey was distributed to emergency medicine housestaff in May 2020 and submissions were accepted through August 2020.

Results: 64 residents and fellows responded to our survey (a 62% response rate). 42% of responders tested positive for SARS-CoV-2 antibodies. Most residents experienced symptoms that could be consistent with COVID-19 however few received PCR testing. Fevers and/or chills along with loss of smell and/or taste were the most specific symptoms for COVID-19, with p-values <0.05. All 13 housestaff who reported no symptoms during the study period tested negative for SARS-CoV-2 antibodies.

Conclusions: Our study demonstrated that the rate of COVID-19 illness among emergency department housestaff is much higher than previously reported. Further studies are needed to characterize illness among medical staff in emergency departments across the nation. The high infection rate among emergency medicine trainees stresses the importance of supplying adequate PPE for healthcare professionals.

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Original Manuscript

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A Cross Sectional Study onCOVID-19 Infection, Symptom Severity Amongst Emergency Medicine Residents and Fellows in Urban Academic Hospital Settings

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ABSTRACT

Purpose: COVID-19, an illness caused by the novel coronavirus SARS-CoV-2, affected many aspects of healthcare worldwide in 2020. From March to May of 2020, New York City (NYC) experienced a large surge of cases. The authors aimed to characterize the amount of illness experienced by residents and fellows in 2 NYC hospitals during this time period.

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Conclusions: Our study demonstrated that the rate of COVID-19 illness among emergency department housestaff is much higher than previously reported. Further studies are needed to characterize illness among medical staff in emergency departments across the nation. The high infection rate among emergency medicine trainees stresses the importance of supplying adequate PPE for healthcare professionals.

STRENGTHS AND LIMITATIONS

- Selection bias and recall bias given retrospective design

- Small sample size
- High percentage of survey participation from the cohort
- Inclusion of symptoms and correlation with antibody positivity

INTRODUCTION

COVID-19 is a viral respiratory illness caused by the SARS-CoV-2 virus that has plagued the world in 2020. By March 2020, COVID-19, also known as novel coronavirus, reached epidemiological criteria to be declared a global pandemic.[1] After its initial identification in Wuhan, China, COVID-19 quickly spread across the world.[2] Since first identified on January 15th, 2020 in Seattle, Washington, the United States has become the country with the largest number of confirmed cases. To date, the United States has had over 13.8 million COVID-19 cases with over 320,000 of those from New York City alone.[3] New York City experienced a massive surge of cases between March and May 2020.

At the time of the writing of this article, the county of Kings, New York, also known as the city of Brooklyn, has seen the highest number of COVID-19 related deaths in the United States at over 24,000[2]. SUNY Downstate Medical Center and Kings County Hospital are state and public city hospitals respectively, located in central Brooklyn. The emergency departments in both hospitals are staffed primarily by Board Certified Emergency Medicine (EM) Attending Physicians and EM residents. As of November 18, 2020, Kings County Hospital cared for 2,701 COVID-19 patients and reported 348 COVID-19 related deaths. As of November 18, 2020, SUNY Downstate Medical Center, which was designated a “COVID-19 only facility” by state governor’s mandate[11], admitted 864 COVID-19 patients and reported 298 deaths.

Resident physicians in teaching hospitals act as the front lines of the emergency department, intensive care units, and clinics. Their exposure rates given the large volumes of patients they see

over long and frequent shifts are perceived to be great. Furthermore, this study includes COVID-19 exposures early on in the first wave when Personal Protective Equipment (PPE) was limited, and before stockpiles were mandated in NY.

The objective of this study is to evaluate the COVD-19 exposure of emergency medicine resident physicians and fellows working at the above-mentioned urban academic medical centers. After quantifying the exposure, their symptoms, the number of patients with COVID-19 treated and intubated, and perceived adequacy of PPE was correlated with residents' and fellows' antibody test results.

METHODS

Study design, setting, and population

A cross-sectional survey study was conducted at SUNY Downstate Medical Center and Kings County Hospital Center in Brooklyn, NY among individual emergency medicine residents and pediatric emergency medicine fellows.

Study protocol

The electronic survey questionnaire was generated using the Qualtrics Survey platform (Qualtrics, Version August 2020. Provo, UT) and was self-administered in May 2020 via email listserv to the residents and fellows of the SUNY Downstate Emergency Medicine Residency department. The survey and investigation received IRB exemption status from the SUNY Downstate IRB with participant consent waived. Participation in the study was voluntary and no compensation was given for participation. Results were kept anonymous and confidential.

During the study period, residents were offered three laboratory options for SARS-CoV-2 IgG antibody testing:

1. Wadsworth Center (WC) microsphere immunoassay (MIA)[4], performed at the public health laboratory of the New York State Department of Health (NYSDOH)

2. Abbott Laboratories Inc chemiluminescent microparticle immunoassay (CMIA)[5] performed at Quest Diagnostics
3. Abbott ARCHITECT[5] nucleocapsid immunoassay analyzer, performed at University Hospital of Brooklyn Laboratory

Residents that had RT-PCR (PCR) testing were offered the following tests from our institutions:

1. Hologic Panther Fusion® System[6] performed at Lenco Diagnostic Laboratory (March 2020)
2. Cepheid GeneXpert®Systems[7] performed at University Hospital at Brooklyn Laboratory (April to August 2020)
3. BioFire® Respiratory 2.1-EZ (RP2.1-EZ) Panel[8] performed at University Hospital at Brooklyn Laboratory (July to August 2020).

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Key outcome measures

Survey questions (see Appendix) included a range of options for the total number of patients with COVID-19 that the housestaff were exposed to, the total number of patients with COVID-19 that the housestaff intubated, average clinical weekly hours worked, symptoms of illness, and whether or not the housestaff felt PPE provided was adequate. The survey questions referenced the time period between February 2020 and until survey completion. Results were collected through August 2020.

Data analysis

Survey responses were tabulated and compiled in table format with ranges. Frequency data were reported as percentages with 95% Confidence Intervals (95%, CI). Group comparisons were analyzed by Fisher's Exact Test. Alpha set as 0.05, all tests were 2-tailed. IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

RESULTS

Table 1	Demographics of Survey Participants	
Characteristics	Category	Total Number (%)
		(n=64)
Age (years)	26-30	39 (61%)
	31-35	21 (33%)
	36-40	4 (6%)
Postgraduate Year	1	13 (20%)
(PGY)	2	20 (31%)
	3	14 (22%)
	4	12 (19%)
	5+	5 (8%)
Gender	Female	33 (52%)
	Male	31 (48%)
Clinical Hours	11-20 hours	1 (2%)
(average/week)	21-30 hours	4 (6%)
	31-40 hours	11 (17%)
	41-50 hours	17 (27%)
	51-60 hours	23 (36%)
	61-70 hours	6 (9%)
	71-80	2 (3%)
COVID-19 PCR test	Positive	9 (14%)
	Negative	8 (12%)
	Indeterminate	1 (16%)
	Did not take PCR test	46 (72%)
Ab test	Positive	27 (42%)
	Negative	34 (53%)
	Indeterminate	1 (16%)
	Did not take antibody test	2 (3%)

From Table 1, 64 out of 104 residents, and fellows responded to the survey yielding a 62% response rate. Of the 64 housestaff, 27 (42%) were positive for COVID-19 IgG antibodies, 2 residents did not undergo antibody testing and 1 resident had indeterminate results. Most of the respondents were female (52%) between 26-30 years of age (61%). The most common post-graduate year (PGY) was 2, with PGY3 and 1 second and third most common, respectively. Residents mostly

(36%) worked 51-60 hours per week. The majority of study participants (72%) did not take a SARS-CoV-2 PCR test but 97% of respondents had taken a SARS-CoV-2 antibody test. All residents with a positive PCR (N=9) also had a positive antibody test.

Table 2 Characteristics comparing COVID-19 IgG antibody-negative to antibody-positive residents

	Category	Antibody Negative n (%)	Antibody Positive n (%)	p-value
		(n=34)	(n=27)	
Number of patients treated	<10	1 (3%)	1 (4%)	1.000
	10-20	0 (0%)	1 (4%)	1.000
	20-40	8 (24%)	4 (15%)	0.520
	40-60	8 (24%)	7 (26%)	1.000
	60-80	6 (18%)	5 (19%)	1.000
	80-100	2 (6%)	1 (4%)	1.000
	>100	9 (26%)	8 (30%)	1.000

Number of patients intubated	<5	26 (76%)	20 (74%)	1.000
	5-10	2 (6%)	6 (22%)	**0.050**
	10-15	3 (9%)	1 (4%)	**0.023**
	15-20	3 (9%)	0 (0%)	0.250
Resident symptoms of illness	Fever/chills	8 (24%)	18 (67%)	**0.002**
	GI symptoms	8 (24%)	8 (30%)	0.770
	Upper respiratory symptoms	13 (38%)	15 (56%)	0.205
	Loss of taste/smell	2 (6%)	19 (70%)	< **0.001**
	Headache	11 (32%)	11 (41%)	0.395
	None	13 (38%)	0 (0%)	< **0.001**
Adequate PPE	Yes	18 (52%)	11 (41%)	0.441
	Maybe	10 (29%)	9 (33%)	0.786
	No	6 (18%)	7 (26%)	0.247

- **Bold text** indicates $p < 0.05$

Table 2, compares COVID-19 exposure between those residents who tested antibody positive versus negative for SARS-CoV-2 virus. There was no significant difference in the risks of a positive antibody test based on the number of COVID-19 patients the residents treated during the study period. Most respondents (73%) intubated less than 5 COVID-19 patients at the time of the survey, which left too few events to accurately compare the number of intubations to the risks of becoming antibody-positive. A significant difference in symptoms was noted between antibody-positive and -negative residents. Although none of the antibody-positive residents were without symptoms 62% of antibody-negative residents had a symptom commonly associated with COVD-19 infection. Fever and chills (67% vs. 24%) and loss of taste and smell (70% vs. 6%) were both significantly ($p < 0.05$) more commonly experienced by antibody-positive compared to -negative residents. Gastrointestinal (GI) and upper respiratory symptoms and headache did not appear to correlate to antibody status. The perception of the adequacy of PPE was similar regardless of antibody status.

DISCUSSION

Our survey had an adequate response rate of (64/104) 62%. Overall, 42% of our residents and fellows tested positive for SARS-CoV-2 antibodies, indicating a high rate of exposure within the first few months of the pandemic. No residents or fellows were hospitalized.

One prior study by Breazzano et al. conducted by surveying cross-specialty program directors in NYC in April 2020 including 2306 residents found that the rates for resident COVID-19 illness were 4.4% confirmed, 7.1% presumed, and 3.3% suspected.[9] They also found that emergency medicine, anesthesiology, and ophthalmology appeared to cluster as high-risk specialties by the proportion of residents with confirmed COVID-19, with rates of COVID-19 illness among 382 emergency medicine residents being 6.5% confirmed, 8.4% presumed, and 3.1% suspected.

A prior study in Italy reported 20% of healthcare professionals (n=350) had become infected within the first month of working with COVID-19 patients.[10] A more recent study in California, US conducted in September to October of 2020 found only 2.9% of their emergency department staff (n=139) had antibodies for SARS-CoV-2.[11] Anti-spike or anti-nucleocapsid IgG antibody presence has been shown to be associated with a substantially reduced risk of SARS-CoV-2 reinfection (adjusted incidence rate ratio 0.11; 95% confidence interval, 0.03 to 0.44; P = 0.002).[12]

The percentage of young physicians in our emergency departments who developed COVID-19 was more than double those previously reported. This is likely multi-faceted and could be due to the high-risk nature of our specialty, the use of antibody testing in addition to PCR testing to determine exposure, and our hospital and regional setting. Antibody testing captures the incidence of infections over a longer timeframe (both active and past infections) as compared to PCR testing which is usually only positive in an active infection. Additionally, our practice area of Flatbush, Brooklyn was a COVID-19 hotspot and the University Hospital of Brooklyn was identified as a COVID-19 only facility by governor mandate[13] which may have increased housestaff exposure.

Our study was not powered to detect a relationship between the number of patients seen and/or intubated and antibody status. A larger study is needed to further evaluate. Another component that could be included in a further study is controlling for outside sick contacts, which would ensure that the risk assessed for infection was work-related. Identification of the exposure can be difficult though, especially if using the antibody test as a proxy for infection due to the longer time frame for positivity.

Lack of PPE at the onset of the pandemic was an issue nationally. More than half of the housestaff polled who developed COVID-19 antibodies stated they felt the PPE provided to them was inadequate or may be inadequate.

Only 28% of housestaff had taken a SARS-CoV-2 PCR test by the time they answered the survey, despite most reporting symptoms. This is in comparison to 97% of respondents reporting having an antibody test within the same time frame. PCR testing identifies individuals with acute infection and active viral shedding and is also used to determine isolation needs. Our low reported PCR-testing rate is likely due to poor availability of PCR testing at the onset of the pandemic and could have contributed to our high rate of infection as our housestaff may have unknowingly reported working while carrying the virus. PCR testing was limited to the critically ill and hospitalized despite the presence of COVID-19-like symptoms.

The majority of housestaff, both those with and without antibodies, had symptoms that could be consistent with COVID-19 during the study period. Fever/chills could be considered a good symptom for use in screening, but interestingly, only 66% of those who developed antibodies experienced fevers or chills. Therefore, symptoms alone are not good enough as a screening test. Loss of smell and/or taste was very specific in identifying individuals with COVID-19 antibodies. More data is needed to determine if other symptoms are sensitive and/or specific to identify COVID-19 illness in housestaff. Asymptomatic pooled PCR testing is another adjunct that can be used to identify individuals shedding virus.

Our study is hypothesis-generating and we would like to expand the survey across other emergency departments to gather more data. Due to the fact that our study demonstrated a much larger percentage of residents experiencing COVID-19 illness compared to prior studies, we believe a larger study across multiple institutions and cities would be the next step in documenting housestaff illness and identifying causative factors, some of which may be possible to address prior to future waves of COVID-19 or other illnesses with a similar spread. Given our reasonably large response rate, we feel a larger survey study would be feasible.

Limitations

Our study allows for both selection bias and recall bias. The 62% of housestaff who responded to the survey on a voluntary basis may have been more skewed towards individuals who underwent antibody testing and/or who had a particular result. Additionally, the survey was retrospectively asked about the adequacy of PPE, and residents who tested positive for antibodies may have felt that due to their illness they lacked PPE compared to their counterparts. Similarly, when asked retrospectively about symptoms of illness, our housestaff may have over or underreported their symptoms.

Another limitation of our study was the relatively small sample size. Our study only included residents and fellows in two emergency departments in Brooklyn and therefore was underpowered to identify a significant trend in comparing patient encounters and intubations with COVID-19 illness in housestaff.

CONCLUSION

The rate of COVID-19 infection in emergency medicine residents and fellows during the first few months of the 2020 pandemic was 42%, much higher than previously reported. Other significant results include the association of fever and/or chills and loss of smell and/or taste with COVID-19 infection as well the association of absence of any symptoms with SARS-CoV-2 antibody negativity in housestaff. This calls for continued advocacy for sufficient PPE and more routine PCR testing of asymptomatic carriers to identify those who are acutely-ill shedding.

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The survey and investigation received IRB exemption status from the SUNY Downstate IRB with participant consent waived.

This material has not been previously presented.

Contributorship statement: SF, SAJ, JW and RS planned the study. SF and SAJ conducted the study. RS performed the statistical analyses for the study. SF, JW and RS drafted the manuscript. SF is the guarantor who accepts full responsibility of overall content and data.

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Supplementary Files