

## Original Research

# Protective Equipment Preparedness and Accessibility: A Survey of Medical Trainees

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### Abstract

#### Introduction

After being removed from patient care due to equipment shortages, medical students and new residents around the United States are returning to clinical medicine/acute care settings as the SARS-CoV-2 (COVID-19) pandemic continues. We hypothesize that trainees returned with increased preparedness and had better access to and knowledge of personal protective equipment (PPE).

#### Methods

Anonymous online surveys were distributed via snowball sampling to medical students and residents performing clinical duties in the United States. Respondents completed self-assessments for preparedness regarding PPE use, access to PPE and COVID-19 testing, and access to COVID-19 positive patients. Group comparisons were conducted using chi-square analysis and the Kruskal Wallis rank sum test. Multivariate ordinary least squares regression analysis was used to estimate the relationship between feeling prepared and other variables.

#### Results

A total of 194 trainees (63 year 3 [MS3] medical students, 95 year 4 [MS4] medical students, and 36 year 1 [PGY1] postgraduates) completed the survey. Collectively, 27% provided their own PPE on  $\geq 1$  rotation, 27% did not know how/where to obtain PPE, 36% did not know how/where to get tested, and 57% were never asked to demonstrate proficiency with PPE. In-person training was reported at 31.3% prior to 2020, which decreased to 21% during 2020. Mask-fit testing decreased from 83.1% to 56.9%. Online video lectures on PPE training increased from 52% to 80%. The mean ( $\pm$ SD) preparedness for return to clinical duty for MS3 students was 3.4/5 ( $\pm$ 1.0), for MS4 students was 3.8/5 ( $\pm$ .90), and for PGY1 residents was 4.1/5 ( $\pm$ .89) ( $P = .002$ ). PPE training in 2020 was not associated with feeling prepared ( $P = .81$ ).

#### Conclusion

Survey respondents felt prepared by their institutions to return to clinical duties during the COVID-19 pandemic. There was some apprehension about knowledge of or access to PPE and COVID-19 testing. The confidence in the ability to don/doff PPE was the main factor associated with increased feelings of preparedness. While in-person training decreased from pre-2020 to during 2020, an increase of in-person training with supervised donning and doffing provides one potential avenue of further increasing the preparedness of trainees.

#### Keywords

personal protective equipment; PPE; COVID-19; medical students; training; health personnel; medical education; safety

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## Introduction

Medical students and new resident physicians in the United States (US) have returned to clinical medicine after being removed from duties

because of safety concerns brought on by the SARS-CoV-2 (COVID-19) pandemic. On March 17, 2020, the Association of American Medical Colleges (AAMC) strongly recommended

suspending all medical student rotations. The first section of this recommendation relates to the adequate provision of personal protective equipment (PPE) to medical students. The AAMC's report said, "If availability of PPE is not adequate to fully meet medical student PPE needs, medical students should not be involved in any direct in-person patient care activities for which their roles require PPE."<sup>1,2</sup>

Improper PPE techniques by healthcare workers can lead to widespread contamination.<sup>2,3</sup> A serious challenge with the COVID-19 pandemic has been PPE shortages, thereby multiplying the risk of contamination to patients and healthcare personnel.<sup>4</sup> The groups surveyed in this study represent the medical student classes whose clinical duties were reduced due to COVID-19. More junior medical trainees are typically kept away from direct contact with COVID-19 positive patients for safety reasons. However, given their inevitable proximity to individuals with the virus, they should be prepared to protect themselves through knowledge of and access to PPE.

Fourth-year medical student (MS4) and post-graduate year one resident (PGY1) classes may have been affected by removal from rotations, while many third-year medical students (MS3) had their rotations delayed or reduced. Previous studies have shown medical students and residents do not receive proper training on PPE, yet this training plays an important role in preventing the spread of hospital-acquired infections.<sup>5-7</sup> In this survey study, we assess the preparedness of returning medical trainees to return to clinical duties through their knowledge of and access to PPE. We hypothesize that trainees returned with increased preparedness and better access to and knowledge of PPE.

## Methods

Over 8 weeks from July to September 2020, we sent an anonymous online survey (**Supplement 1**) via Google Forms to MS3, MS4, and PGY1 trainees from accredited US medical institutions, distributed through contacts at the programs via email. The contacts were a combination of designated officials (such as deans) and known contacts of the principal investigator (PI); 40 original emails were sent out by the PI. All distribution mechanisms were shareable to

facilitate snowball sampling. Our institutional review board approved this study as exempt human subjects research, and no identifying information was collected.

Informed consent was obtained, and general demographic data were collected. The survey included 20 questions. Trainees were asked to what extent they felt they had been prepared by their institution to carry out clinical duties safely during the pandemic with response options of "strongly agree," "agree," "neither agree nor disagree," "disagree," or "strongly disagree." The response to the preparedness question was coded as a continuous variable, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). We further asked about types of PPE training, confidence in using PPE, COVID-19 testing, PPE testing, PPE accessibility, concern for contracting COVID-19, and access to infected patients.

Group comparisons were conducted using the chi-square analysis and the Kruskal-Wallis rank sum test. Multivariate ordinary least squares (OLS) regression analyses were used to estimate the relationship between feeling prepared and the medical training year, demographic characteristics, PPE training-related responses, and concerns for contracting COVID-19 to see if the effect of the medical training year remained as a statistically significant predictor of feeling prepared against COVID-19 accounting for all differences in individual characteristics. In the multivariate regression, responses to types of PPE training were summarized and recategorized as "none" compared to any types of PPE training for ease of interpretation. A *P*-value threshold of .05 was used to determine statistical significance.

## Results

A convenience sample of 194 participants 21 years or older from 17 states/territories completed the survey. Sixty-three MS3s (32.5%), 95 MS4s (49.0%), and 36 PGY1s (18.5%) responded (**Table 1**). Collectively, 27.8% provided their own PPE on at least 1 rotation, 26.8% did not know how/where to obtain PPE, and 57.7% never demonstrated proficiency with PPE. In-person PPE training prior to 2020 was recorded at 31.3%, while the rate was recorded at 21% during 2020. Mask-fit testing also decreased from 83.1% prior to 2020 to 56.9% during 2020.

**Table 1.** Respondent Demographics (N = 194).

Characteristics	n (%)
<b>Age</b>	
21-23	3 (1.5)
24-26	99 (51.1)
27-29	74 (38.1)
30+	18 (9.3)
<b>Gender</b>	
Men	86 (44.3)
Women	108 (55.7)
<b>Race/Ethnicity</b>	
White	92 (47.4)
African American	9 (4.6)
Hispanic	14 (7.2)
Asian	58 (29.9)
Other	21 (10.9)
<b>Geographic location</b>	
East	114 (58.8)
Midwest	10 (5.2)
West	70 (36)
<b>Year of medical training</b>	
MS3	63 (32.5)
MS4	95 (49.0)
PGY1	36 (18.5)

Online-video lectures on PPE training increased from 51.8% to 79.5% (**Figure 1**).

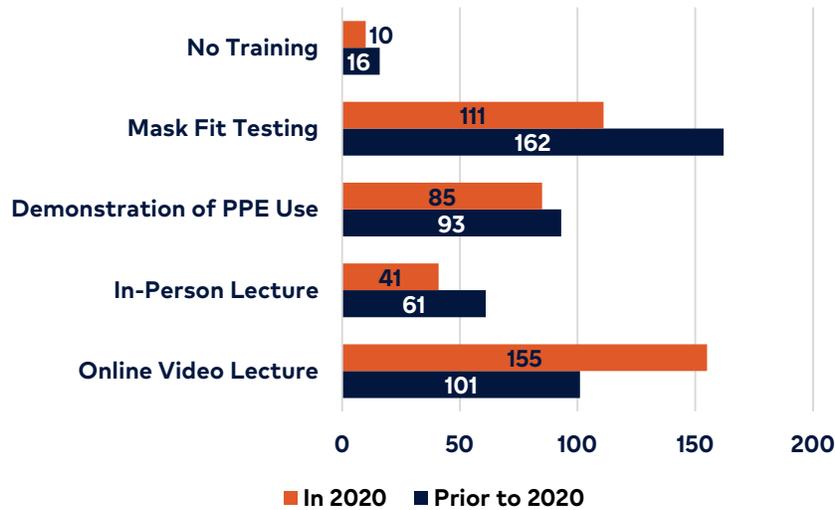
A total of 35.6% (n = 69) of all trainees did not know how or where to get tested for COVID-19 infection. In rating concern for contracting COVID-19, 17.4% (n = 34) answered “very concerned” and 28.2% (n = 55) answered “concerned.” A total of 64.1% (n = 125) reported that their institution had shown them how/where to get tested for COVID-19, and 70.3% said they could get tested within 48 hours. A

total of 82% (n = 159) had at least some restrictions when seeing patients with diagnosed or suspected infection. MS4s were most likely to supply their own PPE (15.5%) followed by MS3s (10.3%) and then PGY1s (2%) (*P* = .046) (**Table 2**). Trainees were more likely to know how and where to obtain PPE with a more advanced year of training. A more advanced year of training was associated with a higher likelihood of knowing how and where to obtain PPE (**Table 3**).

**Table 2.** Differences Between Classes in Supplying Their Own PPE (N = 54).

	%	n	$\chi^2$	<i>P</i>
<b>MS3</b>	10.3	20	6.16	.046*
<b>MS4</b>	15.5	30		
<b>PGY1</b>	2.0	4		

**Note.** The chi-squared test was used as the response category was non-parametric. Significance level indicated with \* *p* <.05, \*\* *p* <.01, \*\*\* *p* <.001.



**Figure 1.** Comparison of Reported Types of PPE Training Prior to 2020 Versus in 2020.

In response to if they felt prepared to carry out clinical duties, MS3s selected “neither agree nor disagree” (mean ± SD 3.4/5 (± 1.0)), MS4s “agree” (mean ± SD 3.8/5 (± 0.90)), and PGY1s “agree” (mean ± SD 4.1/5 (± 0.89));  $P = .002$  (Table 4). The effect of the medical student year was a significant predictor of feeling prepared against COVID-19, showing higher feelings of preparedness on average with increases each training year, which was consistent from the univariate (Table 5: Model 1) to the multivariate models (Table 5: Model 2-3). From the multivariate OLS regression (Table 5: Model 3), it was found that confidence in their ability to don/doff PPE was associated with feeling prepared by one’s institution ( $b = 0.21$  [SE = 0.07];  $P = .002$ ). Trainees felt less prepared if they reported increased concern for contracting COVID-19 ( $b = -0.015$  [SE = 0.05];  $P = .008$ ), not knowing about COVID-19 testing locations ( $b = 0.38$  [SE = 0.13];  $P = .005$ ) or not knowing how to obtain PPE ( $b = 0.61$  [SE = 0.15];  $P < .01$ ). Neither PPE training in 2020 nor access to infected patients was significantly associated with trainees feeling prepared ( $b = -0.07$  [SE

$= 0.28$ ];  $P = .81$  and  $b = 0.07$  [SE = 0.13];  $P = .59$ , respectively). Race was not associated with preparation by one’s institution (all  $P > .05$ ).

### Discussion

In this convenience sample survey in the beginning months of the 2020-2021 academic year, medical trainees reported changes in education regarding PPE. While most medical students and PGY1 residents received adequate training and preparation, a large percentage reported inability to obtain PPE and testing. Virtual methods of PPE training became more common while all types of in-person training became less common. The PGY1 cohort felt the most prepared by their institutions, with a stepwise decline in this regard for MS4s followed by MS3s. Several factors were associated with trainees feeling less prepared, such as concern for infection and not knowing where to obtain PPE or COVID-19 testing. While the ability to don/doff PPE made trainees feel more prepared, training in or prior to 2020 was not associated with feeling more prepared.

**Table 3.** Differences Between Classes in Not Knowing How and Where to Obtain PPE (N = 52).

	%	n	$\chi^2$	P
***MS3	15.5	30	22.41	< .001***
MS4	9.8	19		
PGY1	1.5	3		

**Note.** The chi-squared test was used as the response category was non-parametric. Significance level indicated with \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

**Table 4.** Comparison of Preparation Confidence Between All Three Cohorts (N = 194).

	Mean	SD	P
MS3	3.38	1.05	.002**
MS4	3.82	0.90	
PGY1	4.06	0.89	

**Note.** The Kruskal-Wallis rank sum test was used because the response category was an ordinal scale. Significance level indicated with \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

A similar study from the United Kingdom studied the association between COVID-19-related anxiety and adequacy of PPE as well as infection prevention and control in medical students and intern residents.<sup>8</sup> In their survey to trainees, the authors reported that COVID-19-related anxiety was significantly higher in those without sufficient reported PPE or infection prevention and control (IPC) training, in women compared to men, and in first-year residents compared to medical students. Even before the COVID-19 pandemic, the medical literature had established that medical trainees play an important role in preventing the spread of hospital-acquired infections, yet they do not always receive proper instruction in its use.<sup>5,6</sup>

This study is the first to look at how US medical trainees feel they have been prepared by their institutions to return to clinical duties during the COVID-19 pandemic. As medical trainees were removed from clinical duties following the AAMC's recommendation, this study essentially evaluates how institutions responded to the recommendation by implementing better resources for trainees so that they could carry out their duties safely. Snowball sampling has demonstrated efficacy in looking at vulnerable populations, such as medical students and residents, who can more anonymously complete surveys without concern for repercussion by the institution or otherwise affecting the reputation of their institution.

There are several limitations to this study. Firstly, we are not able to determine the response rate because of the snowball distribution that was used to send out surveys. Secondly, the sample size of the study is small but sizeable enough for hypothesis generation. Lastly, the generalizability of these results would only be limited to MS3, MS4,

and PGY1 trainees. Thus, follow-up studies are required if the other graduating years are to be considered.

## Conclusion

We conclude that survey respondents felt prepared by their institutions to return to clinical duties during the COVID-19 pandemic. There was still some apprehension about knowledge of or access to PPE as well as COVID-19 testing. Confidence in the ability to don/doff PPE was the main factor associated with an increased feeling of preparedness. An increase of in-person training with supervised donning/doffing provides one potential avenue to continue increasing the preparedness of trainees. Further studies or guidelines are needed for clinicians focusing on improved PPE training by their institution.

## Conflicts of Interest

The authors declare they have no conflicts of interest.

Dr An is an employee of Riverside Community Hospital, a hospital affiliated with the journal's publisher.

Drs Prasad and Bal are employees of TriStar Centennial Medical Center, a hospital affiliated with the journal's publisher.

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**Table 5.** Multivariate Linear Regression Modeling the Association Between Responses and Feeling of Preparation By One's Institution.

	Model 1			Model 2			Model 3		
	Estimate			Estimate			Estimate		
	(b)	(SE)	P	(b)	(SE)	P	(b)	(SE)	P
<b>Constant</b>	3.38	(0.12)	< .01***	4.88	(0.55)	< .01***	3.44	(0.64)	< .01***
<b>Medical training group (ref=MS3)</b>									
MS4	0.44	(0.15)	< .01**	0.51	(0.16)	.001**	0.31	(0.15)	.045*
PGY1	0.67	(0.20)	< .01***	0.82	(0.21)	< .01***	0.41	(0.20)	.036*
<b>Age (ref=21-23 years)</b>									
24-26 years				-1.31	(0.56)	.02*	-0.88	(0.49)	.077
27-29 years				-1.54	(0.57)	.007**	-0.93	(0.50)	.06
30+ years				-1.49	(0.60)	.013*	-0.95	(0.53)	.07
<b>Women (ref=Men)</b>									
				-0.32	(0.14)	.025*	-0.20	(0.13)	.11
<b>Race/Ethnicity (ref=White)</b>									
Black or African American				0.19	(0.33)	.56	0.42	(0.29)	.145
Hispanic				-0.37	(0.27)	.17	-0.17	(0.25)	.48
Asian				0.05	(0.16)	.75	0.22	(0.14)	.12
Others				0.13	(0.23)	.58	0.31	(0.20)	.13
<b>Confidence in using PPE</b>							0.21	(0.07)	.002**
<b>Had PPE use training in 2020</b>							-0.07	(0.28)	.81
<b>Concern about contracting COVID-19</b>							-0.15	(0.05)	.008**
<b>Knowledge about COVID-19 testing</b>							0.38	(0.13)	.005**
<b>Knowledge how to obtain PPE</b>							0.61	(0.15)	<.01***
<b>Access to PUI/COVID patients</b>							0.07	(0.13)	.59
	<i>R</i> <sup>2</sup>	0.07	.001**	0.14		.001**	0.38		< .01***

**Note.** Model 1 is the univariate model, Model 2 adjusts for demographic characteristics, and Model 3 additionally adjusts for the predictors related to COVID-19.

Significance level indicated with \* p <.05, \*\* p <.01, \*\*\* p <.001.

Abbreviation: PUI: patients under investigation for possible COVID-19 infection

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