

Impact of medical school responses during the COVID-19 pandemic on student satisfaction: a nationwide survey of US medical students

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Purpose: Medical schools have faced various challenges in preparing their clinical students for the frontlines of a pandemic. This study investigated medical students' satisfaction with their institutions during the coronavirus disease 2019 (COVID-19) pandemic with the intention of guiding educators in future public health crises.

Methods: In this cross-sectional study surveying students in clinical rotations, the primary outcome was overall satisfaction regarding medical schools' responses to the pandemic, and the four secondary outcomes were school communication, exposure to COVID-19, availability of personal protective equipment, and access to COVID-19 testing.

Results: The survey was distributed to ten medical schools, of which 430 students responded for a response rate of 13.0%. While most students were satisfied (61.9%, n=266) with their schools' response, more than one in five (21.9%, n=94) were dissatisfied. Among the four secondary outcomes, communication with students was most predictive of overall satisfaction.

Conclusion: In future crises, schools can best improve student satisfaction by prioritizing timely communication.

Key Words: COVID-19, Medical education, Public health

Introduction

The severe acute respiratory syndrome coronavirus 2 (coronavirus disease 2019, COVID-19) pandemic has caused major disruptions worldwide. With clerkships necessitating in-person components for students to re-

ceive clinical experiences, medical schools needed to rapidly evolve to ensure student safety.

The widespread impact of the pandemic on medical students warrants investigation into how medical schools handled the crisis with respect to trainees' learning and well-being so that future medical educators and students may be better prepared for similar challenges. Previous

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studies have reported one-third of students to be uncomfortable with returning to in-person rotations [1,2]. While studies have reported on student satisfaction with pre-clinical curricula that has largely gone virtual, there is a lack of studies specific to satisfaction regarding institutional support during the pandemic of medical students in their clinical years [3,4].

We hypothesized that medical students on clinical rotations would not be satisfied with how schools protected their students during the COVID-19 pandemic. Thus, we investigated ways in which medical schools could better address the needs of students in future health crises.

METHODS

1. Participants

Ten allopathic institutions across the United States were chosen to participate in this study. Of the schools that allowed survey distribution on official platforms, we selected schools that would give comprehensive geographic (two to three schools from each US region determined by the US Census [5]), equal public/private status (five private, five public), and proportionate racial and gender distributions to ensure a representative sample. All medical students in clinical years were eligible. This study was approved by the Brown University Institutional Review Board (protocol #2101002887). A waiver of documentation of informed consent for remote procedures was obtained as well (45 CFR 46.117) in accordance with the Helsinki Declaration. All participants of the study provided written informed consent and consent for publication.

2. Data collection

A locally-designed Qualtrics survey queried students

about satisfaction with their school's response to the COVID-19 pandemic and included five categories: demographics, school communication, exposure to COVID-19, personal protective equipment (PPE) availability, access to COVID-19 testing, and overall satisfaction. Prior to survey creation, a preliminary, internal survey was distributed to students asking "What are your thoughts on COVID-19 as clinical medical students?" The survey question and secondary outcomes were derived from the most common responses.

The survey was distributed to students by email from school administrations, class emails, or word-of-mouth and was open for four weeks (February 17-March 14, 2021) with no compensation.

3. Statistical analysis

Satisfaction features were dichotomized to satisfied (strongly/somewhat satisfied) and dissatisfied (strongly/somewhat dissatisfied). Associations between satisfaction and feature were analyzed with Pearson chi-square and Wilcoxon rank-sum tests. [6].

Multivariate logistic regression analyses of school communication, exposure to COVID-19, PPE availability, and access to COVID-19 testing satisfaction were performed using Stata ver. 16.0 (Stata Corp., College Station, USA). For each model, neutral satisfaction responses and non-significant variables were excluded. The effect of satisfaction to school communication, exposure to COVID-19, PPE availability, and access to COVID-19 testing on overall satisfaction was also studied. Demographic features were added to create an adjusted overall satisfaction model.

RESULTS

The survey received 430 responses for a response rate

of 13.0%. More than two-thirds of respondents were in their third year (67.0%, n=288), almost half were white (46.7%, n=201), and more than half were female (55.3%, n=238). Responses were distributed across the Midwest, Northeast, South, and West in a 14.2% (n=61), 21.4% (n=92), 34.0% (n=146), and 30.5% (n=131) distribution (Table 1).

Table 1. Overall Survey Respondent Characteristics

Demographic characteristic	Value
All	430
Year	
2	14 (3.3)
3	288 (67.0)
4	128 (29.8)
Race	
Asian/Pacific Islander	110 (25.6)
Black or African American	53 (12.3)
Hispanic or Latino	31 (7.2)
White	201 (46.7)
None of the above/mixed	35 (8.1)
Gender	
Female	238 (55.3)
Male	187 (43.5)
Non-binary/non-conforming	4 (0.9)
Prefer not to respond	1 (0.2)
Self-perceived socioeconomic status	
Lower class	20 (4.7)
Lower middle class	67 (15.6)
Middle class	129 (30.0)
Upper middle class	38 (8.8)
Upper class	174 (40.5)
Region	
Midwest	61 (14.2)
Northeast	92 (21.4)
South	146 (34.0)
West	131 (30.5)
Categorized as	
Healthcare worker	153 (35.6)
Student	277 (64.4)
Vaccine status	
Vaccinated/will receive earlier than general population	416 (96.7)
Will receive same time as general population/unsure	14 (3.3)
Age (yr)	26 (25–27)
Medical school enrollment size	624 (598–750)

Data are presented as number (%) or median (interquartile range).

Regarding schools' responses to COVID-19, 61.9% (n=266) of students were satisfied, 21.9% (n=94) were dissatisfied, and 16.0% (n=69) were neutral (Table 2). Geographic region was significantly associated with overall satisfaction ($p=0.005$). Accordingly, 71.4% and 70.2% of students from the Northeast and West were satisfied in contrast to 55.7% and 51.4% of students from the Midwest and South.

Of the five categories evaluated, school communication was most predictive of overall satisfaction ($p<0.001$), followed by exposure to COVID-19 ($p<0.001$), and access to COVID-19 testing ($p=0.019$). PPE availability, however, was not statistically significant in determining overall satisfaction ($p=0.217$). Despite not being a significant determinant of overall satisfaction, PPE availability was included in the overall satisfaction model to be inclusive of all aspects on an institution. Notably, when the significant demographics were included in the overall satisfaction model, all demographic features were no longer significant (Table 3).

For school communication, important messages consisted of content reporting availability of PPE ($p=0.001$), number of COVID-19 cases ($p=0.001$), and supportive messages ($p=0.001$). For every additional important message, the odds that students were satisfied was 2.6 times higher ($p<0.001$).

The most important factor in determining exposure to COVID-19 satisfaction was the presence of a clear quarantine policy during rotations ($p=0.037$). In contrast, for every increase in student discomfort in the workplace due to improper PPE usage by others or frequency of seeing COVID-19 positive patients, the odds that students were satisfied were 2.6 and 1.6 times smaller, respectively ($p<0.001$ and $p=0.048$). Testing positive for COVID-19, however, was not significant in predicting exposure satisfaction ($p=0.799$).

Unrestricted access to COVID-19 testing was the most

Table 2. Survey Respondent Characteristics Based on Overall Satisfaction

Demographic characteristic	Dissatisfied	Neutral	Satisfied	p-value
All	94 (21.9)	69 (16.0)	266 (61.9)	-
Year				0.002 ^{a)}
2	1 (7.1)	2 (14.3)	11 (78.6)	
3	76 (26.4)	50 (17.4)	162 (56.2)	
4	17 (13.4)	17 (13.4)	93 (73.2)	
Race				0.371 ^{a)}
Asian/Pacific Islander	23 (20.9)	18 (16.4)	69 (62.7)	
Black or African American	12 (22.6)	9 (17.0)	32 (60.4)	
Hispanic or Latino	4 (12.9)	3 (9.7)	24 (77.4)	
White	43 (21.5)	36 (18.0)	121 (60.5)	
None of the above/mixed	12 (34.3)	3 (8.6)	20 (57.1)	
Gender				0.038 ^{a)}
Female	66 (27.8)	29 (12.2)	142 (59.9)	
Male	28 (15.0)	37 (19.8)	122 (65.2)	
Non-binary/non-conforming	0	3 (75.0)	1 (25.0)	
Prefer not to respond	0	0	1 (100.0)	
Self-perceived socioeconomic status				0.993 ^{a)}
Lower class	5 (25.0)	2 (10.0)	13 (65.0)	
Lower middle class	17 (25.4)	7 (10.4)	43 (64.2)	
Middle class	27 (20.9)	27 (20.9)	75 (58.1)	
Upper middle class	36 (20.8)	31 (17.9)	106 (61.3)	
Upper class	9 (23.7)	2 (5.3)	27 (71.1)	
Region				0.005 ^{a)}
Midwest	15 (24.6)	12 (19.7)	34 (55.7)	
Northeast	14 (15.4)	12 (13.2)	65 (71.4)	
South	43 (29.5)	28 (19.2)	75 (51.4)	
West	22 (16.8)	17 (13.0)	92 (70.2)	
Categorized as				0.238 ^{a)}
Healthcare worker	31 (20.4)	15 (9.9)	106 (69.7)	
Student	63 (22.7)	54 (19.5)	160 (57.8)	
Vaccine status				0.001 ^{a)}
Vaccinated/will receive earlier than general population	86 (20.7)	67 (16.1)	262 (63.1)	
Will receive same time as general population/unsure	8 (57.1)	2 (14.3)	4 (28.6)	
Testing status				<0.001
Both clinical and preclinical students tested	21 (16.7)	16 (12.7)	89 (70.6)	
Clinical students tested; pre-clinical students not tested	28 (11.8)	50 (21.1)	159 (67.1)	
Clinical students not tested; pre-clinical students tested	25 (80.6)	4 (12.9)	2 (6.5)	
Both clinical and preclinical students not tested	15 (41.7)	14 (38.9)	7 (19.4)	
Age (yr)	26 (25-27)	26 (25-27)	26 (25-27)	0.565 ^{b)}
Medical school enrollment size	746 (602-750)	679 (598-750)	624 (598-746)	0.002 ^{b)}

Data are presented as number (%) or median (interquartile range). Satisfaction reported with the "testing status" variable is satisfaction with coronavirus disease 2019 testing.

^{a)}Derived using the Pearson chi-square test (neutral responses are excluded). ^{b)}Derived using the Wilcoxon rank-sum test (neutral responses as excluded).

predictive factor of student satisfaction with their school’s testing policy ($p < 0.001$). Additionally, for every increase in testing frequency while on rotations, the odds that students were satisfied with their school’s testing policy

was 3.1 times larger ($p < 0.001$). While 67.1% ($n = 159$) of clinical students who both were tested for COVID-19 and attended schools that did not test their preclinical peers were satisfied, only 6.5% ($n = 2$) who were not tested but

Table 3. Logistic Regression Models Predicting Satisfaction

Logistic regression model	OR (95% CI)	p-value
Overall satisfaction model (n=224)		
Satisfied with school communication ^{a)}	69.058 (17.898–266.449)	<0.001
Satisfied with exposure to COVID-19 ^{a)}	30.413 (5.475–168.938)	<0.001
Satisfied with PPE availability ^{a)}	3.078 (0.517–18.345)	0.217
Satisfied with access to COVID-19 testing ^{a)}	4.283 (1.268–14.463)	0.019
Adjusted overall satisfaction model with demographic characteristics significant in chi-square and rank sum analysis (n=224)		
Satisfied with school communication ^{a)}	70.013 (15.424–317.797)	<0.001
Satisfied with exposure to COVID-19 ^{a)}	37.787 (7.154–199.598)	<0.001
Satisfied with PPE availability ^{a)}	4.087 (0.508–32.906)	0.186
Satisfied with access to COVID-19 testing ^{a)}	3.239 (0.756–13.887)	0.114
Year: third-year student	0.301 (0.071–1.269)	0.102
Region		0.081
Northeast	0.060 (0.003–1.104)	0.058
South	0.091 (0.008–0.988)	0.049
West	0.750 (0.068–8.312)	0.815
Medical school size	0.992 (0.984–1.000)	0.061
Vaccine status		
Will receive same time as general population/unsure	0.065 (0.000–14.565)	0.323
School communication satisfaction model (n=355)		
No. of important messages	2.565 (1.982–3.319)	<0.001
Exposure to COVID-19 satisfaction model (n=349)		
Policy exists for rotations if quarantine needed	2.155 (1.046–4.440)	0.037
Extent to which agree: comfortable with sharing positive results to school ^{b)}	1.551 (1.171–2.054)	0.002
Extent to which agree: experience discomfort due to improper PPE usage by peers ^{b)}	0.386 (0.268–0.554)	<0.001
Frequency of exposure to COVID-19 patients ^{b)}	0.625 (0.392–0.996)	0.048
PPE availability satisfaction model (n=398)		
Extent to which agree: adequate/accessible PPE ^{b)}	15.518 (6.829–35.261)	<0.001
Extent to which agree: properly trained to use PPE ^{b)}	4.149 (2.565–6.711)	<0.001
Access to COVID-19 testing satisfaction model (n=346)		
Access to COVID-19 testing if desired	5.682 (2.213–14.590)	<0.001
COVID-19 testing frequency ^{b)}	3.115 (2.038–4.760)	<0.001
Regular testing of first- and second-year students	0.303 (0.153–0.598)	0.001
COVID-19 symptoms required or unsure if required for testing	0.442 (0.212–0.922)	0.030

OR: Odds ratio, CI: Confidence interval, COVID-19: Coronavirus disease 2019, PPE: Personal protective equipment.

^{a)}Dichotomized variable. ^{b)}Categorical Likert scale variable that was coded continuously numerically (i.e., 1=strongly disagree, 2=somewhat disagree, 3=neither disagree nor agree, 4=somewhat agree, 5=strongly agree; or 0=never, 1=weekly).

attended schools that tested their preclinical peers were satisfied ($p<0.001$).

DISCUSSION

Our study found that while most students were satisfied with their school's response to the COVID-19 pandemic,

more than one in five were dissatisfied. Although this study did not measure student satisfaction of education quality, the Association of American Medical Colleges found 89.2% of US medical school graduates in 2019 (pre-pandemic) to be satisfied with the quality of medical education, which calls into question the impact that the pandemic may have had on students' experiences [7]. As responses were well-distributed across all regions of the

United States, our study is generalizable across US allopathic medical schools. Moreover, our study highlights important demographic differences that may contribute to satisfaction. For example, students in the Northeast and West were significantly more satisfied than those in the Midwest and South. This can be explained by differences in COVID-19 incidence as cumulative county-level incidence rates through December 1, 2020 were highest in the Midwest and South and lowest in Northeast and West [8].

Among PPE availability, school communication, exposure to COVID-19, and access to COVID-19 testing, the extent to which schools communicated with students regarding the pandemic was the strongest predictor for student satisfaction. Significant components of institutional communication included information regarding number of COVID-19 cases, PPE availability, and supportive messages such as emphasizing self-care. Overall, these results may aid in communications between students and medical schools during future public health crises.

Students who were satisfied with their exposure to COVID-19 patients attended schools with clear policies for post-exposure quarantine. Conversely, student satisfaction decreased with both increasing levels of exposure to COVID-19 patients and improper PPE usage by peers, which can be addressed with stricter enforcement by hospital administration of correct PPE usage in the hospital. Interestingly, testing positive for COVID-19 was not predictive of satisfaction, possibly because students understand that exposure to COVID-19 will inevitably result in infection of some students. What matters more to students was whether sufficient precautions and post-infection care were provided to minimize impact on health and education.

Regarding testing protocols, students were more satisfied if testing access was unrestricted and if increased testing was available during rotations. Additionally, the

option for pre-clinical students to be regularly tested for COVID-19 was a significant predictor for the satisfaction of clinical students. This finding was especially significant if clinical students were not being tested but their preclinical peers were. Cronin et al. [9] found that medical students strongly felt that they and other frontline healthcare workers should be provided regular testing. Thus, given that clinical medical students spend the most time in the hospital [10], the statistical significance of preclinical students' being tested for COVID-19 may be attributable to whether clinical students felt that the allocation of testing resources was appropriate.

All demographic features were no longer statistically significant when the other four institutional aspects were factored into an overall satisfaction model. These findings suggest that all schools, regardless of region or enrollment size, have the potential to adequately prepare their students for future public health crises.

Our study did have limitations. Firstly, our cross-sectional study captured one time point of a rapidly evolving pandemic, limiting the ability to draw conclusions on the direct effects of the pandemic on altering student satisfaction with schools. Secondly, this data was collected shortly after vaccines began to become available, and therefore, further studies should evaluate how opinions on policies changed after getting vaccinated. Lastly, our study was limited by response rate. As passionate feelings toward a school's response may motivate survey participation, the low response rate may indicate sample bias toward students with stronger opinions regarding their school's response to the pandemic.

While most medical students are satisfied with how their schools have responded to COVID-19, more than one in five students remain dissatisfied. For future global crises, medical schools can best improve student satisfaction by prioritizing timely communication with their students.

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References

1. Compton S, Sarraf-Yazdi S, Rustandy F, Radha Krishna LK. Medical students' preference for returning to the clinical setting during the COVID-19 pandemic. *Med Educ.* 2020;54(10):943-950.
2. O'Byrne L, Gavin B, McNicholas F. Medical students and COVID-19: the need for pandemic preparedness. *J Med Ethics.* 2020;46(9):623-626.
3. Dost S, Hossain A, Shehab M, Abdelwahed A, Al-Nusair L. Perceptions of medical students towards online teaching during the COVID-19 pandemic: a national cross-sectional survey of 2721 UK medical students. *BMJ Open.* 2020; 10(11):e042378.
4. Kim JW, Myung SJ, Yoon HB, Moon SH, Ryu H, Yim JJ. How medical education survives and evolves during COVID-19: our experience and future direction. *PLoS One.* 2020;15(12):e0243958.
5. US Bureau of the Census. Statistical groupings of states and counties. In: US Bureau of the Census, ed. *Geographic Areas Reference Manual.* Washington DC (USA): U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census; 1994:25 leaves.
6. Virtanen P, Gommers R, Oliphant TE, et al. SciPy 1.0: fundamental algorithms for scientific computing in Python. *Nat Methods.* 2020;17(3):261-272.

7. Association of American Medical Colleges. 2020 AAMC Medical School Graduation Questionnaire: all schools summary report & individual school report. Washington DC (USA): Association of American Medical Colleges; 2020.
8. Puranik A, Venkatakrishnan AJ, Pawlowski C, et al. Higher COVID-19 vaccination rates are linked to decreased county-level COVID-19 incidence across USA. medRxiv [Preprint]. 2021 Jan 1 [Epub]. <https://doi.org/10.1101/2021.03.05.21252946>.
9. Cronin AO, Coyne CJ, Castillo EM, Dameff C. COVID-19 screening, testing and vaccination: perceptions from emergency medicine residents and medical students. *Am J Emerg Med.* 2022;51:418-419.
10. Chen J, Kamath R, Lam A, et al. How will changes in resident work hours affect medical students? *Curr Surg.* 2003;60(3):268-270.