Original Article

Impact of COVID-19 pandemic on specialty choice: A survey of fresh medical graduates of Pakistan

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Abstract

Background & Objective: Medical students form an integral part of future taskforce for the healthcare sector. We aimed to assess the impact of demographic charcateristics and COVID-19 pandemic affecting choice of speciality among medical graduates in Pakistan.

Material & Methods: A cross sectional study was carried out on fresh medical graduates using two self-designed online questionnaire surveys before and after two months of house job, inquiring choice of specialty, reasons for choosing it, exposure to pandemic and its effect on choice of specialty using Chi Square test.

Results: Fifty nine percent of medical graduates had chosen field of speciality, significantly impacted by higher socioeconomic class (p = 0.006), fathers with higher education (p = 0.046) and advice about specialty selection (p = 0.044). Internal medicine (20%), surgery (19%), obstetrics and gynaecology (O&G) (17%) and dermatology (13%) were most commonly selected. Age (p = 0.027), female gender (p = 0.009) and mothers with higher education (p = 0.022) significantly affected choosing O&G, while advice to choose this specialty impacted choosing O&G (p = 0.027) and dermatology (p = 0.022). Better patient outcomes, challenging specialty, reputation/prestige and inspiration from a doctor were common reasons to choose a specialty. 9.1% changed their initial choice of specialty based on exposure to COVID-19 pandemic of whom majority switched to COVID unrelated fields, but it was not statistically significant.

Conclusion: This study identifies that demographic, patient outcome and personal factors were primary determinants of specialty choice. COVID-19 pandemic did not significantly affect career choices among medical graduates.

Keywords: future specialty, specialization, field of choice, medical students, medical education, COVID

Introduction

The path of becoming a health care professional involves students to make many important decisions. Beginning with the decision to study medicine, selecting a medical school and then followed by the choice of entering one of the several clinical specialties (1). Factors affecting these decisions include advice from friends/family, cultural/sociobiological aspects and genuine interest in the specialty (2). Additionally, medical school, student characteristics, values, a satisfying career and perception of specialty are the five major categories of factors associated with specialty preferences derived from the Bland-Meurer model (3).

Majority of the literature body from around the world that address factors affecting medical student specialty choice include countries like United States, Australia, United Kingdom, China and Canada (5, 6, 7). A study done in Australia, respondents rated appraisal of own aptitudes (79%), content of the specialty (75%), work culture (72%), flexibility (56%) and hours of work (54%) as influencing factors (5). While social orientation and prestige associated with field were additionally identified as important factors influencing carrer choices (6), experiences during the pre-clinical and clinical years of medical school, country of residence, personal income,

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selection criteria of the country also determined how the physician chooses a specialty (7).

Previous researches have highlighted the impact of disruptions on medical education and healthcare students' inclinations about future specialty choices. Although, Severe Acute Respiratory Syndrome (SARS) pandemic in 2002-2004 and Middle East Respiratory Syndrome (MERS) caused temporary disruption in direct patient contact with students (8, 9), a study done in Hong Kong highlighted how the pandemic had reaffirmed student's identity as healthcare workers and increased their sense of morality of serving people in times of crisis (10). Similarly, in the aftermath of Hurricane Katrina in United States, medical students were found to be significantly more inclined towards emergency medicine (11).

The impact of COVID-19 pandemic is much more global and has profoundly disrupted medical education and affected the next generation of doctors' future choices. There have been many reports of the effect of COVID-19 pandemic on training of medical students (12), medical students' psychological impact (13, 14) and the adaptive measures for virtual curriculum during COVID-19 lockdowns (15, 16). All these factors have a profound effect on future choices made by medical graduates. A study of Chinese medical students highlighted this impact as 6.9% and 9.5% showed decreased willingness to become doctors and respiratory specialists (17). 20.2% of US medical students felt that COVID pandemic had influenced their choice of speciality (18). Pakistan, one of the most populous countries in East-Mediterranean region has been greatly affected by COVID-19 pandemic with 1,496,693 cases, however to date no study has been carried out to assess to the impact of COVID on career choices made by Pakistani medical students (19).

Our study aimed to investigate the specific factors that influenced the medical students' decisions to choose a particular specialty during the pandemic: firstly, by exploring the role of demographic characteristics such as age, gender, academic performance, socioeconomic status, parent's education and career advice, and secondly, by assessing the impact of COVID-19 pandemic directly on medical graduates' choices. The findings of this study will allow us to add to the current body of knowledge on this topic and provide vital information to policymakers and stakeholders in medical education, so future strategies to tackle national healthcare emergencies can be devised well in advance taking and taskforce can be redirected towards the field where it is needed the most.

Material & Methods

Design and setting(s)

A cross-sectional survey was carried out. The study protocol was approved by the Ethical Review Committee of PAF Hospital Islamabad and informed consent was taken from all students before the start of the study.

Participants and sampling

The study was conducted at Pakistan Air Force Hospital, affiliated with Fazaia Medical College. 100 fresh FMC medical graduates of 2021 who joined PAF Hospital Islamabad for House-job training were included in the study.

Tools/Instruments

Two questionnaires were designed based on extensive literature review to add pertinent modifiers and questions pertaining to choice of career. The decision to use two separate questionnaires in our study was driven by the need to assess different aspects of the factors influencing career choice among medical graduates. The first questionnaire was designed to collect demographic data and other factors associated with specialty selection, whereas the second questionnaire was developed to assess the effect of the COVID-19 pandemic on career decisions after the students had begun working in the hospital, allowing us to gather data on the effect of direct exposure to COVID-19 patients.

The first questionnaire was divided into two parts. The first part consisted of seven close ended questions related to demographics including age, gender, marital status, family income per month, father's and mother's education status and percentage of marks in final year of medical school. The second part consisted of five questions related to the choice of medical speciality including chosen field, reason for the choice, advice received regarding choice and source of advice. For choice of speciality, 15 options and one open-ended option were given. For reason for choice, 26 choices and one open ended choice were given in a multiple response question. The second questionnaire consisted of three questions regarding the exposure to COVID-19 patients and impact of pandemic on the choice of field.

To ascertain the validity and reliability of our questionnaire, content validity and face validity was assessed. Two independent experts in medical education evaluate the questionnaire for content validity and determined whether the questions sufficiently covered the 'impact on career choice'. The feedback they provided was used to verify that our questionnaire accurately captured the construct of interest. Face validity was

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assessed in a small pilot group from our target population. 6 medical students participated in the pilot test, completed the questionnaire, and offered input on its readability, clarity, and applicability to the objectives of the study. When was asked if they felt the questions seemed to measure the impact of educational experiences on career choice, and their feedback was overwhelmingly positive. A few minor modifications were made to the questionnaire in response to the input.

Data collection methods

First questionnaire was distributed during their orientation period before they started House-job training in June 2021, and second questionnaire was distributed after two months of House-job training in August 2021 after the students had started working in different hospital departments including Covid related units. Both questionnaires were designed on Google Forms® and sent to medical students via email. Each participant was given one week to complete the survey, failing which two reminder emails were sent.

Data analysis

Data was analysed using SPSS version 23. Percentages and frequencies were calculated for all variables. Chi square test was used to assess association between choice of future speciality and demographic characteristics. Chi square was also used to assess impact of COVID-19 on choice of specialty. p value < 0.05 was considered to be statistically significant. Multivariate analysis with logistic regression was carried out keeping choice of speciality as the binary dependent variable (where choosing a specialty was assigned dichotomous responses with a value of 1 indicating selection of a specific specialty and a value of 0 representing non-selection) and demographic characteristics as independent variables. The cut-off point chosen was 0.5 which is similar to cut-off used in similar studies allowing for easier comparison of results.

Results

The response rate for the first questionnaire was 100% while for the second questionnaire, it was 55%. Demographic characteristics of the respondents are tabulated in Table 1.

The four specialities most commonly selected were internal medicine (20%), surgery (19%), O&G (17%) and dermatology (13%) (Figure 1). Reason for opting for their future field are tabulated in Table 2.

Table 1. Sociodemographic characteristics of medical graduates

		N	%
Age	< 22 years	3	3%
	> 22 years	97	97%
Gender	Female	77	77%
	Male	23	23%
Marital status	Married	11	11%
	Unmarried	89	89%
Monthly family income	< 100,000 Rupees	20	20%
	> 100,000 Rupees	80	80%
Father's education	High School	4	4%
	Diploma	10	10%
	Bachelors	26	26%
	Masters/PhD/Fellowship	60	60%
Mother's education	High School	16	16%
	Diploma	8	8%
	Bachelors	48	48%
	Masters/PhD/Fellowship	28	28%
Marks in medical college in percentage	> 80	0	0%
	60-80	94	94%
	40-60	6	6%
	< 40	0	0%
Specialty selected	Yes	59	59%
	No	41	41%

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Figure 1. Choice of specialty among medical graduates (n)

Table 2. Reasons for choosing the speciality

Reason	N	%	Cumulative %
Would like to see good treatment outcomes in pts	36	10.6%	36.7%
Challenging specialty	28	8.2%	28.6%
Good reputation and prestige	26	7.6%	26.5%
Inspired by a doctor	26	7.6%	26.5%
Personal experience	23	6.7%	23.5%
Like a doctor known to me	21	6.2%	21.4%
Good Social life	20	5.9%	20.4%
Acceptable working hours	20	5.9%	20.4%
Wide variety of patients	19	5.6%	19.4%
Acceptable on call duty hours	15	4.4%	15.3%
High adrenaline rush and stress	12	3.5%	12.2%
Interventional field	12	3.5%	12.2%
Long term relation with patients	11	3.2%	11.2%
High income	11	3.2%	11.2%
Prefer emergency cases	10	2.9%	10.2%
Lack of specialists in the country	9	2.6%	9.2%
Research Opportunities	9	2.6%	9.2%
Better opportunities	7	2.1%	7.1%
Prefer non-urgent cases	7	2.1%	7.1%
Patients in clinics	7	2.1%	7.1%
Patients in wards	6	1.8%	6.1%
Prefer specific age groups of patients	5	1.5%	5.1%
Do not want direct interaction with patients	1	٠.3%	1.0%
Treat less complicated patients	1	٠.3%	1.0%
Others[a]	7	2.1%	7.1%

Note: [a]Others included, Enjoy the speciality (n = 4), To spread awareness about the taboo of dark skin colour (n = 1), Better application of knowledge (n = 1), Potential for growth due to technological advancements (n = 1)

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Majority of graduates had received advice for choosing specialty (53%) from family (43.8%), doctors (28.1%), friends (20.2%) and faculty (7.9%).

Multiple logistic regression of selection of future specialty according to demographic characteristics showed that medical graduates who had already made their speciality choices were significantly more likely to belong to a higher socioeconomic class (OR = 10.281, 95% CI = 1.932-54.703, p = 0.006), had fathers with higher education of Masters or above (OR = 3.412, 95% CI = 1.023-11.382, p = 0.046) and had received advice about specialty selection (OR = 2.933, 95% CI = 1.03-8.348, p = 0.044) (Table 3).

Table 3. Analysis of selection of future specialty according to demographic characteristics

Characteristic		n (Total)	Future specialty selected		
			N (Yes)	OR (CI 95%)	P
Age	< 22 years	3	1	R	
	> 22 years	97	59	0.070 (0.002-2.691)	0.153
Gender	Male	23	15	R	
	Female	77	45	1.098 (0.321-3.759)	0.882
Marital Status	Unmarried	11	9	R	
	Married	89	51	3.057 (0.515-18.142)	0.219
Monthly family income	< PKR 100.000	20	17	R	
	> PKR 100.000	80	43	10.281 (1.932-54.073)	0.006
Fathers' education	High school or less	4	2	R	
	Diploma	10	5	1.488 (0.150-14.764)	0.734
	Bachelors	26	20	1.009 (0.186-5.474)	0.991
	Masters or PhD	50	33	3.412 (1.023-11.382)	0.046
Mother's education	High school or less	16	10	R	
	Diploma	8	4	1.995 (0.443-8.978)	0.368
	Bachelors	48	30	0.709 (0.109-4.595)	0.719
	Masters or PhD	28	16	1.788 (0.568-5.629)	0.321
Marks in percentage in medical school	40-60%	94	57	R	
	60-80%	6	3	0.376 (0.040-3.547)	0.393
Advice received regarding specialty selection	No	53	34	R	
	Yes	47	26	2.933 (1.031-8.348)	0.044

Note: Cut-off point used for this analysis was 0.5

Multiple logistic regression of top four specialty choices showed that medical graduates aged more than 22 years (OR = 82.381, 95% CI = 1.665-4-76.327, p = 0.027), females (OR = 13, 95% CI = 0.75-226.01, p = 0.009), those whose mothers had acquired higher education of Masters and above (OR = 0.095, 95% CI = 0.013-0.708, p = 0.022) and those who had received advice to choose this specialty (OR = 23.860, 95% CI = 1.428-398.779, p = 0.027) were significantly more likely to choose O&G. Graduates who had received advice to choose dermatology were also significantly more likely to opt it as their future field (OR = 0.112, 95% CI = 0.017-0.725, p = 0.022). However, none of the demographic factors were significant for graduates opting for medical or surgical specialties.

54.5% of graduates had dealt with COVID-19 patients directly during hospital rotations, 43.6% and 5.5% had reported family members/friends or themselves affected with COVID-19 infection respectively while 5.5% had only heard of it through media. 9.1% of respondents changed their original choice of specialty based on exposure to COVID-19 pandemic. 40% of those who had changed their specialty had switched to COVID related fields while 60% had opted for non-COVID fields, with no significant difference in change of specialty according to COVID-19 pandemic exposure (Table 4).

Table 4. Change in choice of specialty after COVID-19 exposure

Exposure to COVID		Changed original choice of specialty		p- Value	More inclined towards covid related specialties		p-Value
		Yes	No		Yes	No	
Family/friends had covid infection	Yes	1	4	0.248	3	8	0.199
	No	23	26		21	22	
Had covid infection him/herself	Yes	3	2	0.068	2	9	0.511
	No	11	38		12	31	
Dealt with covid patients	Yes	2	3	0.462	7	4	0.546
	No	28	21		23	20	
Only heard of covid through media	Yes	0	5	0.569	1	10	0.566
	No	3	46		2	41	

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Discussion

In our study, the most commonly chosen speciality was Internal medicine (20%), followed closely by surgery (19%), O&G (17%) and dermatology (13%). Majority surveys carried out in multiple countries have also shown internal medicine (19,20) or surgery as the most chosen specialty (21, 22). Repeated exposure during clinical rotations and most medical school's curriculums could explain why more medical graduates felt comfortable with these two specialties as future choices. In our study, graduates who chose O&G as future specialty were significantly more likely to be females ($p = 0.009$). This has consistently been observed in many researches and suggests the comfort of female doctors choosing a specialty dealing with women (23, 24). This disparity has led to a marked shortfall of men in this specialty due to lack of interest. We also observed that significantly more graduates choosing O&G and dermatology had received advice about choosing this specialty ($p = 0.027$ and $p = 0.022$ respectively). It is likely that supportive advice provided financial and emotional encouragement as well as inspiration for graduates to opt for these fields.

The most commonly reported reasons to choose a specialty in our study were better patient outcomes (36.7%), challenging specialty (28.6%), reputation/prestige (26.5%) and inspiration from a doctor (26.5%). Medical students in Japan opting for lifestyle controllable specialties such as radiology, dermatology, ophthalmology and anaesthesiology were more likely to value job security and controllable workhours while those who opted for internal medicine, surgery and O&G valued interest in field and reputation.(20) Additionally, students choosing surgery reported challenging specialty as an important influence (25).

COVID-19 pandemic has globally affected medical students; disrupting their clinical curriculum and adding anxiety of working in a high stress environment. In spite of high COVID-19 exposure of respondents in our study, the pandemic did not significantly alter the medical student's choice of specialty. 20% of the respondents were inclined towards choosing COVID-19 related specialties. Among the graduates who had changed their specialty after working in COVID-19 units, a lesser proportion, 40% of them were inclined towards COVID-19 related specialties. In contrast, majority of Chinese medical students were reported as willing to be doctors (10.6%) and respiratory specialists (11.7%) (17).

This highlights the important role medical students can play in assisting an overworked health sector by volunteering as students and later choosing to be future taskforce in pandemic related fields. 85.6%, 93.9%, 72.5%, 48.7%, 48% and 71.2% of medical students in China, Sri-Lanka, Vietnam, Indonesia, United States and United Kingdom have shown willingness or felt morally obligated to volunteer during pandemic respectively (25, 26, 27, 28, 29, 30). In most countries medical students reported feeling under-utilized in national COVID-19 response plans (12); but in United Kingdom and United States, they were given the opportunity to volunteer as healthcare assistants (31, 32). Early introduction of medical students to direct patient care may allow students to be better equipped for career choice decisions (34).

9.1% of medical students in our study reported changing their original choice of specialty after dealing with COVID-19 patients, with the majority of them (60%) changing to COVID-unrelated fields. Chinese medical students also showed decreased willingness to be doctors (6.9%) and respiratory specialists (9.5%) and 6.7% of students, nurses and doctors regretted choosing healthcare as their profession during COVID-19 pandemic (16, 34). 20.2% students in United States felt that pandemic had altered their choice of future specialty, where emergency medicine was the least chosen specialty (17).

These numbers reflect pandemic's psychological impact on medical students. Increasing anxiety levels were consistently related to decreased motivation to work in COVID-related specialties (16, 35). It is a pressing priority to introduce policies safeguarding student's mental health, which in turn support the students to be prepared to cope with unprecedented challenging emergencies such as those seen in this pandemic.

Our study, we believe is one of the first comparing the influence of COVID-19 pandemic on specialty choice by medical students in Pakistan. One of the strengths of this study is enrolling only fresh medical graduates who had completed all their clinical rotations and had been uniformly exposed to all specialties before making their choice. The study was conducted in Islamabad which is one of the worst COVID-19 hit cities in Pakistan (19), ensuring that all graduates were sufficiently exposed to the dynamics of COVID-19 pandemic. Conducting this research in a two-step questionnaire is also a strength of this study as the real-time impact of directly dealing with COVID-19 patients on choices made by graduates was observed.

However, several factors may limit the strength of the results derived from this study. This study enrolled graduates from a single medical college set in urban setting with a small study group. It is possible that

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graduates in smaller cities or rural setting might have different preferences. Additionally, the response rate for first questionnaire was 100% while the second questionnaire was 55%. Perhaps, once the graduates were actively involved in hospital, they had lesser interest in research activities due to rigorous training. Moreover, the impact of COVID on specialty choices was not stratified according to demographic characteristics, neither the change in specialty was assessed according to initial specialty choice. Lastly, an important limitation of this study is related to the measurement of the construct 'impact on career choice' . The questionnaire used in the study included only three items to assess this construct, which were scored dichotomously. While this approach was necessary given the scope and design of the study, it does restrict the ability to detect relationships between variables and the internal consistency reliability of the measures. However, we undertook measures to make sure that the instrument was both valid and reliable by establishing content validity through expert review and face validity in a pilot study. Despite these limitations, our study provides valuable insights into the impact of educational experiences on career choice, and lays the groundwork for more in-depth exploration of this topic in future research, perhaps with a more comprehensive questionnaire and a wider range of response options.

Conclusion

This study explores the factors influencing career choices by medical graduates. Internal medicine was the most chosen specialty while better patients' outcomes was the most influential factor determining the choice. COVID-19 pandemic did not significantly alter medical student's choice of specialty and among those who changed their speciality choice due to COVID, most opted for COVID-unrelated fields.

Ethical considerations

Synopsis of the study was submitted to the ethical board review committee of PAF Hospital Islamabad and upon the approval, Ethical review board certificate (ETH/2022/3/05) was issued. Throughout the study, the ethical board guidelines were strictly adhered to.

Artificial intelligence utilization for article writing

No.

Acknowledgment

None.

Conflict of interest statement

We declare that there is no conflict of interest. This manuscript has been read and approved by all authors.

Author contributions

Fatima Sajid- Writing the manuscript, study design, data collection, data entry and data ananlysis.
Shayan Rizwan- Writing the manuscript, data collection,Muneeza Rizwan-Principal investigator, study idea design, proof reading before submission
Asad Ullah Wasim - Data collection, data entry and data ananlysis, writing the manuscript.
Malik M Mufeez-Writing the manuscript, study design
Iraj Khalid - data collection, data entry, proof reading.

Supporting resources

No grants, equipment, or other resources were acquired to support this research or manuscript

Data availability statement

Data can be made available as per requirement.

References

1. Lefevre JH, Roupret M, Kerneis S, Karila L. Career choices of medical students: A national survey of 1780 students. Medical Education. 2010;44(6):603-612. [https://doi.org/10.1111/j.1365-2923.2010.03707.x]
2. She LB, Wu BL, Xu LY, Wu JY, Zhang PX, Li EM. Determinants of career aspirations of medical students in southern China. BMC Medical Education. 2008;8(1):1-7. [https://doi.org/:10.1186/1472-6920-8-59/FIGURES/5]
3. Querido SJ, Vergouw D, Wigersma L, Batenburg RS, Rond MEJD, Cate OTJT. Dynamics of career choice among students in undergraduate medical courses. a BEME systematic review: BEME Guide No. 33. Medical Teacher. 2016;38(1):18-29. [https://doi.org/:10.3109/0142159X.2015.1074990]
4. Chang PY, Hung CY, Wang KI, Huang YH, Chang KJ. Factors influencing medical students' choice of specialty. Journal of the Formosan Medical Association. 2006;105(6):489-496. [https://doi.org/:10.1016/S0929-6646(09)60189-3]
5. Harris MG, Gavel PH, Young JR. Factors influencing the choice of specialty of Australian medical graduates. The Medical Journal of Australia. 2005;183(6):295-300.

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[https://doi.org/:10.5694/J.1326-5377.2005.TB07058.X]
6. Wright B, Scott I, Woloschuk W, Brenneis F. Career choice of new medical students at three Canadian universities: family medicine versus specialty medicine. Canadian Medical Association Journal. 2004;170(13):1920-1924. [https://doi.org/:10.1503/CMAJ.1031111]
7. Aslam M, Ali A, Taj T, et al. Specialty choices of medical students and house officers in Karachi, Pakistan -PubMed. Eastern Mediterranean Health Journal. 2011;17(1):74-79.
8. Lim EC, Oh VM. The challenges of "continuing medical education" in a pandemic era. Annals of the Academy of Medicine, Singapore. 2009;38(8):724-726.
9. Park SW, Jang HW, Choe YH, et al. Avoiding student infection during a Middle East respiratory syndrome (MERS) outbreak: a single medical school experience. Korean Journal of Medical Education. 2016;28(2):209-217. [https://doi.org/:10.3946/KJME.2016.30]
10. Townsend MH. The effect of hurricane Katrina on medical student career choice. Academic Psychiatry. 2012;36(3):258-259. [https://doi.org/:10.1176/APPI.AP.11030056]
11. Brown A, Kassam A, Paget M, Blades K, Mercia M, Kachra R. Exploring the global impact of the COVID-19 pandemic on medical education: an international cross-sectional study of medical learners. Canadian Medical Education Journal. 2020;12(3):28-43. [https://doi.org/:10.1101/2020.09.01.20186304]
12. Imran N, Haider II, Mustafa AB, et al. The hidden crisis: COVID-19 and impact on mental health of medical students in Pakistan. Middle East Current Psychiatry. 2021;28(1). [https://doi.org/:10.1186/S43045-021-00123-7]
13. Lasheras I, Gracia-García P, Lipnicki DM, et al. Prevalence of anxiety in medical students during the covid-19 pandemic: A rapid systematic review with meta-analysis. International Journal of Environmental Research and Public Health. 2020;17(18):1-12. [https://doi.org/:10.3390/IJERPH17186603]
14. Calhoun KE, Yale LA, Whipple ME, Allen SM, Wood DE, Tatum RP. The impact of COVID-19 on medical student surgical education: Implementing extreme pandemic response measures in a widely distributed surgical clerkship experience. The American Journal of Surgery. 2020;220(1):44-47. [https://doi.org/:10.1016/J.AMJSURG.2020.04.024]
15. Mukhopadhyay S, Booth AL, Calkins SM, et al. Leveraging technology for remote learning in the era of covid-19 and social distancingtips and resources for pathology educators and trainees. Archives of Pathology & Laboratory Medicine. 2020;144(9):1027-1036. [https://doi.org/:10.5858/ARPA.2020-0201-ED]
16. Deng J, Que J, Wu S, et al. Effects of COVID-19 on career and specialty choices among Chinese medical students. Medical Education Online.2021;26(1). [https://doi.org/:10.1080/10872981.2021.1913785]
17. Byrnes YM, Civantos AM, Go BC, McWilliams TL, Rajasekaran K. Effect of the COVID-19 pandemic on medical student career perceptions: a national survey study. Medical Education Online. 2020;25(1). [https://doi.org/:10.1080/10872981.2020.1798088]
18. COVID-19 health advisory platform by ministry of national health services regulations and coordination. Published online 2022. [https://covid.gov.pk/stats/Pakistan]
19. Takeda Y, Morio K, Snell L, Otaki J, Takahashi M, Kai I. Characteristic profiles among students and junior doctors with specific career preferences. BMC Medical Education. 2013;13(1). [https://doi.org/:10.1186/1472-6920-13-125]
20. Abdulrahman M, Makki M, Shaaban S, et al. Specialty preferences and motivating factors: A national survey on medical students from five UAE medical schools. Education for Health. 2016;29(3):231-243. [https://doi.org/:10.4103/1357-6283.204225]
21. Diderichsen S, Johansson EE, Verdonk P, Lagro-Janssen T, Hamberg K. Few gender differences in specialty preferences and motivational factors: a cross-sectional Swedish study on last-year medical students. BMC Medical Education. 2013;13:39. [https://doi.org/:10.1186/1472-6920-13-39]
22. Anand R, Sankaran PS. Factors influencing the career preferences of medical students and interns: a cross-sectional, questionnaire-based survey from India. Journal of Educational Evaluation for Health Professions. 2019;16:12. [https://doi.org/:10.3352/JEEHP.2019.16.12]
23. Cleland JA, Johnston PW, Anthony M, Khan N, Scott NW. A survey of factors influencing career preference in new-entrant and exiting medical students from four UK medical schools. BMC Medical Education. 2014;14(1). [https://doi.org/:10.1186/1472-6920-14-151]
24. Ibrahim M, Fanshawe A, Patel V, et al. What factors influence British medical students' career intentions? Medical Teacher. 2014;36(12):1064-1072. [https://doi.org/:10.3109/0142159X.2014.923560]

[DOI: 10.61186/edcj.17.54.122]

25. Yu NZ, Li ZJ, Chong YM, et al. Chinese medical students' interest in COVID-19 pandemic. World Journal of Virology. 2020;9(3):38-46. [https://doi.org/:10.5501/WJV.V9.I3.38]
26. Wickramasinghe ND, Jayarathne SW, Pilapitiya SD. Value-added roles of medical students during the COVID-19 pandemic: assessment of medical students' perceptions and willingness in Sri Lanka. International Journal of General Medicine. 2021;14:3187-3196. [https://doi.org/:10.2147/IJGM.S309021]
27. Tran VD, Pham DT, Dao TNP, Pham KAT, Ngo PT, Dewey RS. Willingness of healthcare students in vietnam to volunteer during the covid-19 pandemic. Journal of Community Health. Published online 2021. [https://doi.org/:10.1007/S10900-021-01030-Y]
28. Chinsky R, Morris A, Suh A, et al. Medical student perspectives on their role as emerging physicians during the COVID-19 pandemic. Medical Science Educator. Published online 2021. [https://doi.org/:10.1007/S40670-021-01374-Z]
29. Lazarus G, Findyartini A, Putera AM, et al. Willingness to volunteer and readiness to practice of undergraduate medical students during the COVID-19 pandemic: a cross-sectional survey in Indonesia. BMC Medical Education. 2021;21(1). [https://doi.org/:10.1186/S12909-021-02576-0]
30. Michno D, Tan J, Woollard A. How can we help? Medical students' views on their role in the COVID-19 pandemic | Semantic Scholar. Journal of Public Health (Oxford, England). 2021;43(3):479-489.
31. Buckland R. Medical student volunteering during COVID-19: lessons for future interprofessional practice. Journal of Interprofessional Care. 2020;34(5):679-681. [https://doi.org/:10.1080/13561820.2020.1822790]
32. Rolak S, Keefe AM, Davidson EL, Aryal P, Parajuli S. Impacts and challenges of United States medical students during the COVID-19 pandemic. World Journal of Clinical Cases. 2020;8(15):3136-3141. [https://doi.org/:10.12998/WJCC.V8.I15.3136]
33. Bosveld MH, Doorn DPC van, Stassen PM, et al. Lessons learned: contribution to healthcare by medical students during COVID-19. Journal of Critical Care. 2020;63:113-116. [https://doi.org/:10.1016/J.JCRC.2020.09.015]
34. Yang G, Wang L, Wang J, Geng Z, Liu H, Xu T. Career choice regret during COVID-19 among healthcare students and professionals in mainland China: a cross-sectional study. BMC Medical Education. 2021;21(1):534. [https://doi.org/:10.1186/S12909-021-02972-6]
35. Puranachaikere T, Hataiyusuk S, Anupansupsai R, et al. Stress and associated factors with received and needed support in medical students during COVID-19 pandemic: a multicenter study. Korean Journal of Medical Education. 2021;33(3):203-213. [https://doi.org/:10.3946/KJME.2021.200]

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