Awareness and Attitudes of Medical Students, Interns, and Residents Toward Telemedicine in Medical Education During the COVID-19 Pandemic: Survey-Based Cross-Sectional Study From Northern Iran

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ABSTRACT

BACKGROUND: Telemedicine is widely used in medical treatment and education systems. Therefore, it is essential to investigate the attitudes and awareness of medical students about it. We aimed to examine the awareness and attitudes of medical students, interns and residents toward telemedicine in medical education during the COVID-19 pandemic.

METHOD: This cross-sectional study was conducted after new educational approaches were implemented due to the COVID-19 pandemic. Two questionnaires were used to assess the new educational methodologies. Participants included residents (R), interns (I), and students (S) from the internal medicine department. A census sampling method was employed, inviting all medical education members who met the entry criteria to participate. The data were analyzed descriptively, and group differences were tested using chi-square, independent samples T-test, Mann–Whitney, and Kruskal–Wallis tests.

RESULT: Out of 278 medical education members eligible to participate, 249 (89.5%) completed the study. The mean score for participants' attitudes was above 3 ($M = 3.78$, $SD = 0.24$) indicating a generally favorable view of telemedicine. A significant gap was noted between participants' awareness and attitudes, with residents showing the lowest scores in both areas (P-value = .02). Our assessment revealed that "Satisfaction with the platform and facilities for e-classes" received the highest consensus from residents and interns, rated moderately agreeable by students (R: 64.5%, I: 59.7%, S: 48.8%). Responses to "Using e-learning courses alongside postcrisis face-to-face courses" and "Using e-learning courses alone postcrisis" varied among the groups (R: 58.1% and 54.9%, I: 59% and 58.2%, S: 47.6% and 45.3%).

CONCLUSION: The results of this survey reveal that medical students and interns may demonstrate a favorable awareness and attitude toward telemedicine. Consequently, developing educational programs and enhancing exposure to telemedicine should be considered since these elements could be vital for the future training of medical professionals.

KEYWORDS: telemedicine, tele-education, medical education, awareness, attitude, telehealth

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Introduction

The COVID-19 pandemic has placed a significant global burden despite its rapid emergence. Hospitals, as primary providers of clinical education in medical sciences, shifted their focus to COVID-19 treatment, leading to the suspension of in-person classes and alteration of educational practices.[1] At our Golestan University of Medical Sciences in Gorgan, Sayyad Shirazi Hospital, a major referral center for internal patients, faced a surge in COVID-19 admissions. Consequently, hands-on experience in various clinical settings was minimized for medical students, interns, and residents. The disruption in their education raised concerns about their readiness to provide high-quality patient care in the future. Despite these challenges, the hospital administration quickly adapted by implementing virtual learning platforms and telemedicine opportunities to continue medical education remotely. This shift not only allowed students

to stay connected with their medical attendants but also enabled them to gain a better understanding of the impact of the pandemic on healthcare delivery. While the situation was far from ideal, the resilience and flexibility demonstrated by both educators and learners during this crisis highlighted the importance of innovation and adaptability in medical training.

The Internet infrastructure has brought valuable benefits to the modern educational system. Tele-education is now globally more accessible due to high-speed internet and smart devices. Nowadays, numerous innovative and user-friendly applications are accessible for electronic devices, enabling work or education from home or anywhere globally. Moreover, they have opened up opportunities for group or individual learning in offline and online settings.[2–5] The widespread availability of online resources has revolutionized how students access information and interact with their peers and teachers. Virtual classrooms, webinars, and online forums have become common tools for collaborative learning and knowledge sharing.[6] Telemedicine is a health service that uses telecommunications and electronic information technology.[7] Technological advancements and reliable network services have allowed individuals to enhance healthcare delivery and expand access to more patients in recent years.[7] It is a vital and advantageous technology that can enhance preventive care and promote long-term health. Moreover, it can streamline healthcare delivery, improve organization, and increase accessibility. This approach is increasingly being utilized to provide specialized palliative care to seriously ill patients in their homes, enhance the management of chronic diseases, assist in emergency medicine, and serve as a crucial resource during pandemics.[7–9] A systematic review study by Gentili et al (2022), on the cost-effectiveness of digital health interventions reviewed existing literature and found increasing evidence of their favorable impact on costs and health outcomes. The study highlighted that various digital health interventions, such as telemedicine, mobile health apps, and online therapy platforms, not only enhance healthcare access but also have the potential to lower overall healthcare costs. These interventions often improve patient engagement and self-management, key factors in achieving positive health outcomes. Furthermore, several studies in the review indicated significant cost savings from reduced hospital admissions and emergency visits, particularly for chronic disease management. Additionally, the integration of digital tools in patient care has been associated with better medication adherence and health literacy, which further enhance health outcomes and reduce long-term costs.[8]

To achieve educational purposes during the pandemic, developing new plans and approaches leveraging existing potentials was crucial. Given the practical nature of internal medicine knowledge, thorough investigations are necessary for virtual education in this field.[10,11]

Research in this field is still in its early stages but is rapidly expanding. In Iran, telemedicine studies have primarily focused on healthcare workers in referral hospitals, with limited exploration of awareness and attitudes toward telemedicine during the pandemic.[7,12] Since telemedicine is a new frontier in Iranian healthcare and aims to provide essential medical services to medical education, we aimed to assess the awareness and attitudes of medical students, interns, and residents toward telemedicine in medical education during the COVID-19 pandemic. Literature on the efficacy of telemedicine and quality of medical education on telemedicine is very limited. The insights gathered from these evaluations will be instrumental in shaping future educational strategies in the internal medicine field, not just during crises but also as a part of our ongoing commitment to innovation and excellence in medical education. In addition, understanding the effects of the COVID-19 outbreak on medical education and the utilization of telemedicine as a tool for enhancing educational practices can inform authorities and policymakers in devising strategies to enhance the quality of medical education in similar circumstances.

Material and Method

Study design, setting and sample size

This descriptive cross-sectional study was conducted following to assess the awareness and attitudes of medical students, interns, and residents toward telemedicine in medical education during the COVID-19 pandemic. This survey conducted in Sayyad Shirazi Hospital, Gorgan, Iran in January 2022 until April 2022. Out of 278 medical education members, 249 (89.5%) completed the study. Medical education during the COVID-19 pandemic highlighted that daily communication among physicians occurred through messaging apps (eg, WhatsApp, Skype) in group chats, allowing residents to learn and discuss topics such as diagnosis, decision-making, surgical techniques, complications, and outcomes. Fellows and residents educated and assessed medical interns and students in separate groups, reporting progress to an assigned attending. Daily morning reports were conducted, with materials discussed via text and voice messages, alongside necessary videos and images uploaded to a chat group prior to the session. A 1-hr video conference took place via Skype 5 days a week, enabling team members to observe and discuss management plans. Educational topics for medical students and interns were provided in packages that included PowerPoint presentations, recorded lectures, and self-assessment quizzes. An interactive virtual class followed each presentation, and a 1-hr online book review session was held every other day under the supervision of an attending, moderated by a fellow or resident. Journal clubs continued their routine of meeting online for 1 hr each week.

Participant selection and variables

The medical education members were categorized into three groups: (a) residents (R) ($n = 31$), (b) interns (I) ($n = 134$),

and (c) medical students (MS) ($n = 84$). A census sampling method was employed, inviting all medical education members who met the entry criteria to participate. Inclusion criteria encompassed all medical education members of Sayyad Shirazi Hospital who were employed during the COVID-19 pandemic, while exclusion criteria included lack of cooperation among medical education members and failure to complete the questionnaire.

Data collection

Information was gathered using two questionnaire comprising parts. The demographic data of medical education members (age, gender, marital status, education level) were collected.

Attitude and awareness toward telemedicine. First questionnaire featured a 5-point Likert scale questionnaire addressing telemedicine awareness (7 questions), attitude (19 questions), and self-report readiness (3 questions), Question formulation was informed by a review of existing literature, with feedback obtained from 5 specialists in medical and clinical informatics and health information to ensure validity. Awareness scores on the Likert scale ranged from *very little* (1 point) to *very much* (5 points). Attitude scores ranged from *completely disagree* (1 point) to *completely agree* (5 points). The questionnaire used in this part was adapted from the analysis conducted by Mazandarani et al in 2023[7] (Supplemental Tables 1 and 2). The questionnaire's reliability was assessed by 30 medical education completing it, resulting in a Cronbach's alpha value of 0.85.

Virtual medical education during COVID-19 pandemic. The second questionnaire included 22 (R), 22 (I), and 15 (S) statements for the 3 groups, respectively. A total of 27 statements were included across seven domains: (1) facilities and platforms for participating in e-courses, (2) quality of education in internal knowledge and skills, (3) the possibility of discussions, interactions, evaluations, and feedback, (4) educational and research activities outside the program, (5) the impact of shift schedules and training curriculum changes, (6) time and cost consumption, and (7) stress level. The scores ranged from *strongly disagree* (1 point) to *strongly agree* (5 points). The survey statements were designed to emphasize the main challenges within each domain for each group and to develop effective strategies and methods to tackle them. The questionnaire used in this part was adapted from the analysis conducted by Vahdati et al in 2023,[2] and they used a Delphi process to construct the questionnaire (Supplemental Tables 3–5).

Statistical analysis

IBM SPSS statistical software (SPSS, 25.0) was used for statistical analysis. Continuous variables in cases of normal distribution were described with mean ± standard deviation, nonnormal with median (interquartile range) and categorical variables with frequency (percentage). Data analysis was performed using chi-square, Mann–Whitney, independent samples t-test, and Kruskal–Wallis tests. Categorical variables were compared with chi-square and nonnormal continuous variables were compared with Mann–Whitney test between 2 groups and Kruskal–Wallis test between more than 2 groups. A P-value under .05 was considered significant.

Ethics approval

All research participants provided informed consent, with a written copy available for review. The study's purpose was thoroughly explained, and confidentiality was ensured. It adhered to the Declaration of Helsinki principles and received approval from the ethical committee of Golestan University of Medical Sciences (Ethical code: IR.GOUMS.REC.1402.418).

Study bias

We addressed study bias and limitations at the end of our discussion.

Result

Out of 278 medical education members, 249 (89.5%) participated in the study, including medical students, interns, and internal medicine residents from Golestan University of Medical Sciences, who were present at our educational hospitals during the research and strategy changes (Table 1). Most of the participants (55.4%) were female, and 31.7% were married. The mean age was 26.67 years ($SD = 4.16$). The majority of participants (53.8%) were interns, followed by medical students (33.7%), and internal medicine residents (12.4%) being the

Table 1. General characteristics of participants included in the study.

VARIABLES		MEDICAL STUDENTS ($n = 84$)	INTERNS ($n = 134$)	RESIDENTS ($n = 31$)	TOTAL ($n = 249$)
Age (year ± *SD*)		25.37 ± 2.35	25.75 ± 2.9	34.13 ± 4.99	26.67 ± 4.16
Gender	Male (%)	67 (79.8)	33 (24.6)	11 (35.5)	111 (44.6)
	Female (%)	17 (20.2)	101 (75.4)	20 (64.5)	138 (55.4)

SD, standard deviation.

third most common. Among them, 228 (91.5%) participants had no experience with telemedicine programs, and 21 (8.5%) had telemedicine experience.

Attitude and awareness toward telemedicine

The most frequent sources of information about telemedicine are continuing education (42.1%), social media and the Internet (26.2%), and colleagues (9.7%). Other sources include articles (8.2%), workshops (6.8%), formal education (4.5%), and conferences (2.5%). The awareness of medical students using continuing education, social media, the Internet, or conferences was significantly higher (*P*-value < .05).

The mean score for participants' attitudes was above 3 ($M = 3.78$, $SD = 0.24$) indicating a generally favorable view of telemedicine. The awareness of medical students using continuing education, social media, the Internet, or conferences was significantly higher ($t = 7.2$, $P = .028$). However, the mean score of their awareness is less than 3, which shows they have relatively little awareness about telemedicine. The minimum score obtained from the questionnaire regarding the attitude toward telemedicine is more than 3, which shows that all the participants had a positive view of telemedicine (Table 2). A strong relation exists between computer familiarity and telemedicine familiarity (*P*-value < .05) especially positive attitudes toward telemedicine's role in enhancing clinical decisions and follow-up, as well as reducing medical errors, led to a more favorable assessment of their organization's readiness. Individuals familiar with computers are 8.97 times more likely to be familiar with telemedicine. Specifically, 72.2% of computer users are also familiar with telemedicine, compared to only 22.4% of noncomputer users (Table 3).

There was no statistically significant relation between participants' familiarity with telemedicine and their gender ($P = .6$), age ($P = .66$), or educational level ($P = .4$). This indicates that familiarity with telemedicine is consistent across all gender and age groups, as well as among interns, medical students, and residents (Table 4). However, in terms of educational level, there is a difference between participants' awareness and attitude toward telemedicine, and residents have the lowest awareness score and the lowest attitude score toward telemedicine (*P*-value = .02) (Table 5).

Virtual medical education during COVID-19 pandemic

The results of the residents' questionnaire showed "Satisfaction with the platform and facilities for using e-classes," "Increasing the quality of education (knowledge) for Interns," and "Improving the quality of education (skills) for Students" had the highest level of agreements (all 64.5%). On the other hand, residents mostly disagreed with "Reducing stress levels and mental conflicts" with 35.5% of participants, "Improving

Table 2. Attitude and awareness of participants included in this study.

						PERCENTILES	
VARIABLE	MEAN	MEDIAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	25	75
Attitude	3.78	3.79	0.24	3.32	4.16	3.58	4
Awareness	2.58	2.43	0.48	1.29	3.29	2.14	2.86

Table 3. Familiarity of participants included in this study.

		FAMILIARITY		
VARIABLE		UNFAMILIAR	FAMILIAR	*P*-VALUE*
Gender	Male	88 (79.3%)	23 (20.7%)	.6†
	Female	113 (81.9%)	25 (18.1%)	
Educational levels	Medical student	65 (77.4%)	19 (22.6%)	.4†
	Intern	109 (81.3)	25 (18.7%)	
	Resident	27 (87.1%)	4 (12.9%)	
Age (years ± *SD*)		26.79 ± 4.58	26.56 ± 3.77	.66*

SD, standard deviation.
P-value less than .05 considered significant.
†Chi square test was used for these variables.
*independent t-test was used for this variable.

Table 4. Relation between computer familiarity and attitudes toward telemedicine among study participants.

VARIABLE		ATTITUDES TOWARD TELEMEDICINE			CHI-Square Test Value	*P*-VALUE*	OR
		YES	NO	TOTAL			
Computer familiarity	Yes	109 (72.2%)	42 (27.8%)	151 (100%)	58.966	<.05	8.97
	No	22 (22.4%)	76 (77.6%)	98 (100%)			
	Total	131 (52.6%)	118 (47.4%)	249 (100%)			

**P*-value less than .05 considered significant.

Table 5. Attitude and awareness of participants included in this study based on gender and educational level.

VARIABLE		ATTITUDE			AWARENESS		
		MEDIAN	TEST VALUE	*P*-VALUE	MEDIAN	TEST VALUE	*P*-VALUE†
Gender	Male (*N* = 111; 44.6%)	3.89 (3.58, 4)	−1.424*	.154	2.86 (2.14, 2.86)	−1.607*	.108
	Female (*N* = 138; 55.4%)	3.79 (3.53, 3.95)			2.43 (2.14, 2.86)		
Educational level	Medical student (*N* = 84; 33.7%)	3.89 (3.58, 4)	14.240**	.001	2.86 (2.14, 2.86)	7.151**	.028
	Intern (*N* = 134; 53.8%)	3.79 (3.58, 4)			2.43 (2.14, 2.86)		
	Resident (*N* = 31; 12.4%)	3.47 (3.47, 3.84)			2.14 (2.14, 2.86)		

*Mann–Whitney test.
**Kruskal–Wallis test.
†*P*-value less than .05 considered statistically significant.

the quality of education (skills) for Interns" 32.3% of participants, and "Increasing participation in research" with 32.3% of participants (Figure 1).

Most interns agreed with "Satisfaction with the platform and facilities for using e-classes," "Increasing discussion opportunities," "Increasing learning of internal medicine contents (due to reducing presence in the ward)," "Increasing the rate of internal medicine study," and "Increasing participation in research" statements (all of them with 59.7% of interns). While "Increasing the quality of education by flexible shifts curriculum," "Increasing the quality of journal club meetings," and "Satisfaction with the educational situation" had the most disagreement among them (all of them 29.1%).

After medical students were asked to complete their questionnaire, the result showed that "Improving the quality of education (skills)" and "Increasing learning of internal medicine contents (due to reduced presence in the ward)" had the most agreement among them (both of them 50%). In addition, they mostly disagreed with "Improving educational curriculum" and "Improving evaluations and assignments," with 35.7% for each of them.

In our evaluation, "Satisfaction with the platform and facilities for using e-classes" had the most agreement among both residents and interns groups, and it was second-level agreement in the students group (R: 64.5%, I: 59.7%, and S: 48.8%). Moreover, "Improving the quality of education (skills) for Students" and "Increasing the quality of education (knowledge) for Students" had different results among residents and medical students group (R: 64.5% and 58.1%, S: 50% and 47.6%). In addition, "Increasing the quality of education (knowledge) for Interns" and "Improving the quality of education (skills) for Interns" were asked among residents and interns groups as well (R: 64.5% and 54.8%, I: 59% and 58.9%) (Figure 2).

The "Using e-learning courses alongside postcrisis face-to-face courses after the crisis" and "Using e-learning courses alone after the crisis" were asked to investigate how to continue medical education in the post-COVID-19 epidemic. The results of these statements varied among these groups. Although more than half of residents and interns agreed with these statements, the majority of medical students did not have the same opinion as them (R: 58.1% and 54.9, I: 59% and 58.2%, and S: 47.6 and 45.3%).

In our study, most of the residents and interns agreed with "Increasing the quality of training and participation in morning sessions," but less than half of medical students agreed (R: 61.3%, I: 59%, and 47.6%). Residents, interns, and nearly half of the students agreed with "Increasing discussion opportunities" and "Increasing participation in research" (R: 54.8, and 58.1%, I: both 59.7, S: both 48.8%). Moreover, "Increasing the rate of internal medicine study" also had the same trend among these 3 groups (R: 61.3%, I: 59.7%, S: 48.8%). According to our findings, most interns had satisfactory with the educational management, situation, and treatment

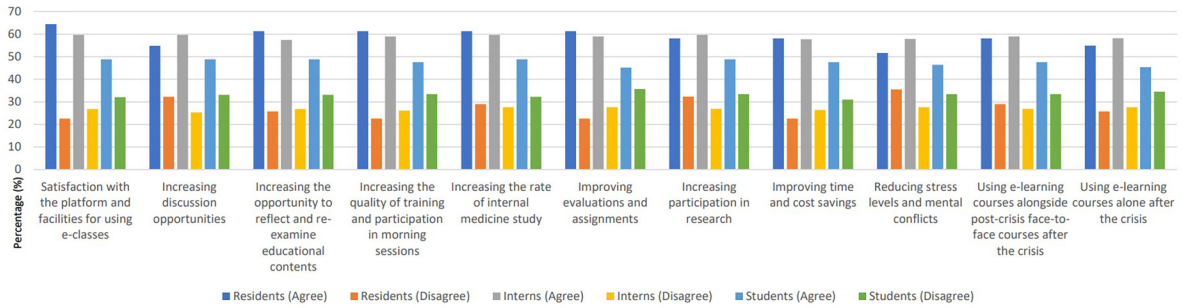

Figure 1. Common statements among medical students, interns, and residents.

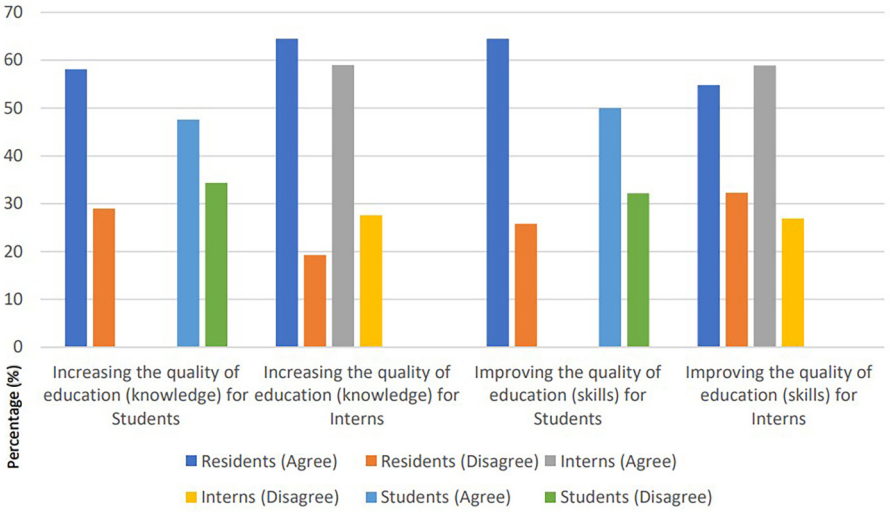

Figure 2. Common statements among medical students, interns, and residents about quality of education.

status when compared with medical students (I: 58.2%, 57.4%, and 59%, S: 46.4%, 46.4%, and 45.2%) (Figure 3).

Most residents and interns agreed with "Improving time and cost savings" and "Reducing stress levels and mental conflicts" (R: 58.1% and 51.6%, I: 57.5%, and 57.9%); however, 47.6% and 46.4% of medical students agreed with them.

Discussion

Of 278 medical education members, 249 (89.5%) participated in the study. Participants had a mean attitude score above 3, reflecting a positive view of telemedicine. A notable gap existed between awareness and attitudes, particularly among residents with the lowest scores ($P = .02$). The highest consensus was "Satisfaction with the platform for e-classes," rated positively by residents and interns (R: 64.5%, I: 59.7%).

Telemedicine is not merely a temporary fix but a long-term solution to numerous healthcare challenges. With advancing technology and improved accessibility, its potential to transform global healthcare delivery has never been greater. With the ability to provide remote consultations, monitoring, and even treatment options, telemedicine has the potential to narrow the divide between patients and healthcare, ultimately improving health outcomes for all.[13–15] Additionally, in the context of the global COVID-19 pandemic, a significant shift occurred in healthcare delivery, as a large number of hospitals were designated exclusively for the treatment of COVID-19 patients. This resulted in a decrease in the number of hospital beds available for non-COVID-19 patients, underscoring the heightened importance of telemedicine as a means of providing medical care. Consequently, the need for interdisciplinary collaboration among healthcare professionals became more pronounced. Specialists were compelled to utilize telemedicine and engage in multidisciplinary teamwork to effectively treat patients.[16,17]

Nowadays, with the rise of telemedicine in providing medical treatment and education, the significant role of healthcare providers such as physicians within the healthcare system has grown. Consequently, there has been a surge in research focusing on the attitudes and awareness of medical students toward this evolving aspect of healthcare provision.[13,14,18] In our study, it was observed that medical students exhibited greater awareness of telemedicine through avenues such as continuing education, social media, the Internet, and conferences compared to residents and interns (P-value < .05).

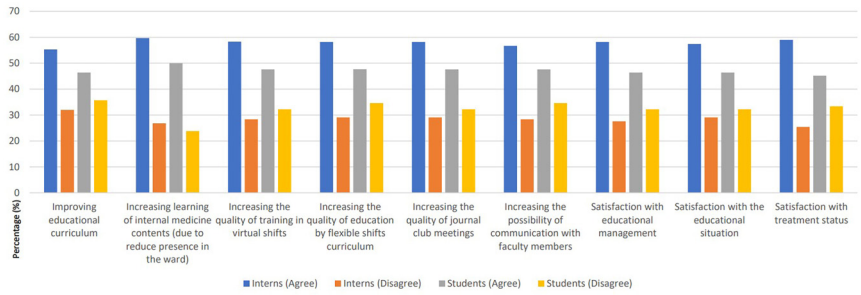

Figure 3. Common statements among medical students and interns.

Additionally, the majority of participants demonstrated a favorable attitude toward telemedicine in our study. In line with our findings, by studying the attitude of medical students toward telemedicine in Saudi Arabia, Adelbasi et al, found that the general perception regarding the utilization of telemedicine was positive, as indicated by approximately 73.4% of students expressing a positive attitude toward its use. Furthermore, a substantial number of students, surpassing 78.4%, reported engaging in good practices related to it.[19] A study by Yaghobian et al (2020), reported on the knowledge, attitudes, and practices of telemedicine education and training of French medical students and residents. A total of 3312 medical students and residents responded to the survey. Synchronous video consultations were the most recognized telemedicine practice (86.9%); asynchronous telemedicine was the least recognized (40.3%). Most respondents (84.8%) reported being unaware of telemedicine regulations. The relevance of telemedicine in improving access to care was identified by 82. 8% of students and residents; 14% of respondents reported practicing telemedicine during their studies; 14.5% reported receiving telemedicine education and training; however, 97.9% reported not receiving adequate training.[20]

Various research indicates that stress and burnout tend to be more pronounced in critical situations such as a pandemic, often due to inadequate personal protective equipment, insufficient training to address novel challenges, and the fear of transmitting the virus to others. Studies suggest that medical students are also significantly impacted by this crisis, with feelings of anxiety potentially overshadowing their dedication to caring for the patients.[20,21] This study aimed to assess the internal department's virtual educational and telemedicine methods utilized during the COVID-19 pandemic. Our findings revealed that participants generally expressed satisfaction with the e-learning platform and telemedicine. These approaches were mostly agreed upon by residents and interns, which demonstrated significant potential for time and cost savings, reducing stress levels. The research by Rajabi et al found that 41.8% of participants had little to no prior experience with online teaching/learning before the pandemic, and 62.5% favored a mix of online and face-to-face instruction. Challenges in online medical education during the COVID-19 crisis included communication issues (59%), student assessment difficulties (57.5%), limited familiarity with technology tools (56.5%), navigating online platforms (55%), pandemic-induced stress or anxiety (48%), time management concerns (35%), and technophobia (17%). Despite these obstacles, a majority of respondents (70.7%) felt the pandemic had increased their confidence in online medical education. Consequently, 76% of respondents planned to incorporate the online skills acquired during the pandemic into their professional practice. In essence, the recent study highlighted a predominantly positive influence of the COVID-19 pandemic on online medical education.[22]

Utilizing e-learning techniques and telemedicine has pleased numerous students, providing them with fresh study opportunities and enabling them to interact more with their academic content and research endeavors.[2,23] In our study, while residents and interns felt the increase in the quality of training and participation in morning sessions, medical students did not agree. In addition, most interns and nearly half of medical students found that telemedicine allowed for greater schedule flexibility, making balancing their clinical duties with educational activities easier. Accessing materials online also allowed them to review content at their own pace, resulting in a deeper understanding of the material. Overall, integrating e-learning and telemedicine has been a positive change for residents and medical students. In a study by Nepal et al, medical students found online classes less effective than traditional classrooms. Out of 226 surveyed students, almost a third ($n=$ 173, 76.5%) never attended online classes. The majority used smartphones for online learning, with 65.5% relying on broadband internet. Two-thirds rated online classes inferior to traditional teaching, and 77.8% preferred traditional classrooms for future learning.[13] Similar to our study, the majority of medical students did not agree with using online classes alone or with traditional classes after the pandemic.

Telemedicine technology is a new concept in Iran; it is not adequately incorporated into the medical sciences curriculum, and many healthcare physicians and medical students have not received training on it. Moreover, the lack of infrastructure and internet access, coupled with pandemic restrictions and the absence of clear guidelines, have resulted in limited awareness

among physicians and medical students.[7,24–27] There is an urgent need for extensive training programs, investment in infrastructure, and the development of clear guidelines to ensure the successful implementation of telemedicine across the country. By addressing these challenges, Iran can harness the full potential of telemedicine technology to enhance medical education and improve education outcomes for all its medical students. In our study, most of the residents and interns noted more chances for discussion via virtual platforms. However, students held a contrasting view, likely due to their limited engagement in the discussions. In addition, unlike interns, medical students expressed dissatisfaction with the educational curriculum amid the COVID-19 crisis. Despite these challenges, residents generally had a more positive outlook on the virtual learning experience compared to interns and medical students. The study by Motte-Signoret et al surveyed 146 students and 26 faculty members on online learning in pediatrics. They found that 89% of students agreed that online teaching was a suitable method during the pandemic. However, less than half of the students and teachers believed they had received or delivered training equivalent to traditional courses. Roughly one-third supported continuing online teaching postcrisis. Medical students had varied opinions compared to residents and fellows. Learner attendance significantly increased with synchronous online classes (P-value < .001), particularly among advanced learners (P-value < .002).[28] This study uniquely assessed the views of medical students, residents, fellows, and their teachers on online programs. It highlighted online teaching as fitting for the pandemic. Additional research is necessary to gauge the impact of such methods on medical skills and communication abilities.

A limited understanding among healthcare physicians and medical students about telemedicine and its benefits can disrupt implementation, raising costs, and time needed for administration. This lack of awareness may hinder performance and engagement postimplementation. Enhancing training programs for medical students and addressing key barriers like financial support, infrastructure, and cultural considerations can boost efficiency during emergencies such as pandemics.[29–31] By fostering a comprehensive understanding of telemedicine's advantages and intricacies, healthcare professionals can seamlessly integrate this technology into their practices. By strategically investing in education and infrastructure, healthcare systems can unlock the complete potential of telemedicine, thereby enhancing access and quality of care for everyone.[32] The study by Hayat et al, revealed that perception of e-learning feasibility, standardization of e-learning, dedicated teaching, and networking and interdisciplinary collaborations impacted medical e-learning development. The main challenges were categorized into four subcategories, including noncompliance with virtual classroom etiquette, insufficient interactions, time constraints, and infrastructure issues. Participants indicated that e-learning evaluation methods were more suitable for diagnostic and formative assessments.[33] Medical schools have increasingly embraced e-learning to address the disruption in traditional classroom education, leading to a shift from conventional classes to online learning. These rapid and extensive changes in teaching and learning approaches have implications for medical institutions.

In our limitation, the study's setting within one medical training hospital and its focus on medical students, interns, and residents in internal medicine department introduces the potential for selection bias. Furthermore, the exclusion of cases that did not complete all survey questions raises concerns regarding survivor bias.

Conclusion

The survey results indicate that medical students and interns generally have a positive awareness and attitude toward telemedicine. This favorable perspective is likely due to the growing incorporation of telemedicine into medical education and clinical practice. Our study highlights the need for continuous support and resources for healthcare professionals and students adapting to virtual learning. By examining the effectiveness of these methods and addressing pandemic-related stressors, we can better prepare future internal medicine physicians to handle crises with greater resilience and effectiveness.

The EQUATOR Network Guidelines

We utilize the STROBE Statement Checklist to ensure all necessary items are included in reports of cross-sectional studies[34] (Supplementary Table S6).

Authors Contributions

M.M and R.S suggested the study conception and design. N.L and M.M performed material preparation and data collection. S.Gh performed data analysis. N.L and M.M wrote the first draft of the manuscript, and all authors commented on previous versions. All authors read and approved the final manuscript.

Consent for Publication

Informed consent was obtained from all individual participants included in the study.

Ethics Aapproval and Consent to Participate

Informed consent was taken from all participants in the research. A written consent copy is available for review. The research purpose was explained in detail, ensuring confidentiality. The research adhered to the Declaration of Helsinki principles. The ethical committee of Golestan University of Medical Sciences approved it. Ethical code: IR.GOUMS.REC.1402.418.

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Supplemental Material

Supplemental material for this article is available online.

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