JOURNAL OF HEALTH AND SOCIAL SCIENCES

Journal of Health and Social Sciences (JHSS)
The Italian Journal for Interdisciplinary Health and Social Development *EDIZIONI FS Publishers*

Original Article in Public Health and Primary Care

Knowledge, attitudes and perception of medical and nursing students towards telemedicine/telehealth

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Abstract

Introduction: Despite widespread use of advanced technology in a range of health applications, telemedicine is still in its infancy. Acceptance of telehealth/telemedicine strategies in health-care has increased significantly, in part due to the COVID-19 pandemic. Previous studies indicate a significant gap in preparation of healthcare providers in e-medicine concepts, despite some exposure to telemedicine during training. The purpose of this study was to explore knowledge, attitudes, and perception to gauge the readiness of medical and nursing students to engage in telemedicine.

Methods: Using a cross-sectional research design, a 26-item questionnaire was administered electronically to nursing and medical students attending institutions in the Southern United States.

Results: A total of 109 students completed the survey. The mean age of participants was 28.28 (SD=8.46). The majority of participants were nursing students (61.5%), female (82.6%), and white (74.3%). With regard to knowledge, only 23% feel the curriculum adequately prepared them for telemedicine/telehealth. Sixty percent of respondents said they agreed or strongly agreed that telemedicine lowers healthcare expenses, while 40% said it improves healthcare quality. Nearly a quarter (24%) reported that they are very/completely likely to use telemedicine in practice after graduation. Perceived obstacles in practicing telemedicine included technology that is difficult to use (31.2%), disinterest among clients (25.7%), and lack of adequate telemedicine training (20.2%).

Discussion: This study demonstrated that health-care students have a perception that they are inadequately prepared for the challenges of telemedicine/telehealth, despite recognition of its

potential value. Given the significant increase in the use of telemedicine/telehealth, additional studies are needed to design a more effective health-care curriculum to ensure proper preparation and instill confidence in the next generation of health-care providers.

Take-home message: Our study showed that perceived barriers among students, such as problems with technology and lack of training in telemedicine. Our study identified a lack of perceived preparation regarding telemedicine/telehealth, despite recognition of its potential value, in health-care students.
Keywords: Attitudes; medical students; nursing students; telehealth; telemedicine; knowledge.

Cite this paper as: Aman I, Welsch MA, Zhang L, Mann J, Davis RE, Islam RK, Clark JT, Brodell RT, Nahar VK. Knowledge, attitudes, and perceptions of medical and nursing students toward telemedicine and telehealth. J Health Soc Sci. 2025;10(1):86-98. Doi: 10.19204/2025/KNWL7.

Received: 10 August 2024; Accepted: 20 February 2025; Published: 15 March 2025.

INTRODUCTION

Telemedicine is defined by the World Health Organization (WHO) as the delivery of healthcare services using information and communication technologies to exchange valid information for diagnosis, treatment, and prevention involving direct patient communication [1]. In contrast, telehealth is a broader term that includes administrative management and other non-clinical services [2]. Telemedicine can be classified into two types: synchronous, which involves real-time interaction between patients and healthcare providers, and asynchronous, where patient data is collected, stored, and then reviewed by healthcare providers at a later time [3].

Despite the widespread use of advanced technology in various health systems, telemedicine is still in its infancy and undergoing rapid evolution. This field requires ongoing examination, and continuing efforts to enhance education to promote the adoption of the newest technologies if its full potential is to be realized. Of critical importance is the identification of specific areas for improvement in patient and healthcare provider acceptance [4]. Telemedicine has demonstrated numerous advantages over the past decades, such as reducing readmission rates, shortening patient stays, improving medication compliance, and providing a cost-effective alternative to in-person care. For instance, patients with traditional access barriers can consult with healthcare providers via video links for follow-ups, counseling, education, results updates, and medication queries [5].

Technological advancements have certainly enhanced telemedicine. Wearable sensors provide real-time physiological and behavioral data, paving the way for precision medicine [6]. However, the availability, accuracy, validity, accessibility, and affordability of these devices have not been fully demonstrated. Health inequities, particularly in states like Mississippi, continue to be a problem [7]. Early data suggests high satisfaction rates among clinical staff and patients' families with telemedicine services [8]. Nevertheless, telemedicine faces challenges, such as limitations in conducting physical examinations, performing biopsies, and the need to improve imaging technologies while keeping costs low.

Telemedicine's history dates back to the 1860s, with telegraph messages were used for medical consultations during the Civil War. The term telemedicine was first introduced in the United States by Bird in 1970 [9]. Since then, it has progressed through various stages of innovation, from the early use of radio for medical advice on naval ships to the development of teleradiology and television for medical education. NASA's "Space Technology Applied to Rural Papago Advanced Health Care" (STARPAHC) project in the 1970s is a notable example of early telemedicine initiatives. The evolution continued with the advent of synchronous telemedicine models like TelaDOC Health and the expansion into fields such as tele-dentistry, tele-dermatology, and telepsychiatry [10].

The COVID-19 pandemic has significantly accelerated the acceptance and utilization of telehealth and telemedicine. Offering telehealth services has transformed the scope of medical

practice and altered patient expectations [2]. Today, 76% of United States' (US) hospitals use telehealth, and 35 states have enacted laws requiring insurers to cover telehealth services [11]. Technological advancements, such as phone apps and wearable devices that monitor health metrics, are becoming increasingly prevalent, and future tele-devices are likely to be even more compact and multifunctional [12].

A systematic literature review was conducted to assess the knowledge, attitudes, and perceptions (KAP) of medical and nursing students towards telemedicine. While many students are familiar with synchronous telemedicine, studies in Europe highlight deficiencies in knowledge related to telemedicine regulations rooted in inadequate training. For example, a national survey in France revealed that 84.8% of medical students were unaware of telemedicine regulations, and only 14% had experience with the clinical practice of telemedicine during their studies [13]. Similarly, a study in Poland found that 67% of nursing students anticipated the implementation of telenursing into the healthcare system, but only a few universities offered telenursing classes [14].

Given the increasing reliance on telemedicine, it is crucial to understand the readiness of future healthcare professionals to utilize this technology. Our study is the first to explore the knowledge, attitudes, and perceptions of telemedicine by medical and nursing students in Mississippi. By identifying gaps in education and training, we hope to provide insights that will enhance the sustainability of quality e-healthcare delivery, improve community health access, and ensure patient compliance. This is particularly important in poor rural states like Mississippi.

Understanding these perspectives is essential for developing standards of care and policies that support telemedicine in various community settings. As the healthcare industry continues to evolve, it is imperative to equip future healthcare professionals with the necessary skills and knowledge to effectively utilize telemedicine and improve patient outcomes.

METHODS

Design and participants

The design of this study was cross-sectional and opted to evaluate the knowledge, attitudes, and perception of medical and nursing students towards telehealth/telemedicine. Also, this study assessed their level of acceptance to utilize telemedicine in this era of health care technological advancement, especially during pandemics.

A convenience sample of medical and nursing students enrolled at a large medical University in the Southern US were invited to participate. Nursing students received an email that included study information and a survey link. Nursing students received two reminder emails in the second and third weeks, and data was collected for a minimum of three weeks. For medical students, information about the study and the survey link was included in the electronic student newsletter. Additionally, medical students were approached in the common sitting area and invited to participate in the study. Those who agreed were given a paper-and-pencil survey to complete. Nursing and medical students Participants were notified about the confidentiality of their survey responses, as well as the fact that participation is entirely voluntary, and that no personally identifiable information was obtained from the data. All participants in the study were requested to provide their informed consent via electronic and verbal means. This study was approved by the Institutional Review board (IRB) at the University of Mississippi Medical Center (UMMC).

Instrumentation and validity

This study instrument (Appendix: Telemedicine Questionnaire) was adapted from previously published literature, with permission granted for its use of a survey instrument [13]. The survey instrument was modified for the focus of our study and validated by four independent experts over a two-round process during the period of October 2022-Nov 2022. These experts assessed the readability, relevance and clarity of the survey items. Based on the experts' feedback, necessary changes were made in order to improve the survey instrument and establish face/content validity.

Instrument

The 26-item questionnaire survey has major domains of demographics, specific information about e- health retrieval, knowledge and attitudes of students and residents towards telemedicine.

These domains have been further broken down into subcategories of questions. Apart from system data (of age, gender, race/ethnicity, information volunteered by respondents on geographical location, and education level (college or university). Options were presented via multiple choice questions from to assess knowledge of telemedicine by asking what methods medical and nursing students prefer for e-health retrieval. The familiarity of participants was evaluated with the terms telehealth and telemedicine self-rated by students and residents. Additionally, we covered the attitude and perception of participants towards telemedicine corresponding with barriers, advantages and disadvantages, reliability of telehealth data, reasonability of data exchange, and physician-patient rapport. Additional questions assessed telemedicine training and students' confidence. The intent of students to implement telehealth/telemedicine knowledge in their future practice was assessed. In addition, the usefulness of telemedicine/telehealth for chronic disease or disability was evaluated utilizing a Likert scale ranging from 1-5 (1=less likely agree and 5= strongly agree). Furthermore, series of open-ended questions such as ”Is there anything else you want to tell about e-Health and telemedicine?” which were designed to allow participants to have the freedom to comment on barriers and usefulness of telemedicine.

RESULTS

A total of 109 participants surveys were completed (n =109). Table 1 shows the demographics of study participants. The mean age of participants was 28.28 (SD = 8.46). The majority of participants were nursing students (61.5%), female (82.6%), and white (74.3%).

Table 1. Characteristics of participants (n = 109).

Variables	Mean (SD)	*n* (%)
1. Gender		
Male		18 (16.5)
Female		90 (82.6)
Other		1 (0.9)
2. School		
Medical student		40(36.7)
Nursing student		67(61.5)
Others		1(0.9)
3. Academic Classification		
First year student		37(33.9)
Second year student		22(20.2)
Third year student		13(11.9)
Fourth year student		5(4.6)
Fifth year student		6(5.5)
Others		26(23.9)
4. Race		
American Indian/Alaskan Native		1(9)
Asian		9 (8.3)
Black or African American		16 (14.7)
White		81 (74.3)
Others		3 (2.8)
5. Ethnicity		
Hispanic/Latino		1 (9)
Not Hispanic/Latino		103 (94.5)
Others		1 (9)
6. Age	28.28 (8.46)	

Tables 2 and 3 show the attitudes and perceptions of participants about telemedicine during their training and healthcare delivery. With regard to knowledge, only 23% feel the curriculum adequately prepared them for telemedicine/telehealth. Sixty percent of respondents said they agreed or strongly agreed that telemedicine lowers healthcare expenses, while 40% said it improves healthcare quality.

Table 2. Knowledge regarding telemedicine.

Items	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
	Not informed at all	**Less informed**	**Fairly informed**	**Adequately informed**	**Very adequately informed**
7. How well informed do you feel about telemedicine/telehealth?	6 (5.5)	18 (16.5)	46 (42.2)	25 (22.9)	12 (11.0)
	Not reliable at all	**Less reliable**	**Fairly reliable**	**Adequately reliable**	**Fully/very well reliable**
8. How reliable do you feel health information from the Internet is?	6 (5.5)	38 (34.9)	46 (42.2)	14 (12.8)	2 (1.8)
	Not effective at all	**Less effective**	**Fairly effective**	**Adequately effective**	**Fully/very well effective**
9. How effective is electronic health information exchange between health care professionals and patient?	0 (0.0)	15 (13.8)	49 (45.0)	32 (29.4)	6 (5.5)
	Not useful at all	**Less useful**	**Fairly useful**	**Adequately useful**	**Fully/very well useful**
10. How useful is the collection of health data through portable sensors for a healthy lifestyle derived from them?	2 (1.8)	10 (9.2)	41(37.6)	35 (32.1)	10 (9.2)

Table 3. Attitude towards telemedicine.

Items	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
11. Data security and privacy are guaranteed for electronically collected health data	3 (2.8)	20 (18.3)	21 (19.3)	29 (26.6)	15 (13.8)

12. Collecting health data via tele-monitoring improves the holistic view of the patients	1 (9)	16 (14.7)	23 (21.1)	30 (27.5)	18 (16.5)
13. Online health information improves patient knowledge	3 (2.8)	8 (7.3)	20 (18.3)	42 (38.5)	15 (13.8)
14. Telemedicine improves interaction between physicians and patients	5 (4.6)	9 (8.3)	27 (24.8)	32 (29.4)	15 (13.8)
15. Telemedicine reduces healthcare costs	2 (1.8)	7 (6.4)	14 (12.8)	45 (41.3)	20 (18.3)
16. Telemedicine enhances quality of healthcare	9 (8.3)	7 (6.4)	29 (26.6)	30 (27.5)	13 (11.9)
17. Telemedicine enhances the doctor patient-relationship	4 (3.7)	19 (17.4)	33 (30.3)	23 (21.1)	9 (8.3)

Table 4 demonstrates training and observation of telemedicine. The table showed a majority of the proportion strongly disagreed (16%) and (22%) disagreed that they observed telemedicine/telehealth visits during their training. A similar proportion (17%) reported as "strongly disagree" that they participated in telemedicine/telehealth visits. Only 24% agreed to receive legal framework information during their training.

Table 4. Telemedicine training and observation.

Items	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
18. During my training I observed telemedicine/telehealth visits	16 (14.7)	22 (20.2)	12 (11.0)	28 (25.7)	7 (6.4)
19. During my training I participated in telemedicine/telehealth visits	17 (15.6)	29 (26.6)	16 (14.7)	18 (16.5)	5 (4.6)

20. During my training I received information about the use of legal framework that best suits telemedicine/tele-health visit (HIPPA compliance, HIPPA flexibility, cyber security, liability and malpractice protection)	8 (7.3)	16 (14.7)	12 (11.0)	33 (30.3)	15 (13.8)
21. During my training I received information about wearable sensors for the purpose of remote monitoring of clinical outcomes (e.g. blood pressure, blood glucose, heart rhythms)	13 (11.9)	25 (22.9)	16 (14.7)	21 (19.3)	10 (9.2)

	Not confident at all	**Slightly confident**	**Somewhat confident**	**Fairly confident**	**Completely confident**
22. At this point in your education, how confident are you that you could manage a telemedicine/telehealth visit with a patient?	15 (13.8)	22 (20.2)	25 (22.9)	16 (14.7)	6 (5.5)

Table 5. Telemedicine implementation and practice.

Items	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
	Not at all likely	**Somewhat likely**	**Moderately likely**	**Very likely**	**Completely likely**
23. After graduation, how likely are you to use telemedicine in your practice?	11 (10.1)	24 (22.0)	23 (21.1)	20 (18.3)	6 (5.5)

	Not confident at all	**Slightly confident**	**Somewhat confident**	**Fairly confident**	**Completely confident**
24. How confident are you that you can use data retrieved from wearable sensors to guide your treatment strategies?	6 (5.5)	18 (16.5)	21 (19.3)	34 (31.2)	3 (2.8)

25. What barriers do you anticipate facing while using telemedicine upon graduation?	
Technology difficulty	34 (31.2)
Lack of a satisfactory platform to conduct tele-medicine visits	18 (16.5)
Lack of training in telemedicine	22(20.2)
Difficulty in determining charges for telemedicine	12 (11.0)
Malpractice and legal issues	20 (18.3)
Not preferred by clients	28 (25.7)
Others	7 (6.4)

Table 5 shows barriers and intentions toward telemedicine utilization after their graduation. The table shows that nearly a quarter (24%) reported that they are very/completely likely to use telemedicine in practice after graduation. Perceived obstacles in practicing telemedicine included technology difficulty (31.2%), clients' disinterest (25.7%), and lack of telemedicine training (20.2%).

DISCUSSION

The aim of this study is to assess knowledge, attitudes, and perceptions (KAP) of medical and nursing students towards telemedicine. As part of the 1135 waiver authority and Coronavirus Preparedness and Response Supplemental Appropriations Act, effective March 6th, 2020, and for the duration of the COVID-19 Public Health Emergency, the Centers for Medicare and Medicaid Services (CMS) began to cover Medicare telehealth services The COVID-19 Pandemic has the undeniable need for telehealth/telemedicine. Medical and nursing students must be equipped during their training to utilize advanced health care practice tools, including telemedicine.

Interestingly, the literature showed very few studies have been performed to evaluate the availability or effectiveness of training in this area. Our study focused on medical and nursing students in a poor, rural southern state (Mississippi).

Given the lack of confidence expressed by students related to the independent use of telemedicine and the perception of minimal training, it is difficult to imagine health care providers independently practicing telemedicine and telehealth. Current curricula largely focus on writing medical records, scheduling, and ordering diagnostic workups. Students report little understanding of the legal framework of telehealth, HIPPA privacy regulations, specific telemedicine/telehealth terminology, and the optimal approach to the patient in a telemedicine visit. These and other

curriculum gaps must be identified with a focus on stakeholders and steps taken to correct them. In particular, there appears to be a need for hands-on practice in developing telemedicine skills, especially examination skills, as opposed to the didactic lectures that are commonly reported.

Given the scientific support favoring hands-on training as the optimal learning approach (Taylor & Hamdy, 2013), it is time to consider curriculum reforms that focus on audio-video-based patient encounters with actual patients and mock patients [15–18]. Unfortunately, most of these studies focus on student's satisfaction related to curriculum effectiveness rather than more definitive outcomes both in the United States and around the world [19-21].

Benefits of students curriculum update for telemedicine

There is some evidence that medical students who participated in telemedicine practice improved their level of knowledge and gained better insight into the practice of telemedicine [18,21–30]. The vast majority of students (87%) strongly agreed that telehealth would be "a valuable service to offer to patients [24]. Multiple studies have demonstrated that curriculum involving telemedicine participation can prepare students to run telemedicine consults effectively [31,32].

Challenges/barriers for students in telemedicine

There are documented challenges to learning telemedicine, including a lack of visual impression and inability to interpret the patient's affect and level of distress [24, 33]. Students also may question the reliability of information shared via telemedicine and its privacy and security [13,34]. These issues also point to inadequate knowledge rooted in the absence of hands-on training in obtaining histories from patients- utilizing telemedicine [22].

Incorporating telemedicine into medical curriculum

Telemedicine is being introduced into medical curricula around the globe including in the US therefore, curriculum should be upgraded to match rapidly advancing technological demands and to make improvements to the existing telemedicine system [32,35,36]. For instance, Iancu et al. recommended incorporating functional physical examination skills and telemedicine terminology into curriculum for students. Pathipati et al. recommended familiarizing themselves with remote monitoring tools and, likely more simulation [28,30,37]. The American Medical Association (AMA) has proposed a great suggestion for enhancements of telemedicine environment involving patient care, such as remote examination techniques by Southern California Telemedicine Center, simulation practice for rural telemedicine encounters, or communication to clinical mediators such as to a home aid or care givers. The Council on Medical Education (CME) has advised the adoptions of recommendations in their report. AMA encouraged the Liaison Committee on Medical Education (LCME) and 33 Accreditation Council for Graduate Medical Education (ACGME) to include core competencies in telemedicine in undergraduate medical education and graduate medical education training. The AMA reaffirms their policies to reduce barriers to telemedicine education [38].

Health information considerations

Telemedicine is a high resource modality-means that a provider requires usually a computer with audio and/or video access, a smartphone or tablet with a secure Health Insurance Portability and Accountability Act (HIPAA)-compliant platform to conduct the telemedicine visit [38]. A number of electronic health record (EHR) systems, including Allscripts, Cerner, and Epic, offer basic telemedicine utility.

Limitations of utilization of telemedicine

The obvious limitations of telemedicine are rooted in not being able to touch the patient and perform a traditional physical exam. However, patients often have tools at home that would allow them to provide weight, blood pressure, arterial oxygen (pulse-oximeter), and body temperature (thermometer) to facilitate a visual examination. For patients who do not own them, these are inexpensive tools, which may be covered by the patient's insurance.

Per Dartmouth-Hitchcock Medical Center, dermatologists and patients have come to accept tele-dermatology tools as routine.[38] In densely populated areas with a shortage of healthcare providers and limited resources, telemedicine has become the preferred mode of consultation for some patients. These experiences encourage the improvement of tools/techniques and the training of clinicians.

Moreover, various models exist to incorporate virtual care for some visits and face-to-face care for others. Some models allow patients to choose a care visit in person or by video or phone. Finally, reimbursement for telemedicine visits remains an area that needs further virtual care modernization. CMS did allow for "Virtual Check-Ins," and Medicare Part B covers clinician's payments for certain visits across all settings in US.

Future of telemedicine

There was a surge in the use of telemedicine during the COVID-19 pandemic. Telemedicine solved critical access to care issues during lockdowns and when transportation was not available, or for immunocompromised patients who had special reasons to minimize the risk of serious infectious diseases. Patients can have less waiting time and broader option to choose from a variety of specialists [39]. In some cases, non-compliance was reduced, and quality care and productivity were improved. Thus, telemedicine has options and alternatives offering flexibility and comfort for patients and care providers.

Regulatory and legal implications

It is crucial for providers to ensure the safety of patient data while providing telemedicine services. Efforts are needed from policy reforms by involving all stakeholders from the government sector, including law and policymakers, to modify both HIPAA and the Health Information Technology for Economic and Clinical Health Act (HITECH) to set the standards as telemedicine is integrating into healthcare delivery. Per data, the terminology/language still has gaps to fully support the development of telemedicine as a standard method of healthcare delivery that is safely and fully accessible to all patients across the country.

Based on our survey and previous studies there is also a need for minimum privacy/security standards for health apps and communication platforms, such as to avoid storage on third-party servers [40].

Telemedicine guidelines vary across states, and so far, only a few states have implemented the Interstate Medical Licensure Compact (IMLC) [40].

Ethics of virtual care

Telemedicine, as a unique mode of care, requires special attention to ensure ethical standards of practice are not lost. The American Medical Association (AMA) has defined responsibilities that require ethical principles-continuity of care and informed consent. Many students in our survey reported that they are not fully confident in conducting telemedicine health visits due to a secondary lack of clinical experience.

Technological advancements

One of the biggest advancements coming down the pipeline in telemedicine will be with remote patient monitoring (RPM) by using sensors [41]. Examples include automatic insulin pumps, digital blood pressure cuffs, and digital heart rate monitors. New RPM technologies are rapidly advancing, which demands students to be trained accordingly. The continuously advancing integration of artificial intelligence into telehealth/telemedicine will ease of usability for the apps, care-access, however, it highlights the need for future generation providers to be well equipped in order to adhere to handle telemedicine care model for their patients [42].

Telemedicine has become the preferred mode of consultation for some patients in densely populated areas with a shortage of healthcare providers and limited resources. Given the significant increase in the use of telemedicine/telehealth, additional studies are needed to determine when and how the healthcare curriculum should adapt to ensure proper preparation and confidence in the next generation of healthcare providers. This study identified several perceived barriers among students, such as problems with technology and a lack of training in telemedicine. Many students reported limited opportunities to observe telehealth encounters or to physically operate telemedicine technology, highlighting the need for practical, hands-on experience. Operating telemedicine technology was frequently listed as a barrier, and addressing this through curriculum updates could significantly improve student readiness. Additionally, patient hesitancy was another barrier noted

by students. Strategies to overcome this might include training students in effective communication techniques specific to telemedicine and patient engagement practices [43].

By providing medical and nursing students with opportunities to observe and engage in telehealth encounters and by ensuring they receive thorough training in operating telemedicine technology, we can better prepare them for the future of healthcare. Addressing both technological and patient engagement barriers will be crucial in developing a more robust and effective telemedicine curriculum.

CONCLUSIONS

Telemedicine offers a valuable and critical tool for medical and nursing students, providing knowledge and skills crucial to their future practices. Implementing telemedicine has minimized direct exposure and lowered the workflows for residents and providers, especially during isolation and provider shortages and has offered a possibility of a sustainable mode of care delivery.

In addition, telemedicine/telehealth offers opportunities for inter-departmental collaboration and clinical safety and isolation during the COVID-19 pandemic [44-50]. However, our study results convey perceived barriers among students, such as problems with technology and lack of training in telemedicine. Our study identified a lack of perceived preparation regarding telemedicine/telehealth, despite recognition of its potential value, in health-care students. Given the significant increase in the use of telemedicine/telehealth additional studies are needed to determine when and how the health-care curriculum should adapt to ensure proper preparation and confidence in the next generation of health-care providers.

Given pandemics and technological advancements a new social norm, it appears as an undeniable fact that telemedicine is going to stay and medical and nursing schools need to reform telemedicine curriculum. Thus, in order to be prepared for future medical practice, we need to improve the curriculum and initiate further research studies.

Author Contributions: All authors have read and agreed to the published version of the manuscript.
Funding: This research received no external funding.
Institutional Review Board Statement: This study was approved by the Ethics Committee at the University of Mississippi Medical Center.
Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Conflicts of Interest: Conflict of interest: Robert T. Brodell is a principal investigator for clinical trials (Novartis and Sanofi), the Corevitas psoriasis biologic registry and owns stock in Veradermics, Inc. Iram Aman, Michael A.Welsch, Lei Zhang, Joshua Mann, Robert E. Davis, Rahib K. Islam, Joshua T. Clark, and Vinayak K. Nahar have no conflicts of interest to disclose.

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