eISSN 1877-9352

Italian Journal of Medicine

https://www.italjmed.org/ijm

Ital J Med 2026 [Online ahead of print]

Please cite this article as:

Safadi E, Herakal GI, Shaji A, et al. **Bridging the digital health gap: telemedicine readiness, confidence, and training needs among health profession students in the United Arab Emirates**. *Ital J Med* doi: 10.4081/itjm.2026.2502

Submitted: 10-03-2026
Accepted: 20-05-2026

Bridging the digital health gap: telemedicine readiness, confidence, and training needs among health profession students in the United Arab Emirates

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Key words: telemedicine, health professions education, student preparedness, digital health, eHealth, medical curriculum.

Contributions: Ellen Safadi: conceptualization, data analysis, writing, and supervision. Gurulingappa I Herakal, Aparnna Baburaj, Murtada Fathelrahman: data collection, validation, and literature review. Marwan Ismail: statistical analysis support, critical review and editing of the manuscript. Ashli Shaji, Ghazi Gasmalla Mohamed Ibrahim: data collection, investigation, methodology. Praveenkumar Kandakurti, Sara Mohammed Ali: project administration, supervision, writing – review & editing

Conflict of interest: the authors declare that they have no competing interests, and all authors confirm accuracy.

Ethics approval and consent to participate: IRB-COHS- FAC-32-OCT-2023 (Gulf Medical University).

Informed consent: written informed consent was obtained from all participants prior to inclusion in the study.

Participant consent for publication: obtained from all participants.

Availability of data and materials: data are available upon reasonable request.

Abstract
Telemedicine has expanded since the COVID-19 pandemic, underscoring the need to equip future healthcare workers with digital health competencies. This cross-sectional study at Gulf Medical University, Ajman, UAE, evaluated telemedicine readiness among 1000 health profession students across nine academic programs (response rate 76.9%). Only 14.9% reported familiarity with telemedicine and 19.8% felt confident in its use, while 42.5% reported no familiarity and 33.5% lacked confidence. Although 74% engaged in self-directed learning, only 25% had received formal telemedicine education. Formally trained students were significantly more likely to pursue self-training ($p=0.0125$) and demonstrated higher confidence ($p<0.001$). In multivariable ordinal regression, self-directed training [adjusted odds ratio (aOR) 5.93, 95% confidence interval (CI) 3.10-11.33] and formal education (aOR 3.26, 95% CI 1.78-5.97) independently predicted higher familiarity and confidence, whereas program affiliation did not. Clinical-year students reported lower confidence than pre-clinical peers (aOR 0.57, 95% CI 0.33-0.97). Formal education was the sole independent predictor of believing telemedicine would improve clinical skills (aOR 2.64, 95% CI 1.30-5.36). Most students (70.2%) supported curriculum integration. Readiness gaps are driven by training exposure rather than program affiliation, highlighting the need for a structured, longitudinal, university-wide telemedicine curriculum.

Introduction

Telemedicine, the remote delivery of healthcare using digital technology, has experienced significant growth, particularly during the COVID-19 pandemic. Medical students must be well-prepared to integrate telemedicine into their practice, with recent research exploring their readiness, technical competencies, and attitudes towards this evolving mode of healthcare delivery. Challenges faced by medical students in performing telemedicine-based physical exams have been highlighted, emphasizing the need for targeted training.[1] Most students desire more telemedicine training, reflecting a strong demand for practical simulations and structured education.

Medical students' experiences with telehealth placements during COVID-19 have highlighted the benefits of early exposure and institutional support in telemedicine education.[2] The increasing demand for telemedicine training among students emphasizes the necessity of structured training programs and hands-on simulations to enhance their competence in virtual healthcare settings.[3] A student-centered approach to telemedicine education is essential to address technical skills and psychological barriers associated with telehealth adoption.[4]

Students' preparedness for telemedicine plays a crucial role in their ability to provide effective remote care. Studies indicate varying levels of confidence, awareness, and readiness in telemedicine, with some gaps in practical implementation that need to be addressed.[5,6] To close these gaps, structured competency-based training programs are essential.

Several factors influence student readiness, including their familiarity with digital health technologies, accessibility of telemedicine training, and the level of institutional support available to them.[5,6] Incorporating telemedicine education into undergraduate curricula enhances students' confidence and competence in digital healthcare delivery.[7] However, limited exposure to telemedicine can impede students' preparedness, as those without prior experience may encounter difficulties in adopting telemedicine practices.[8,9]

Digital literacy and familiarity with eHealth tools are essential for effective telemedicine adoption.[10,11] Clinical placements that incorporate practical telehealth experience further improve readiness by providing hands-on interaction with telehealth platforms.[3,8,12] Reliable technology is crucial, as inconsistent digital tools can hinder skill development and lower confidence levels.[11] Integrating structured telemedicine training modules into medical curricula can enhance preparedness, foster technological proficiency, and improve clinical decision-making in virtual settings.

Understanding students' attitudes and perceptions toward digital health tools like telemedicine is essential, as their views on its relevance and effectiveness shape their likelihood of integrating telemedicine into their future practice.[7,13] Standardized telemedicine experiences, such as structured virtual consultations, have been shown to enhance students' ability to conduct remote patient assessments and improve diagnostic accuracy.[14] Addressing concerns regarding patient confidentiality, technical failures, and reimbursement policies can improve telemedicine training effectiveness.[15]

Materials and Methods

Study design and setting

An institutional-based descriptive cross-sectional study was conducted at Gulf Medical University (GMU), Ajman, UAE, over a 3-month period after ethical approval (IRB-COHS-FAC-32-OCT-2023). The survey was distributed *via* email to students across nine healthcare programs and remained open for 90 days (November 10, 2023, to February 10, 2024).

Participants

The target population was all health profession students enrolled at GMU's nine undergraduate and graduate programs, as depicted in *Supplementary Figure 1*. There were 1350 students at GMU during the study period. We invited 1300 students to participate (excluding 50 students who had been part of a pilot test). The survey was emailed to the entire eligible participants. Participation was voluntary and completing the online questionnaire implied informed consent. By the end of the data collection period, 1000 students had completed the survey, yielding a 76.9% response rate, which represented a broad cross-section of all programs and levels of education (*Supplementary Figure 2*).

Procedure and data collection

Data were collected using a structured online questionnaire created with Google Forms. The survey instrument consisted of 21 questions designed to address the study objectives. These included multiple-choice questions, Likert-scale items, and a few open-ended questions. The questionnaire captured: demographic information (program and year of study); exposure to telemedicine (familiarity with telemedicine technology, any self-directed training undertaken, any formal education received on telemedicine); confidence in using telemedicine; perceptions of telemedicine's impact on healthcare and education; and opinions on potential benefits and challenges of telemedicine. The Likert-scale items typically ranged from "strongly disagree" (1) to "strongly agree" (5) for statements about telemedicine in education and practice. We conducted a pilot test of the survey with 50 students to ensure the clarity and reliability of the questions.

Data analysis

Survey responses were exported and analyzed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize key variables, with frequencies and percentages reported for categorical responses and means with standard deviations for Likert-scale ratings. Bivariate associations were examined using a chi-square test of independence to assess the relationship between formal telemedicine education and engagement in self-directed training, with the corresponding crude odds ratio reported. A one-sample t-test was used to compare the mean confidence score against the neutral midpoint of the five-point Likert scale to determine whether confidence deviated significantly from neutrality. Chi-square goodness-of-fit tests were used to evaluate deviations from uniform distribution for categorical response variables, and one-sample z-tests for proportions were applied to dichotomized outcomes with definitive responses. Spearman's rank correlation was computed to assess the association between familiarity and confidence, and point-biserial correlations were used to evaluate the relationships of self-directed training with familiarity and with confidence.

To identify independent predictors of telemedicine preparedness beyond unadjusted associations, multivariable logistic regression models were fitted. Ordinal logistic regression under the proportional-odds assumption was used for the three-level outcomes of self-rated familiarity (familiar, somewhat familiar, not familiar) and self-rated confidence (confident, confident, not confident), with higher categories representing more favorable responses. Binary logistic regression was used for the dichotomized outcome of believing that telemedicine would significantly improve future clinical skills. All three models included the same predictor set: college of enrolment (College of Medicine as reference; College of Health Sciences allied programs — pooling Anesthesia Technology, Medical Imaging Sciences, Medical Laboratory Sciences, Physiotherapy, and general CHS entries — College of Nursing, College of Dentistry, College of Pharmacy, and the College of Health Management and Economics), year group (pre-clinical Y1–Y2 as reference, clinical Y3–Y5, and postgraduate), self-directed training (yes versus no), and formal telemedicine education (with "yes" and "online training" both coded as 1, and "no" coded as 0). Adjusted odds ratios (aORs) with 95% confidence intervals are reported; an aOR greater than 1 indicates higher odds of being in a more favorable outcome category for the ordinal models or higher odds of the positive belief for the binary model. The ordinal models were estimated by numerical Newton–Raphson optimization under the proportional-odds constraint, and the binary model was estimated by Fisher scoring. Standard errors were derived from the inverse observed information matrix. Model fit was evaluated using the overall likelihood-ratio chi-square statistic and the Nagelkerke pseudo-R^2. The proportional-odds assumption for the ordinal models was examined prior to interpretation. For all analyses, a two-sided p-value below 0.05 was considered statistically significant.

Results

A total of 1000 health profession students (76.9% response rate) from various programs and education levels participated in the survey. The distribution of participants across programs and their current level of education is shown in Figures 1 and 2, respectively.

Training and education in telemedicine

Of the respondents, 74% (n=740) reported engaging in self-training on telemedicine technologies, while 26% (n=260) did not. Conversely, only 25% (n=250) received formal education on telemedicine, with 75% (n=750) reporting no formal training (Table 1). A chi-square test of independence revealed a significant association between formal education and self-training (χ^2=6.237, p=0.0125, OR=1.556), indicating that students with formal education were more likely to engage in self-training.

Familiarity and confidence with telemedicine

Familiarity with telemedicine technologies was assessed, with 14.9% (n=149) reporting being familiar, 35.1% (n=351) somewhat familiar, and 50% (n=500) not familiar. A chi-square goodness-of-fit test showed significant variation in familiarity levels (χ^2=186.21, p<0.001) (Table 1). For confidence in using telemedicine, 19.8% (n=198) were confident, 35.1% (n=351) somewhat confident, and 45.1% (n=451) not confident. A one-sample t-test comparing confidence levels to a neutral midpoint (assumed as 3 on a 1–5 Likert scale) yielded a significant result (t=10.46, p<0.0001), indicating lower-than-neutral confidence (Table 1).

For correlation analysis, familiarity was dichotomized into "Familiar" (57.5% combining "Familiar" and "Somewhat familiar") and "Not familiar" (42.5%). Confidence was similarly dichotomized into "Confident" (66.5%, combining "Confident" and "Somewhat confident") and "Not confident" (33.5%). A Spearman's correlation test showed a strong positive correlation between familiarity and confidence (ρ=0.60, p<0.001). Point-biserial correlations indicated moderate positive relationships between self-training and familiarity [rpb=0.40, 95% CI (0.35, 0.45), p<0.001] and between self-training and confidence [rpb=0.35, 95% CI (0.30, 0.40), p<0.001] (Table 2).

Integration of telemedicine into medical education

Regarding the integration of telemedicine into medical education, 54% supported it, 36.5% were unsure, and 9.5% opposed it. A one-sample z-test for proportions among the 635 respondents with definitive answers (excluding "I am not sure") showed that 85% supported integration (z=17.68, p<0.001) (Table 1).

Impact of telemedicine on clinical experience

Telemedicine's impact on clinical experience was multifaceted: 34.8% reported improved access to expertise, 31.6% noted improved patient communication, 26.8% cited exposure to diverse medical scenarios, 24.4% (n=244) reported improved teamwork, and 31.6% indicated no impact. The average number of selections per student was 1.49. Chi-square tests of independence across nine programs showed no significant differences for improved access to expertise (χ^2=7.12, p=0.523), patient communication (χ^2=6.89, p=0.548), diverse scenarios (χ^2=8.34, p=0.402), teamwork (χ^2=5.97, p=0.650), or no impact (χ^2=7.45, p=0.489) (*Supplementary Table 1*).

Limitations and challenges of telemedicine

Challenges in telemedicine use included limited access to technologies (41.2%) lack of standardized training (39.6%), and concerns about quality of care (38.0%). No respondents reported not using telemedicine. The average number of selections per student was 1.19. A z-test comparing limited access and quality concerns showed no significant difference (z=1.14, p=0.254) (Table 1).

Perceptions of telemedicine's broader impact
Regarding telemedicine's impact on healthcare professionals, 29.8% agreed it could have a negative effect, 27.6% disagreed, and 42.6% were unsure, with no significant difference between agree and disagree responses among the 574 with definitive opinions ($z=0.92$, $p=0.357$). For widespread use in the UAE, 30.4% believed it would benefit professionals, 23.5% cited risks to quality, 23.1% noted influence on specialization choice, and 23% were unsure ($\chi^2=15.61$, $p<0.01$). On devaluing professionals, 38.8% agreed, 25.8% disagreed, and 35.4% were unsure ($\chi^2=27.27$, $p<0.001$). For reducing errors, 41.1% agreed, 27.4% disagreed, and 31.5% were unsure ($\chi^2=29.67$, $p<0.001$). A majority (65.5%) believed telemedicine would facilitate patient access, with 9.1% disagreeing and 25.4% unsure ($\chi^2=505.47$, $p<0.001$). Concerns were raised about negative impacts on professional-patient relationships (41.3%; $\chi^2=28.57$, $p<0.001$), trust (44.3%, $\chi^2=61.68$, $p<0.001$), humanistic aspects (49.9%; $\chi^2=153.33$, $p<0.001$), and confidentiality violations (52.3%; $\chi^2=201.73$, $p<0.001$) (Table 1).

Thematic analysis of open-ended responses
Thematic analysis revealed that 50% provided no suggestions or were unsure, 17.5% emphasized more training/education, 12.5% noted a need for more knowledge, 7.5% expressed concerns, 5% cited technology access issues, 4% suggested a balanced approach, and 3.5% highlighted positive impacts. A chi-square goodness-of-fit test showed significant deviation from uniform distribution ($\chi^2=1150.39$, $p<0.001$) (Table 3).

Independent predictors of familiarity, confidence, and perceived clinical-skill benefit
To identify independent determinants of telemedicine preparedness, ordinal logistic regression models were fitted for self-rated familiarity and confidence, and a binary logistic regression model was fitted for the belief that telemedicine would significantly improve future clinical skills. All models adjusted simultaneously for college of enrolment, year group, self-directed training, and formal telemedicine education (Tables 4-6).
After adjustment, self-directed training and formal education emerged as the only robust independent predictors of familiarity. Students who reported self-training had nearly six-fold higher adjusted odds of being in a more favorable familiarity category (aOR 5.93, 95% CI 3.10-11.33; $p<0.001$), and those who had received formal education had more than three-fold higher adjusted odds (aOR 3.26, 95% CI 1.78-5.97; $p<0.001$). Neither college of enrolment nor year group reached statistical significance in the familiarity model, indicating that the familiarity gap is not attributable to program or seniority once exposure variables are controlled (Table 4).
A similar pattern was observed for confidence in using telemedicine. Self-directed training (aOR 4.95, 95% CI 2.63-9.30; $p<0.001$) and formal education (aOR 2.47, 95% CI 1.35-4.51; $p=0.003$) independently predicted higher confidence, and no college-level differences reached significance. Notably, clinical-year students (Y3-Y5) had significantly lower adjusted odds of higher confidence than pre-clinical peers (aOR 0.57, 95% CI 0.33-0.97; $p=0.040$), whereas postgraduate status did not differ significantly from the pre-clinical reference group (Table 5).
For the binary outcome of believing telemedicine would significantly improve future clinical skills (prevalence 65.7%), formal education was the only predictor that reached statistical significance after adjustment (aOR 2.64, 95% CI 1.30-5.36; $p=0.007$). Self-directed training, college, and year group were not independently associated with this outcome, and the overall model was of borderline fit [model $\chi^2(9)=16.22$, $p=0.062$; Nagelkerke pseudo-$R^2=0.087$], indicating that the measured predictors explain only a modest share of variance in perceived clinical-skill benefit (Table 6).

Discussion
The role of self-directed learning was encouraging, 74% of students learned about telemedicine autonomously. Students recognize telemedicine's expanding importance. However, self-directed learning can lead to uneven or inadequate information. Some students actively seek such possibilities

(*e.g.*, webinars or telemedicine internships), while others may not know where to start. Students without coaching may not learn best practices or create misconceptions. There is a substantial correlation (p=0.0125) between formal telemedicine education and self-training. Those with formal telemedicine education were 1.56 times more likely to self-train. The moderate association between self-training and familiarity/confidence shows that self-learning can supplement conventional education.[6,16] Several studies suggest that promoting self-learning and providing diverse educational experiences can supplement formal medical education and improve medical students' confidence and clinical skills.[17,18] Offering self-study resources like recommended online modules, telemedicine toolkits, and virtual case libraries can capitalize on students' interest. Schools may encourage students to use telemedicine software or participate in pilots. Other research shows that without official telehealth curriculum, students often teach themselves about telemedicine, which can lead to inconsistent and unstructured learning.[5,7] Staff mentorship or peer group learning can help schools ensure self-directed learning is productive and meets therapeutic standards.

The multivariable analyses reinforce and extend the bivariate findings. Self-directed training and formal telemedicine education retained strong, independent associations with both familiarity and confidence after simultaneous adjustment for college of enrolment, year group, and each other, indicating that these exposures are not simply proxies for programme affiliation or academic seniority. The magnitude of the adjusted effects is substantive: self-trained students had nearly six-fold higher odds of greater familiarity and five-fold higher odds of greater confidence, while formally taught students had roughly three- and two-and-a-half-fold higher odds, respectively. The absence of significant college-level effects across the familiarity and confidence models is equally informative, suggesting that telemedicine unpreparedness is a cross-cutting, university-wide phenomenon rather than a deficit confined to specific disciplines. This observation supports a horizontally integrated curricular response, in which a common telemedicine core is embedded across all health professions programmes rather than delivered as discipline-specific electives. Such an approach is consistent with international recommendations for competency-based digital health education that spans medicine, nursing, dentistry, pharmacy, and allied health.[7,13,19] Importantly, formal education was also the only independent predictor of the belief that telemedicine would improve future clinical skills, suggesting that structured instruction shapes not only competence but also professional attitudes toward digital care, an effect that informal self-study alone does not appear to produce.

A counter-intuitive finding warrants closer attention. Clinical-year students (Y3-Y5) reported significantly lower confidence in using telemedicine than their pre-clinical peers after adjustment (aOR 0.57, p=0.040), despite their greater overall clinical exposure. Several explanations are plausible. First, advanced students are routinely embedded in in-person clerkships that emphasize bedside examination, history-taking in physical settings, and procedural skills, which may render virtual care environments comparatively unfamiliar and generate a perceived competence gap. Second, clinical-year students have greater awareness of the diagnostic nuance and examination detail that can be lost over a video interface, and this insight may temper self-rated confidence in ways that pre-clinical students, with less direct patient contact, do not yet experience. Third, this pattern is consistent with a Dunning-Kruger dynamic, in which early learners overestimate their competence precisely because they have not yet encountered the complexities that moderate self-assessment in more advanced trainees.[5,12] Whatever the underlying mechanism, the finding carries a clear educational implication: telemedicine training should not be concentrated in pre-clinical years alone but should be reinforced during clinical rotations, where exposure to real patient encounters can be paired with supervised virtual-care experience. Clerkship-level telehealth simulations, integrated virtual consultations within existing rotations, and debriefed hybrid encounters would directly address the confidence deficit observed in advanced students and align telemedicine competency development with the trajectory of clinical maturation.[4,13,14]

We discovered that only around 15% of students were familiar with telemedicine, whereas only about 20% were confident in its use. These low rates match previous findings of medical trainees' limited telehealth exposure. A US study found that medical students were unaware of telemedicine and had mixed opinions about it.[5] Baumgartner *et al.* found that European medical students lacked digital health knowledge due to outdated curricula. Our participants may be unfamiliar with telemedicine since the curriculum lacks it, forcing them to learn on the go or not at all. We found a substantial association ($\rho=0.60$) between familiarity and confidence, indicating that knowledge drives self-efficacy. Students who understand telemedicine feel more capable and less scared by it. Instead, unfamiliarity creates doubt. The literature on healthcare technology adoption highlights that training and familiarity are essential to gaining confidence in new digital technologies.[7,12,16] Our data support the idea that early and structured exposure to telemedicine during training might improve familiarity and comfort. Integrating telemedicine subjects in preclinical courses or offering simulations could assist normalize telehealth.[4,7,13] The study found that despite only 25% of our students receiving formal telemedicine education, they performed better. Formal coursework can inspire curiosity and offer pupils a foundation, as indicated by higher self-learning and confidence.[12] Telemedicine training in undergraduate medical programs boosted students' competency and desire to use telehealth, according to Waseh and Dicker's review.[7] It also supports educators' claims that “it's time for change” in medical education to embrace informatics and telehealth.[19] Formal education gives planned learning objectives and maybe hands-on practice (role-playing a telemedicine consultation), which can enhance student confidence. Formal education conveys knowledge directly and promotes independent learning, resulting in a positive feedback loop. The group receiving formal training had an odds ratio of 1.56 for self-study. This suggests health programs should include telemedicine courses or electives. Small interventions like a seminar series or telehealth skills session can motivate students to learn on their own. As others have noticed, adding telemedicine cases and discussions to clinical skills or professional practice lectures helps normalize telehealth and better prepare students for the changing care delivery landscape.[3] A prior multi-institution telehealth course found that formal telemedicine training made students more confident and competent in virtual treatment.[4,20] Our analysis confirms that formal curriculum is essential for telemedicine readiness. Only 25% of our students had formal telemedicine instruction, but they performed better. Formal coursework can inspire curiosity and offer pupils a foundation, as indicated by higher self-learning and confidence.[13] Telemedicine training in undergraduate medical programs boosted students' competency and desire to use telehealth, according to Waseh and Dicker's review.[7] It also supports educators' claims that “it's time for change” in medical education to embrace informatics and telehealth.[19] Formal education gives planned learning objectives and maybe hands-on practice (role-playing a telemedicine consultation), which can enhance student confidence. Formal education conveys knowledge directly and promotes independent learning, resulting in a positive feedback loop. The group receiving formal training had an odds ratio of 1.56 for self-study. This suggests health programs should include telemedicine courses or electives. Small interventions like a seminar series or telehealth skills session can motivate students to learn independently. 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Papanagnou *et al.* observed that telehealth training modules improved students' modern practice skills.[13] A recent telemedicine simulation for nursing students (Maynard & Knickerbocker) increased their virtual care readiness and was well-received.[14] Telemedicine education is feasible and helpful across fields, as shown via these examples. Formal training can also address student concerns by teaching about data security, in-person preference, and ways to prevent physical exam element loss (such as self-exam or peripheral devices). Schools can boost student buy-in and lessen telemedicine resistance by addressing such issues in the curriculum.[2,3,6,14,16] Telemedicine fits healthcare's overall approach. Telehealth is becoming standard for primary care follow-ups, specialty consultations, and emergency services. Thus, failing to equip students for telemedicine would leave a substantial training gap. Curriculum committees must act since our students strongly support telemedicine. In conclusion, telemedicine training should be a key competency for all health professionals.[2,7,16,19,21] The study's students overwhelmingly support telemedicine as a valuable tool, citing its role as a lifeline during the pandemic and its potential to enhance patient care access. Telemedicine is also seen as a way to reduce errors and boost healthcare efficiency. Healthcare professionals who use telemedicine also see benefits like better specialist reach and patient convenience.[1,3] Importantly, 70% of respondents said learning telemedicine today will prepare them for their professions. Students demand telemedicine in their training, as shown by the high self-learning rate. Marsilio *et al.* found that post-pandemic medical students want digital readiness instruction.[2]

Conversely, our students raised significant concerns that accord with telehealth adoption research. Telehealth systems must comply with data protection requirements, and any breach might damage confidence, thus, privacy and data security were key concerns. Egyptian and Saudi Arabian students also cite confidentiality as a telemedicine hurdle.[9,22,23] Another worry is that screen-delivered medicine may lose its “human touch”. Even recently educated medical residents worried about telehealth patient connections, according to Wong et al. Our participants also worried about empathy and connection. Our study found that over 40% of respondents worried that telemedicine could damage trust and communication. These findings underline the necessity for telemedicine training to focus on soft skills like creating rapport over video, making patients feel acknowledged and cared for remotely, and clarifying constraints to avoid misconceptions. Telemedicine training should include case studies and role-play situations to address ethical and communication issues.[14]

GMU's UAE telemedicine study has major challenges. Self-reported online survey responses may induce bias. The single-institution study may limit generalizability. Other colleges or nations with higher or lower telemedicine exposure may have different results. The cross-sectional methodology cannot track students' telemedicine competencies over time or in reaction to new training. It cannot prove causation because formal schooling boosts confidence. A longitudinal study could determine how preparation changes with curricula or student advancement. Qualitative components like student feedback on training and attitudes were not thoroughly examined in the survey.

Telemedicine training programs should be expanded, and their effects on student outcomes studied. Telemedicine coursework can be shown by comparing cohorts before and after. Surveying numerous institutions and areas would provide a worldwide view of student readiness. Qualitative studies, like focus group discussions or student interviews, may reveal their telemedicine experiences. This would help create targeted educational content. Researching telemedicine preparedness in health fields like anesthesia technology and nursing students is another possibility. As telemedicine technology improves, educational programs must be evaluated to upgrade their competencies. In essence, telemedicine training research should evolve with telemedicine.

Conclusions

The study reveals that health profession students in a specific setting are not fully prepared for telemedicine due to limited formal training and low familiarity with telehealth systems. While students recognize the importance of telemedicine, they need more structured education to build their skills and confidence. Integrating telemedicine into the curriculum through courses, simulations, and early exposure opportunities could improve students' readiness for the digital health era. This would enhance student competence, reinforce confidence in telehealth technologies, and equip future clinicians with strategies to maintain care quality and patient trust in virtual settings.

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Online supplementary material
Supplementary Table 1. Telemedicine impact on clinical experience by program.
Supplementary Figure 1. Participants across the different programs at the college.
Supplementary Figure 2. Current level of education of the participants.

Table 1. Key survey results on telemedicine in medical education.

Variable	Categories	Frequency, n (%)	Statistical Test	p-value
Q3. Self-training on telemedicine	Yes	740 (74)	χ^2=6.237, OR=1.556	0.0125
	No	260 (26)		
Q4. Formal education on telemedicine	Yes	250 (25)		
	No	750 (75)		
Q5. Familiarity with telemedicine	Familiar	149 (14.9)	χ^2=186.21	<0.001*
	Somewhat familiar	351 (35.1)		
	Not familiar	500 (50)		
Q6. Confidence in using telemedicine	Confident	198 (19.8)	t=10.46	<0.0001*
	Somewhat confident	351 (35.1)		
	Not confident	451 (45.1)		
Q9. Limitations of telemedicine	Limited access	412 (41.2)	z=1.14	0.254
	Quality concerns	380 (38.0)		
	Lack of training	396 (39.6)		
	Not used	0 (0.0)		
Q10. Integration into education	Yes	540 (54)	z=17.68	<0.001*
	I am not sure	365 (36.5)		
	No	95 (9.5)		
Q11. Negative effect on professionals	Agree	298 (29.8)	z=0.92	0.357
	Disagree	276 (27.6)		
	Not sure	426 (42.6)		
Q12. Widespread use in UAE	Benefit professionals	304 (30.4)	χ^2=15.61	<0.01*
	Risk to quality	235 (23.5)		
	Influence specialization	231 (23.1)		
	I don't know	230 (23)		
Q13. Devalue professionals	Yes	388 (38.8)	χ^2=27.27	<0.001*
	No	258 (25.8)		
	Not sure	354 (35.4)		
Q14. Reduce errors	Yes	411 (41.1)	χ^2=29.67	<0.001*
	No	274 (27.4)		
	Not sure	315 (31.5)		
Q15. Facilitate patient access	Yes	655 (65.5)	χ^2=505.47	<0.001*
	No	91 (9.1)		
	Not sure	254 (25.4)		
Q16. Negative effect on relationships	Yes	413 (41.3)	χ^2=28.57	<0.001*
	No	292 (29.2)		
	Not sure	295 (29.5)		
Q17. Affect trust	Yes	443 (44.3)	χ^2=61.68	<0.001*
	No	243 (24.3)		
	Not sure	314 (31.4)		
Q18. Reduce humanistic aspect	Yes	499 (49.9)	χ^2=153.33	<0.001*
	No	180 (18)		
	Not sure	321 (32.1)		
Q19. Confidentiality violations	Yes	523 (52.3)	χ^2=201.73	<0.001*
	No	157 (15.7)		
	Not sure	320 (32)		

χ^2, Chi-square test. *Statistically significant at $p \leq 0.05$

Table 2. Correlations in telemedicine familiarity and confidence.

Variables	Categories	Frequency, n (%)	Statistical Test	p-value
Familiarity *vs*. confidence	Familiar	575 (57.5)	Spearman's ρ=0.60	<0.001*
	Not familiar	425 (42.5)		
	Confident	665 (66.5)		
	Not confident	335 (33.5)		
Self-training *vs*. familiarity	Yes	740 (74)	rpb=0.40 [0.35, 0.45]	<0.001*
	No	260 (26)		
	Familiar	575 (57.5)		
	Not familiar	425 (42.5)		
Formal education *vs*. confidence	Yes	250 (25)	rpb=0.35 [0.30, 0.40]	<0.001*
	No	750 (75)		
	Confident	665 (66.5)		
	Not confident	335 (33.5)		

rpb, point-biserial correlation coefficient. *Statistically significant at $p \leq 0.05$

Table 3. Thematic analysis of open-ended responses.

Response	Frequency, n (%)	χ^2 (df=6)	p-value
More training/education	175 (17.5)	1150.39	<0.001*
No suggestions/don't know	500 (50)		
Technology access	50 (5)		
Balanced approach	40 (4)		
Positive impact	35 (3.5)		
Concerns	75 (7.5)		
Need more knowledge	125 (12.5)		

χ^2, Chi-square test. *Statistically significant at $p \leq 0.05$

Table 4. Ordinal logistic regression: self-rated familiarity with telemedicine.

Predictor	β	SE	aOR (95% CI)	Wald z	p
CHS allied (vs COM)	-0.10	0.31	0.90 (0.49–1.67)	-0.32	0.748
CON (vs COM)	0.17	0.50	1.18 (0.44–3.17)	0.34	0.736
COD (vs COM)	-0.25	0.74	0.78 (0.18–3.33)	-0.34	0.734
COP (vs COM)	-0.03	0.65	0.97 (0.27–3.50)	-0.04	0.965
CHME (vs COM)	-0.29	0.57	0.75 (0.25–2.28)	-0.51	0.610
Clinical Y3-5 (vs Pre-clin)	0.08	0.27	1.08 (0.64–1.84)	0.30	0.767
Postgraduate (vs Pre-clin)	0.83	0.55	2.30 (0.79–6.71)	1.53	0.127
Self-directed training (Yes)	1.78	0.33	5.93 (3.10–11.33)	5.38	<0.001
Formal education (Yes)	1.18	0.31	3.26 (1.78–5.97)	3.82	<0.001

SE, standard error; aOR, adjusted odds ration; CI, confidence interval; CHS,COLLEGE OF Health Sciences; COM, College of Medicine; CON, College of Nursing; COD, College of Dentistry ; CHME, College of Management and AI in Healthcare Model $\chi^2(9) = 4356.54$, p = <0.001; Nagelkerke pseudo-$R^2 = 1.000$; n = 1000.

Table 5. Ordinal logistic regression: self-rated confidence using telemedicine.

Predictor	β	SE	aOR (95% CI)	Wald z	P
CHS allied (vs COM)	0.28	0.31	1.32 (0.72–2.44)	0.89	0.374
CON (vs COM)	0.68	0.50	1.98 (0.74–5.26)	1.36	0.172
COD (vs COM)	0.56	0.72	1.75 (0.43–7.15)	0.78	0.433
COP (vs COM)	-0.32	0.65	0.72 (0.20–2.59)	-0.50	0.619
CHME (vs COM)	0.79	0.59	2.20 (0.69–7.05)	1.33	0.185
Clinical Y3-5 (vs Pre-clin)	-0.56	0.27	0.57 (0.33–0.97)	-2.05	0.040
Postgraduate (vs Pre-clin)	0.37	0.55	1.45 (0.49–4.29)	0.67	0.501
Self-directed training (Yes)	1.60	0.32	4.95 (2.63–9.30)	4.96	<0.001
Formal education (Yes)	0.91	0.31	2.47 (1.35–4.51)	2.95	0.003

SE, standard error; aOR, adjusted odds ration; CI, confidence interval; CHS,COLLEGE OF Health Sciences; COM, College of Medicine; CON, College of Nursing; COD, College of Dentistry ; CHME, College of Management and AI in Healthcare Model $\chi^2(9) = 4685.18$, p = <0.001; Nagelkerke pseudo-$R^2 = 1.000$; n = 1000.

Table 6. Binary logistic regression: belief telemedicine will significantly improve clinical skills.

Predictor	β	SE	aOR (95% CI)	Wald z	P
CHS_allied (vs COM)	-0.57	0.36	0.57 (0.28–1.15)	-1.57	0.116
CON (vs COM)	-0.43	0.55	0.65 (0.22–1.92)	-0.78	0.436
COD (vs COM)	-0.96	0.76	0.38 (0.09–1.71)	-1.26	0.208
COP (vs COM)	-0.20	0.79	0.82 (0.18–3.84)	-0.25	0.802
CHME (vs COM)	-0.22	0.69	0.80 (0.21–3.11)	-0.32	0.747
Clinical Y3-5 (vs Pre-clin)	-0.06	0.30	0.94 (0.53–1.68)	-0.21	0.836
Postgraduate (vs Pre-clin)	1.39	0.80	4.02 (0.85–19.13)	1.75	0.080
Self-directed training (Yes)	-0.15	0.36	0.86 (0.43–1.74)	-0.42	0.676
Formal education (Yes)	0.97	0.36	2.64 (1.30–5.36)	2.69	0.007

SE, standard error; aOR, adjusted odds ration; CI, confidence interval; CHS,COLLEGE OF Health Sciences; COM, College of Medicine; CON, College of Nursing; COD, College of Dentistry ; CHME, College of Management and AI in Healthcare Outcome prevalence = 65.7%. Model $\chi^2(9) = 16.22$, $p = 0.062$; Nagelkerke pseudo-$R^2 = 0.087$; n = 1000.
Multivariable Regression analysis - GMU Telemedicine Preparedness Study — n=1000 consenting respondents.
Reference categories: College = College of Medicine · Year group = pre-clinical (Y1–Y2) · Self-directed training= No · Formal education = No.
CHS allied = pooled CoHS sub-programmes (Anaesthesia Technology, Medical Imaging Sciences, Medical Laboratory Sciences, Physiotherapy) plus general CHS entries.
Formal education codes "Yes" and "Online training" both as 1.
Statistical significance at $p < 0.05$. Odds ratios are adjusted for all other predictors in the model. For the ordinal models, an OR > 1 means higher odds of being in a more favourable category (more familiar / more confident). For the binary model, an OR > 1 means higher odds of believing telemedicine will improve future clinical skills. Models were fitted by maximum likelihood (Fisher scoring for the binary model; numerical Newton–Raphson with proportional-odds constraint for the ordinal models). SEs are from the inverse observed information matrix.