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Medical Students' Intentions to Engage with Telemedicine Technologies and Strategies for Professional Development: A Qualitative Inquiry*

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Ethical Statement
This study was conducted in accordance with research ethics principles. Ethical approval was obtained from the Çanakkale Onsekiz Mart University Ethics Committee (Approval No: 2023-YÖNP-0573). Written informed consent was obtained from all participants prior to data collection.

Conflict of Interest
No conflict of interest is present in the conduct or the reporting of this study.

ABSTRACT

This study, conducted as the qualitative phase of an explanatory sequential mixed-methods design, explored medical students' perceptions of their intentions to engage with telemedicine technologies and the professional development strategies they adopt during the adaptation process. Semi-structured individual interviews were carried out with medical students selected through purposive sampling and categorized according to their willingness to receive telemedicine training (willing, undecided, unwilling). Data were analyzed using inductive content analysis. Findings indicated that perceptions toward telemedicine varied by students' prior knowledge and experience. Students with relatively higher knowledge and experience emphasized telemedicine's potential to enhance clinical efficiency, facilitate access to care, and support professional development, whereas those with more limited knowledge and experience highlighted insufficient training, infrastructural constraints, and legal/ethical uncertainties as key barriers. Across groups, telemedicine was predominantly positioned as a complementary tool rather than a substitute for face-to-face clinical practice. Overall, the results suggest that students' knowledge levels and exposure to structured educational experiences play an important role in strengthening their intentions to accept and use telemedicine, underscoring the value of practice-oriented telemedicine training that considers differing readiness levels within medical curricula.

Keywords: telemedicine, medical students, intention to engage, professional development strategies, medical education

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INTRODUCTION

The rapid development of digital health technologies has fundamentally transformed the delivery of healthcare services, rendering telemedicine an increasingly visible and central component of modern health systems. Etymologically referring to "healing at a distance," telemedicine is defined as the effective use of information and communication technologies to enable the provision of healthcare services across spatial distance and physical access constraints (Strehle & Shabde, 2006; Angood, 1998). This mode of practice has been emphasized as facilitating clinical communication and enhancing the accessibility of healthcare services (Barbosa et al., 2021; Celep et al., 2024). With the COVID-19 pandemic, a 230% increase in telemedicine use compared with the pre-pandemic period (Busso et al., 2022) has accelerated the more sustained integration of applications such as remote monitoring, teleconsultation, and digital clinical decision support systems into routine healthcare delivery (Dorsey & Topol, 2020). Collectively, these developments have made the need to strengthen healthcare professionals' digital competencies more explicit.

As telemedicine becomes more widespread, it not only brings significant changes to physicians' and healthcare workers' ways of working but also directly influences the scope and methods of medical education (Waseh & Dicker, 2019). By requiring new competencies in areas such as clinical assessment, physician–patient communication, data security, digital ethics, and remote clinical decision-making, telemedicine technologies have intensified the need for curricular content that places digital health literacy at the center of medical school training. In the international literature, studies aimed at identifying medical students' attitudes, perceptions, and learning needs regarding telemedicine use have been increasing, and this body of work indicates that students' levels of awareness and readiness meaningfully shape their professional development trajectories (Bulik & Shokar, 2010; Brockes et al., 2017; Frankl et al., 2021; Doshi et al., 2025; Kunwar et al., 2022; Bajra et al., 2023; Yaghobian et al., 2020; Borejsza-Wysocki et al., 2024; Murphy et al., 2023).

Although telemedicine practices in Türkiye have been promoted by the Ministry of Health through various initiatives, telemedicine-focused training programs within medical schools remain limited (Celep et al., 2024). Most research on medical students' digital health competencies has concentrated on perceived competence and awareness levels, whereas in-depth qualitative evidence on students' intentions to use telemedicine technologies and on how they structure their adaptation processes remains scarce. Moreover, heterogeneity in students' technology use suggests that telemedicine-related educational needs and learning strategies may vary, thereby increasing the need for personalized instructional designs.

This gap in the literature necessitates an in-depth examination of medical students' intentions, perceptions, and professional development strategies regarding telemedicine technologies. Accordingly, this study aims to elucidate medical students' perceptions of their intentions to use telemedicine technologies and the professional development strategies they adopt in the process of adapting to these technologies. By comparatively considering the perspectives of students with varying levels of knowledge and experience in telemedicine, the study aims to offer practical recommendations to inform the improvement of educational programs and policy development processes in the field of telemedicine. In doing so, it seeks to contribute an evidence-informed framework that can support the digital transformation of medical education. In line with this aim, the study addresses the following research questions:

1. How do medical students report their level of knowledge about telemedicine technologies and their willingness to gain further knowledge about telemedicine?

2.   What factors shape medical students' intentions to use telemedicine technologies?

3.   What knowledge, skills, and educational content do students report needing in the field of telemedicine?

METHOD

Research Design

This study employed an explanatory sequential mixed-methods design. The qualitative phase was conducted to provide an in-depth explanation of the quantitative findings and examined medical students' perceptions regarding (a) their intentions to use telemedicine technologies and (b) the professional development strategies they adopted during the process of adapting to these technologies. Participants for the qualitative phase were identified through purposive sampling and grouped according to their level of willingness to receive telemedicine training. Data were collected through semi-structured individual interviews based on a common core interview guide. During the interviews, probing questions tailored to the characteristics of each participant group were used to elicit context-specific and in-depth insights.

Study Group

The study group comprised medical students enrolled at different universities across Türkiye. The research consisted of quantitative and qualitative phases. In the quantitative phase, a total of 308 students participated, including 136 women (44.2%) and 172 men (55.8%) (Table 1). For the qualitative phase, participants were selected from among the students in the quantitative sample using purposive sampling, with students' willingness to receive telemedicine training taken into account. Only students who voluntarily agreed to participate were included in the qualitative interviews.

Table 1. Demographic characteristics of the study group

Year of study	Female, n (%)	Male, n (%)	Total, n (%)
Year 1	31 (49.2%)	32 (50.8%)	63 (20.5%)
Year 2	30 (43.5%)	39 (56.5%)	69 (22.4%)
Year 3	37 (54.4%)	31 (45.6%)	68 (22.1%)
Year 4	20 (33.9%)	39 (66.1%)	59 (19.2%)
Year 5	9 (37.5%)	15 (62.5%)	24 (7.8%)
Year 6	9 (36.0%)	16 (64.0%)	25 (8.1%)
Total	136 (44.2%)	172 (55.8%)	308 (100%)

Before qualitative data collection began, students who would participate in the interviews received a standardized briefing on the concept of telemedicine, its application areas, and basic modes of use. The briefing was provided both in written and oral form to ensure that participants shared a common conceptual frame regarding the topic. Following this briefing, qualitative interviews were conducted.

Face-to-face semi-structured individual interviews were conducted with a total of 25 students, including 9 willing, 8 undecided, and 8 unwilling to receive telemedicine training. Interviews were held in quiet and interview-appropriate settings arranged according to participants' availability, and each interview lasted approximately 20–30 minutes. Prior to each interview, participants were informed about the study's purpose and scope, and informed consent was obtained. With participants' permission, interviews were audio-recorded.

Based on their attitudes toward receiving telemedicine training, participants were classified into three orientation groups: willing, undecided, and unwilling. Interviews were conducted in line with this classification to ensure participant variation capable of capturing differing attitudes and perspectives related to the research problem. Data were analyzed

concurrently with data collection. After approximately the 22nd interview, no new themes or codes were observed, and data saturation was considered to have been reached. Nevertheless, interviews continued until 25 participants were included to maintain balance across groups and enhance the depth of the findings.

After the interviews were completed, audio recordings were transcribed verbatim by the researcher. Following transcription, interview texts were reviewed for accuracy and prepared for analysis.

Data Collection and Analysis

Quantitative data were analyzed by examining responses to the direct questions using descriptive statistics. Specifically, frequency (f) and percentage (%) distributions were calculated for the relevant items to summarize the findings. Qualitative data were analyzed using an inductive content analysis approach. Content analysis is defined as a process of reducing and structuring comprehensive datasets in a meaningful manner while preserving their overall integrity (Patton, 2018). In this study, the analysis was conducted in five stages in line with approaches recommended in the literature.

The analysis began with repeated readings of the interview transcripts by the research team to develop a holistic understanding of the data. In the second stage, meaningful statements that directly addressed the research questions were identified, whereas statements that were only marginally relevant, decontextualized, or lacking coherence were excluded. In the third stage, brief conceptual codes were generated to represent the meaning of the identified statements. In the fourth stage, codes were grouped into categories based on their similarities and relationships. In the final stage, categories were integrated under broader themes, and the themes were interpreted to complete the analysis (Çelik et al., 2020). To enhance the traceability of the coding process, an illustrative code–category–theme chain reflecting the analytic workflow is presented in Table 2.

Table 2. An illustrative code–category–theme chain from the analytic process

Theme	Subtheme	Code	Exemplar quotation
Perceptions of Telemedicine Technologies	Definition and comprehensibility of telemedicine technology	Level of knowledge about its function in clinical practice	"It is the general term for remote diagnosis, treatment, and consultation services." (K1)
Intention to Engage with Telemedicine Technologies	Factors hindering use	Legal and ethical uncertainties	"In remote consultations, clinical responsibility is not clear; this reduces my confidence." (K4)
Professional Development and Educational Needs	Curriculum and educational expectations	Inclusion of telemedicine training in medical school	"Telemedicine is now part of medicine, but we never see it in practice at school; it should be added to the curriculum." (K8)
Telemedicine and Views on the Future of Medicine	Impact of telemedicine on healthcare services	Accessibility	"Telemedicine is indispensable for delivering services concentrated in city centers to every corner of the country." (E2)
Telemedicine and Views on the Future of Medicine	The position of telemedicine in the future	Trends in digitalization in medicine	"Healthcare is becoming digital; I want to be part of this transformation." (E4)

Note. *Participant labels (e.g., K1, E2) are retained as used in the dataset.*

Trustworthiness and Rigor

Qualitative coding was conducted independently by two researchers to strengthen the reliability of the analysis. Each researcher reviewed the interview transcripts separately and generated open codes. Following independent coding, the researchers met to compare the resulting codes, and consensus was reached through discussion of similarities and differences. In cases of disagreement, the relevant data segments were re-examined and a shared coding structure was

developed through consensus. The agreed-upon codes then served as the basis for constructing categories and themes. In addition, the codes, categories, and themes were reviewed by four subject-matter experts, and the analytic structure was revisited and refined in line with their feedback. To support the transferability of the findings, the research process, sample characteristics, and analytic steps were reported in a clear, detailed, and transparent manner. To assess consistency, the coding and theme-development process was repeated by the same researchers one month later, and the resulting codes, categories, and themes were compared to examine the continuity of the analytic outcomes.

To support the trustworthiness and methodological rigor of the qualitative findings, Lincoln and Guba's (1985) criteria for qualitative validation were adopted. Accordingly, data were examined in a detailed and iterative manner to enhance credibility, and the data collection and analysis procedures were documented transparently to strengthen the traceability of the analytic process. Moreover, a code–recode approach was implemented by re-analyzing the data at a one-month interval, and the resulting outputs were compared to evaluate the consistency of the findings.

Ethical Approval

Participation was voluntary. Accordingly, participants were provided with written information through an informed consent form, and written informed consent was obtained prior to participation. Ethical approval was granted by the Scientific Research Ethics Committee of Çanakkale Onsekiz Mart University (Approval no.: E-84026528-050.01.04-2300181720; Protocol: 2023-YÖNP-0573), confirming that the study complied with the relevant ethical principles. The data were collected as part of the preparatory phase of a thesis study conducted under this ethical approval.

RESULTS

Findings on Medical Students' Technology Use

At the outset, medical students were asked questions aimed at capturing their perceived self-efficacy in using technology and their views regarding the influence of technological developments on their educational and career goals. The distribution of participants' responses is presented in Table 3.

Table 3. Medical Students' Responses Regarding Technology Use

Item	Yes	Partly	No
Do you feel competent in using technology?	202 (65.6%)	106 (34.4%)	0 (0.0%)
Do technological developments influence your educational and career goals?	233 (75.6%)	74 (24.0%)	1 (0.3%)

With regard to perceived self-efficacy in technology use, 65.6% of participants reported feeling competent and 34.4% reported feeling partly competent, while none indicated feeling not competent. When asked about the influence of technological developments on their educational and career goals, 75.6% reported that such developments were influential, 24.0% indicated partial influence, and only 0.3% considered them not influential. Overall, these findings suggest that participants reported relatively high perceived self-efficacy in using technology and tended to relate technological developments to the shaping of their educational and professional goals.

Findings on Medical Students' Telemedicine Use

In this section, medical students were asked questions regarding their level of knowledge about telemedicine, whether they had received any telemedicine-related training, and their willingness to gain further knowledge about

telemedicine. The distribution of participants' responses is presented in Table 4. The findings indicate that a substantial proportion of students reported limited knowledge of telemedicine and that the majority had not received any training in this area. Regarding knowledge level, 10.1% of participants reported having a good level of knowledge, 66.9% reported partial knowledge, and 23.0% reported having no knowledge of telemedicine. This pattern suggests that, despite the increasing visibility of telemedicine within healthcare systems, students may have limited exposure to telemedicine throughout their training.

Table 4. Medical Students' Responses Regarding Telemedicine Use

Item		Yes	Partly	No
Do you have knowledge about telemedicine?		31 (10.1%)	206 (66.9%)	71 (23.0%)
Have you received any training on telemedicine?		44 (14.3%)	0 (0.0%)	264 (85.7%)
Sources of telemedicine-related learning among those who reported receiving training (n=44)*	During medical school training	16 (36.4%)		
	Written resources	18 (40.9%)		
	Television, radio, and the internet	10 (22.7%)		
	Social media	4 (9.1%)		
	Peers	13 (29.5%)		
	Seminars, conferences, symposiums	12 (27.3%)		
Would you like to gain knowledge about telemedicine?		108 (35.1%)	188 (61.0%)	12 (3.9%)

Note. Multiple responses were allowed; percentages are calculated among participants who reported receiving training (n=44).

With respect to training, 85.7% of students reported not having received any formal or informal education in telemedicine. Among those who reported having received training (n=44), the most frequently reported sources were written resources (40.9%) and medical school training (36.4%). These were followed by peers (29.5%) and seminars/conferences/symposia (27.3%), whereas television/radio/internet (22.7%) and social media (9.1%) were reported less frequently. Overall, this distribution suggests that telemedicine-related learning experiences tend to be dispersed across multiple channels rather than being systematically embedded within the formal medical curriculum.

Finally, regarding willingness to gain knowledge about telemedicine, 35.1% responded "yes," 61.0% "partly," and 3.9% "no." This finding suggests that a substantial proportion of students report an interest in telemedicine and openness to acquiring further knowledge and practical experience in this area.

Qualitative Findings

In the qualitative phase, the labels willing, undecided, and unwilling refer to participants' willingness to receive telemedicine training; these labels are used throughout the qualitative findings. Following inductive content analysis of the qualitative data, 12 categories and 4 themes were identified. The themes were labeled "Perceptions of telemedicine technologies," "Intention to engage with telemedicine technologies," "Professional development and educational needs," and "Telemedicine and views on the future of medicine." Each theme, operationalized through the associated categories and codes, captures the salient patterns and points of divergence reflected in participants' accounts. Taken together, this thematic structure provides a coherent framework for understanding students' perceptions of telemedicine, their motivations for use, their learning needs, and their forward-looking appraisals. The themes and categories identified in the study are presented in Table 5.

Table 5. Themes and categories identified in the qualitative analysis

Theme	Subtheme	Codes
Perceptions of Telemedicine Technologies	Definition and comprehensibility of telemedicine technology	How students conceptualize telemedicine; Level of knowledge about its function in clinical practice; Familiarity with the technologies used
	Perceived benefits	Increasing patient access; Facilitating clinical processes; Contribution to education (e.g., observing remote consultations)
	Trust in telemedicine technology	Diagnostic accuracy; Data privacy and security; Perceived clinical responsibility
Intention to Engage with Telemedicine Technologies	Motivations and intentions for telemedicine use	Intentions to use telemedicine in professional practice; Personal attitudes toward technology; Expectation of alignment with digital medicine; Environmental support
	Factors hindering use	Technical infrastructure problems; Legal/ethical uncertainties; Lack of training; Concerns about increased workload
	Inclination to use in the future	Intention to use during clinical placements/after graduation; Motivation to adopt telemedicine within one's specialty
Professional Development and Educational Needs	Digital health literacy	Working with clinical decision support systems; Remote consultation skills; Need for basic technical knowledge
	Curriculum and educational expectations	Inclusion of telemedicine training in medical school; Need for simulation-, scenario-, and practice-based training; Training in remote-care ethics and communication
	Personal professional development strategies	Intention to pursue courses/certifications; Desire to specialize in digital health; Behaviors related to keeping up with technological developments
	Development of professional skills	Remote communication with patients; Ethical and professionalism dimension; Methods for remote physical examination
Telemedicine and Views on the Future of Medicine	Impact of telemedicine on healthcare services	Accessibility; Opportunities in terms of equity and justice; Role in rural areas
	The position of telemedicine in the future	Wider adoption of remote monitoring systems; Trends in digitalization in medicine

Medical students' ways of defining telemedicine technologies and their level of knowledge about the concept appeared to vary markedly. Some students framed telemedicine within a relatively basic scope. For example, a student in the willing group stated, "I don't really know exactly which technologies telemedicine includes, but I thought of it as remote examination or consultation" (K11), which suggests that telemedicine was predominantly construed as a system enabling remote examination. In contrast, other students adopted a broader perspective and positioned electronic health records, digital imaging-sharing systems, online consultation platforms, and clinical decision support systems as components of the telemedicine ecosystem. Taken together, these accounts indicate that a shared and standardized definition of telemedicine has not been consolidated among students, and that their knowledge regarding application domains and operational mechanisms in clinical practice may vary.

In addition, most students reported having heard of telemedicine technologies in theoretical terms. However, as stated by a student in the undecided group, "Telemedicine exists, but we haven't really seen how it works, and I don't know which platforms are used" (K9), participants emphasized limited familiarity with the specific systems used in practice. A student in the willing group noted, "During the pandemic, I participated in some case discussions via teleconferences, so I realized that telemedicine could be used both in education and in the clinic" (E2), indicating that experiences during the COVID-19 period may have contributed to greater awareness. By contrast, other participants highlighted that the absence of direct telemedicine applications within the medical curriculum makes it more difficult to concretize and internalize the concept. In this respect, students' definitions of telemedicine appeared to rely largely on limited personal experience and indirectly acquired information.

The analysis indicates that medical students hold a perception that telemedicine technologies can contribute to healthcare delivery in multidimensional ways. Participants articulated these contributions along three main axes, namely increased patient access, clinical efficiency, and educational benefits. A considerable proportion of students emphasized

that telemedicine can enhance access to healthcare by reducing geographic and physical barriers. For instance, a student in the willing group stated, "Providing rapid access for patients living in rural areas is one of the biggest advantages of telemedicine, I think. It also means that, as a physician, I can reach a wider audience with my expertise" (K1), thereby concretizing this contribution. Similarly, another willing student noted that telemedicine "makes it easier for many patients to reach a physician and also creates opportunities for us as students to see cases from different geographies" (K8), drawing attention to both the access and educational dimensions.

Participants also reported that rapid consultation opportunities enabled through telemedicine platforms, particularly in urgent situations requiring specialist input or within second-opinion processes, can accelerate diagnostic and treatment pathways. In this regard, students noted that telemedicine can support clinical decision-making, reduce travel time and costs, and contribute to overall service efficiency. A participant in the undecided group underscored the collaborative dimension by stating, "In a teleconsultation I attended before, I witnessed two specialists in different cities exchanging views in real time about a diagnosis. This showed how important collaboration is in medical practice and how technology can enable it" (E11).

In addition, some students highlighted that telemedicine technologies may be valuable not only for clinical service delivery but also for their professional development. Within this framing, telemedicine was positioned not merely as a method of service provision, but also as a dynamic learning environment that can support continuing medical education. One participant stated, "Telemedicine saves time not only for the patient, but also for the physician-in-training. I think virtual outpatient practices could be an effective method to balance workload after graduation" (E5), explicitly articulating this educational contribution.

Students' trust in telemedicine technologies appeared to vary. The analysis suggests that some students believed telemedicine applications can support diagnostic accuracy, contribute to clinical decision processes, and strengthen inter-specialty communication. For example, a student in the undecided group stated, "Telemedicine systems can be useful when used correctly, but if incorrect data are entered, they can produce erroneous results. I have reservations about that" (K2), indicating that concerns regarding data accuracy shape perceptions of trust. By contrast, some participants adopted a more cautious stance, noting that remote assessment may increase the risk of error and lead to incomplete or inaccurate information during the diagnostic process. An unwilling participant captured this concern by stating, "If a problem arises in diagnosis, I am not sure who would be responsible, so I am somewhat cautious" (E3).

Data security and patient privacy emerged as important factors shaping students' perceptions of trust. An unwilling participant stated, "Data security is very important; if patients' information leaks, serious problems may occur. That is why the reliability of the system is highly decisive" (E1), explicitly voicing concerns about protecting personal health information on digital platforms. Uncertainty regarding the distribution of clinical responsibility and the lack of clarity around legal obligations in telemedicine practices were also described as undermining trust. For example, an unwilling student noted, "In remote consultations, clinical responsibility is not clear, and it is not evident who will make the decision; this reduces my confidence" (K4), highlighting how such ambiguity weakens trust. At the same time, some participants acknowledged telemedicine's potential benefits while emphasizing that sustained trust depends on robust technical infrastructure and security standards. A willing participant captured this point by stating, "Telemedicine is potentially very useful, but it is hard to fully trust it without the right infrastructure and security" (E2).

Despite individual motivation and generally positive perceptions, participants emphasized that translating intention

into actual practice depends on institutional and environmental conditions. Students noted that the adequacy of technical infrastructure in the healthcare organizations where they would work, the extent to which senior leadership supports telemedicine practices, and the presence of a supportive digital culture within the institution are critical for implementing their intentions. A participant in the undecided group stated, "I am inclined toward technology and digital solutions, and I would like to use telemedicine in my professional life; however, I think this intention depends on whether the institution I will work for has the appropriate infrastructure and vision" (K5), making the role of institutional conditions explicit. A willing participant, emphasizing the professional potential of telemedicine, stated, "Healthcare is becoming digital, and I want to be part of this transformation; especially if I specialize in a field where chronic patient follow-up is intensive, telemedicine will be indispensable for me" (E4), illustrating the interplay between individual willingness and professional context. These accounts indicate that for individual intention to develop into sustained practice, an appropriate institutional infrastructure and a supportive organizational climate are necessary.

The data further suggest that students perceive multiple barriers to telemedicine use. Participants described these barriers in clusters that can be grouped into technical, regulatory, educational, and practical dimensions. On the technical side, infrastructural insufficiencies, low and unstable internet connectivity, and limited user-friendliness of platforms were foregrounded. Such technical disruptions were perceived as potentially rendering telemedicine processes inefficient and leading to time loss. An unwilling student expressed this concern as follows: "When infrastructure is insufficient, I think telemedicine can turn into even more of a waste of time" (E9), drawing attention to the practical consequences of technical problems.

From a regulatory perspective, the lack of a sufficiently clear legal and ethical framework for telemedicine practices appeared to exert a discouraging effect on students. Uncertainties regarding the boundaries of clinical responsibility, the protection of patient privacy, and how professional ethical principles should be adapted to remote consultation contexts make it more difficult for students to develop trust in these technologies. From an educational perspective, limited curricular coverage of telemedicine and the insufficiency of practice-oriented training that would build applied skills lead students to feel unprepared in this area, thereby weakening their willingness to use telemedicine. Finally, as a practical barrier, some students expressed concern that telemedicine applications might increase workload compared with conventional approaches. Scheduling online consultations, allocating additional time to resolve technical issues, and managing digital patient records were described as factors that may impose added time costs on clinical workflows.

Overall, medical students tended to view telemedicine as likely to assume a more central role within the future healthcare ecosystem. This perspective emerged as a factor shaping participants' professional development strategies and their considerations regarding specialty preferences. Students reported that encountering telemedicine applications in a more systematic and practice-oriented manner during later phases of undergraduate training, particularly during clinical placements, could strengthen their perceived competence and intentions to use telemedicine.

At the same time, students' appraisals of telemedicine's future position appeared to vary by the specialties they envisaged. Specialties such as psychiatry, dermatology, internal medicine, and family medicine were perceived as offering more favorable ground for telemedicine applications, particularly in contexts where visual data are salient or chronic disease follow-up is prominent. This perception led some students to treat alignment with digital health applications as a criterion when considering specialty choice. As one willing participant stated, "Telemedicine is used a lot in dermatology, and if I pursue that field in the future, I will definitely use it" (K3). Similarly, another student in the undecided group noted,

"Telemedicine will be indispensable for remote follow-up of chronic patients, so I am considering internal medicine" (E6), indicating that the perceived potential of telemedicine functioned as an attractive factor in career planning. Taken together, these accounts suggest that digital health technologies may play an increasingly influential role in shaping physician candidates' professional identities and career orientations.

The analyses indicate that medical students consider specific digital knowledge and skills necessary for the effective use of telemedicine technologies. Participants emphasized that digital health literacy is not limited to basic technology use; rather, it also encompasses more advanced competencies such as interpreting outputs from clinical decision support systems, managing remote consultation processes within an ethical and professional framework, and being proficient in the functionality of the digital platforms in use. Limited educational exposure to this comprehensive skill set was described by many students as a factor that fosters feelings of inadequacy and mistrust toward these technologies. An unwilling participant stated, "I don't really know how teleconsultation is conducted or how to interpret the data; we need to learn these in order to use it" (K10), explicitly articulating this need. Similarly, a student in the undecided group noted, "Without learning how to evaluate the outputs produced by clinical decision support systems, which alerts we should consider, and in which situations it is appropriate to re-examine those outputs through our own clinical reasoning, it is quite difficult to trust these systems" (K2). This account suggests that digital literacy needs to be integrated with critical clinical reasoning rather than remaining at the level of passive tool use. Overall, these findings indicate that students closely link intentions to use telemedicine with perceived levels of knowledge and skill.

Most medical students considered the integration of telemedicine training into the undergraduate curriculum necessary. Participants stressed that such training should not remain purely theoretical; instead, it should be designed as a comprehensive structure that includes simulations, case scenarios, hands-on sessions, and components such as the ethics and communication dimensions of remote care. A small number of participants, however, were more cautious about adding a standalone telemedicine course, citing concerns about increasing an already intensive curriculum or emphasizing that priority should remain with conventional medical training. At the same time, a substantial proportion of students expressed concern that having no pre-graduation experience with telemedicine technologies may create a meaningful gap and adaptation difficulties when entering professional practice. This concern appears to reinforce the perception that telemedicine applications are insufficiently represented within medical education. Accordingly, students emphasized the need to review the curriculum to better align with digital transformation and to strengthen professional competence. An unwilling participant stated, "Telemedicine is now part of medicine, but we never see it in practice at school; it must definitely be added to the curriculum" (K8). Another unwilling student offered an alternative integration approach by stating, "Instead of adding yet another course to our already intensive program, it might be more efficient to weave these topics into the core courses" (E3).

Participants reported intentions to engage in certificate programs related to telemedicine and digital health, to follow technological developments systematically, and to specialize in this field. An unwilling student stated, "I follow certificate programs to improve myself in digital health; the future of this field looks promising" (K4), explicitly indicating a willingness to invest in professional development. Similarly, a willing participant noted, "I believe that gaining digital health skills alongside classical medical training will put us one step ahead" (K6), reflecting the perception that digital health literacy can enhance professional competitiveness. These accounts suggest that students hold a strong motivation to develop in digital health and that this motivation is closely linked to expectations of expanding future career opportunities.

Medical students also recognized that the effectiveness of telemedicine practices is not limited to technical competence, but is closely related to developing professional skills specific to remote care contexts. Participants emphasized that understanding the nuances of remote patient communication, acting in accordance with ethical principles in digital environments, and learning methods and protocols related to remote physical examination should be considered essential components of professional preparation. A student in the undecided group stated, "Although talking remotely may resemble face-to-face interaction, it can be harder to establish trust with certain patients; I think we need specific training for this" (K5), highlighting communication challenges in telemedicine contexts. Similarly, an unwilling participant noted, "Not being able to fully read the patient's body language in telemedicine is a major limitation; we should learn how to address this gap" (K13), drawing attention to constraints in nonverbal communication. Another unwilling student emphasized heightened ethical responsibilities by stating, "In online consultations, we need to be more sensitive about patient privacy and data security; this requires a very different kind of responsibility compared with face-to-face consultations" (E8). Overall, these findings indicate that strengthening professional skills is viewed by students as a critical requirement for telemedicine practice.

Students considered telemedicine technologies to have a transformative potential in healthcare delivery. In particular, they positioned telemedicine as valuable for public health due to its potential to increase access to care by overcoming geographic and socioeconomic barriers. Across differing levels of willingness, students emphasized the contributions telemedicine may offer in terms of access and equity. One student stated, "People living in rural areas face serious difficulties in reaching specialist physicians; in that sense, telemedicine can be an important tool for democratizing healthcare services" (E10), pointing to access barriers. Another student highlighted telemedicine's relevance to the right to health by stating, "Telemedicine offers an indispensable solution for delivering healthcare services concentrated in city centers to every corner of the country; this is a matter of a fundamental right to health" (E2). In addition, the contribution to access among socioeconomically disadvantaged individuals was articulated as follows: "For patients with low socioeconomic status, being able to receive specialist opinions without travel and accommodation costs truly contributes to achieving justice in healthcare" (K12). Taken together, these accounts indicate that students do not view telemedicine merely as a technical innovation, but also as a social tool that can strengthen equity and accessibility in healthcare.

Students further anticipated that telemedicine will hold a more widespread and influential position within the healthcare system in the future. Developments in remote monitoring systems and the strengthening of broader digitalization trends were described as key factors likely to increase telemedicine use. Participants also suggested that physicians who adapt to digital transformation within healthcare systems may be positioned more advantageously in the future. A student in the undecided group stated, "Healthcare is moving toward digitalization, and it seems that telemedicine will be used much more in the future" (K7), drawing attention to this trajectory.

DISCUSSION

This study examined medical students' awareness, perceptions, and acceptance tendencies regarding telemedicine technologies. The findings suggest that telemedicine is generally perceived positively; however, knowledge gaps, reservations about technological competencies, and uncertainties related to practical implementation may constrain the acceptance process.

Overall, the findings point to a broadly favorable appraisal of telemedicine's potential. In the qualitative accounts, participants particularly emphasized advantages related to time- and location-independent service delivery, enhanced

accessibility, and contributions to healthcare provision. In the quantitative phase, 96.1% of students reported that they would like to gain knowledge about telemedicine either "yes" (35.1%) or "partly" (61.0%), indicating openness to further engagement with telemedicine. This pattern is consistent with prior research. For example, a study involving healthcare professionals and medical students reported that telemedicine offers substantial benefits in terms of access, efficiency, and cost (Wernhart et al., 2019). The present findings similarly suggest that medical students in Türkiye recognize the functional value of telemedicine.

At the same time, marked variation in students' levels of knowledge about telemedicine implies that telemedicine-related content and practice opportunities may remain limited within undergraduate training. The qualitative findings showed that while some students articulated telemedicine within a broader framework, a substantial proportion described the concept in a limited or superficial manner. Moreover, some students tended to equate telemedicine primarily with video consultations or remote follow-up, indicating that gaps in understanding the scope of telemedicine persist. This pattern can be interpreted as supporting the need to strengthen the systematic integration of telemedicine applications within medical school curricula.

The quantitative findings also showed that most students expressed confidence in their general technology competence. Nevertheless, qualitative accounts indicated that some students anticipate difficulties with telemedicine practices that involve more advanced digital platforms and clinical decision support systems. This aligns with frameworks emphasizing that perceived ease of use and perceived competence are influential determinants of technology acceptance (Davis, 1989). Accordingly, effective telemedicine use appears to require not only clinical knowledge but also practice-oriented training that strengthens digital health literacy.

Another salient finding concerns students' concerns related to security and privacy in telemedicine. Such concerns may function as potential points of resistance to technology acceptance. The literature similarly emphasizes that robust security protocols are critical for the sustainability of telemedicine systems (Kichloo et al., 2020). In this context, it is important to enhance students' awareness of security issues and to support their opportunities to gain practical experience with telemedicine systems in which safety and confidentiality are ensured.

Finally, the findings indicate that students tend to position telemedicine not as a substitute for face-to-face examination but as a complementary tool that supports healthcare delivery. This view parallels broader trends in the literature, where telemedicine is often conceptualized as a complementary mechanism, particularly for chronic disease management, follow-up appointments, and contexts in which access is limited (Wernhart et al., 2019; Kichloo et al., 2020).

These findings underscore the need to integrate telemedicine more systematically into undergraduate medical curricula. Training should go beyond didactic content and incorporate simulation- and scenario-based practice, with explicit attention to data security, the distribution of clinical responsibility, and the ethics of remote communication. At the policy and institutional levels, clarifying legal and ethical standards for telemedicine and strengthening collaborations between educational institutions and healthcare providers to establish secure infrastructure and supervised practice environments may support the translation of students' acceptance into sustained use.

Limitations

The findings of this study should be interpreted in light of several limitations. First, although the quantitative sample included participants from multiple universities across Türkiye, the sampling approach and voluntary participation do not

preclude the possibility of selection bias. Second, the qualitative phase drew on purposively selected data from 25 participants, which provides in-depth insight but does not warrant claims of generalizability to all medical students. Third, because the measures relied on self-report, social desirability effects and recall bias are possible. Finally, given the rapidly evolving regulatory and technological landscape of telemedicine, the findings should be interpreted within their temporal context and strengthened through replications across different settings.

CONCLUSION AND RECOMMENDATIONS

This study indicates that medical students' knowledge of telemedicine technologies is generally limited and heterogeneous, whereas their awareness of telemedicine's potential contributions to healthcare delivery remains high. Students regarded telemedicine's capacity to improve patient access and support clinical processes as particularly important; however, they reported difficulties in developing full trust due to uncertainties related to data security, patient privacy, and the distribution of clinical responsibility. At the same time, participants appeared to have relatively high motivation to engage with telemedicine and a clear desire to acquire further knowledge in this area. In light of these findings, it is important to integrate telemedicine more systematically into undergraduate medical curricula, expand practice-based learning opportunities that develop teleconsultation, remote communication, and digital clinical workflow competencies, and strengthen training content that explicitly addresses security, privacy, and ethical responsibilities. In addition, enhancing universities' digital health infrastructure and providing supervised opportunities for research and hands-on practice within secure environments may facilitate effective telemedicine use. Overall, strengthening medical students' digital health literacy and telemedicine-related competencies is critical for preparing future physicians to adapt to ongoing digital transformation.

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