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Telemedicine and medical curriculum: systematic literature review

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ABSTRACT

OBJECTIVE

To analyze how telemedicine is being incorporated into the medical curriculum and its impact on the training of medical students and future medical practice.

METHOD

We conducted a systematic literature review following a defined research protocol. The steps included establishing the research protocol, identifying theses, dissertations, and articles on telemedicine and medical curriculum through databases such as Digital Thesis and Dissertation Bases, Capes, Virtual Health Library, Education Resources Information Center, and PubMed. Keywords used were “telemedicine” OR “telehealth” AND “medical student” OR “undergraduate medical education” OR “medical school". Inclusion criteria were publications from January 2013 to May 2024 in English, Spanish, or Portuguese; while exclusion criteria involved articles without an abstract or those outside the scope of telemedicine and medical education.

RESULTS AND DISCUSSION

The search revealed various areas of interest, such as the use of telemedicine during the pandemic, student experiences with this care modality, technology-supported learning, and the incorporation of telehealth into the medical curriculum. A significant impact of telemedicine on medical training was observed, especially during and after the COVID-19 pandemic.

CONCLUSION

The study concludes that telemedicine plays a crucial role in contemporary medical education, bringing benefits such as enhancement of students' clinical skills and increased confidence in using health technologies. The pandemic was a driving factor for the acceptance of telemedicine, indicating its increasingly central and indispensable role in the future of medical education.

KEYWORDS

Telemedicine, Health education, Information technologies, Profissionalism.

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INTRODUCTION

Telemedicine and mobile technologies are playing key roles in the healthcare revolution, offering new perspectives and challenges for medicine and medical education. Combining medicine and technology, telemedicine has demonstrated its relevance in offering a wide range of services to the community, becoming particularly crucial during the pandemic.[1]

In this constantly evolving scenario, mobile technologies are also playing a transformative role. Concepts such as telemedicine, telehealth, eHealth and mobile health are gaining prominence, promising to improve the quality of healthcare. However, as these innovations gain ground, critical questions arise regarding efficacy, safety, regulation and ethics, which can negatively impact the doctor-patient relationship.[1] Marengo[2] and Azevedo[3], two researchers in this area, point out that, despite showing promising results, the evaluation of these technologies does not yet follow the methodological rigor of clinical drug trials. Crucial issues such as data protection, privacy and technological and social inequalities need to be carefully addressed.

Telemedicine, defined as the use of electronic means of communication to transmit medical information, continues to evolve, with successful implementations both in Brazil and around the world. Khouri[4] and Silva[5], researchers in this field, emphasize the definition given by the World Health Organization (WHO), which highlights its potential to extend health services from specialized centers to regions lacking medical care. However, the expansion of telemedicine faces regulatory and ethical challenges that need to be overcome if this revolution in healthcare is to reach its full potential.

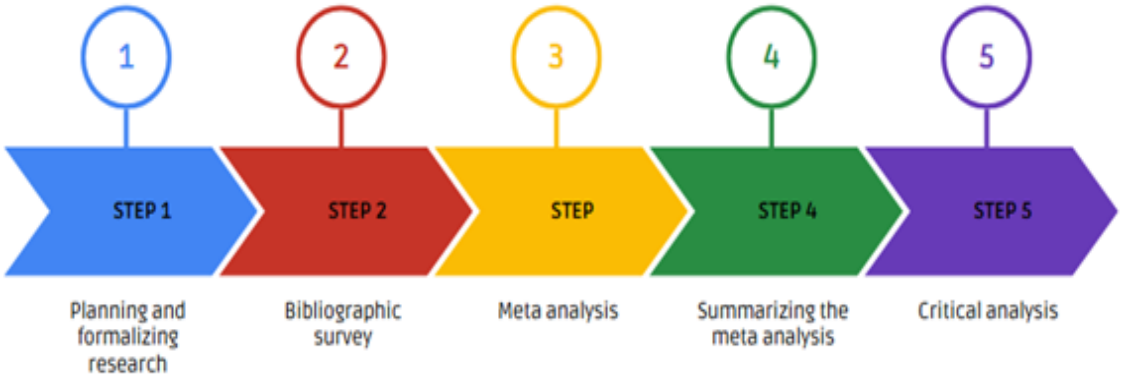
This complex and dynamic scenario involving telemedicine, mobile technologies and telemedicine opens up new possibilities and issues for medicine and medical education.

This systematic literature review aims to analyze the integration of Telemedicine into the medical curriculum, with an emphasis on identifying how it is incorporated into the educational and training process of medical students.

METHODS

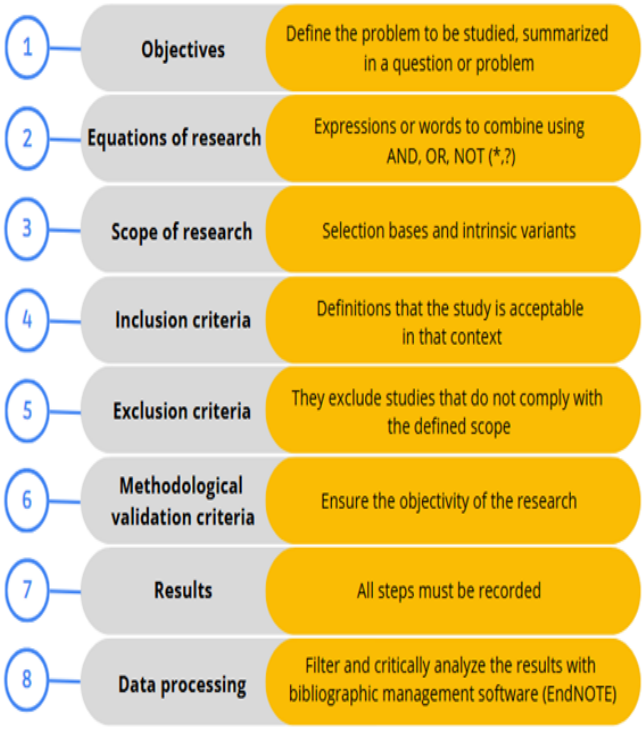
The Systematic Literature Review (SLR) follows the guidelines for a reference base compatible with the topic to be studied[6,7] in which an investigation protocol was produced defining the objectives and inclusion and exclusion criteria. Figures 1 and 2 show the protocol that was followed.

Figure 1 - Stages of the Systematic Literature Review



Source: Adapted from Almeida *et al.*[7]

Figure 2 - Stages of the Systematic Literature Review



Source: Adapted from Ramos[8]

The systematic review follows the criteria set out in tables 1 and 2. Stage 1 was to define the search protocol (Table 1).

Table 1 - Study protocol

Stages of a protocol	Description of the steps
Objectives	To identify theses, dissertations and articles dealing with telemedicine and the curriculum.
Database	Digital databases of theses and dissertations BDTD, Capes, Virtual Health Library (BVS), Education Resources Information Center (ERIC), Pubmed.
Search words	Telemedicine OR telehealth AND medical student OR undergraduate medical education OR medical school
Inclusion criteria	Publications produced between January 2013 and May 2024 in the form of theses, dissertations or scientific articles, presented in Spanish, English or Portuguese.
Exclusion criteria	Articles without abstracts, published in other sources outside the scope of telemedicine and the medical curriculum. Papers whose text is not fully accessible and which are not in English, Spanish or Portuguese.
Methodological validation criteria	References that meet the inclusion criteria and that have passed the methodological sieve and contribute to the work. Duplicates excluded.
Results	Description of the research, record of the steps. All references on the subject of telemedicine and curriculum.
Data processing	Analyze the references and use those related to telemedicine and the curriculum.

Source: Elaborated by the authors

Stage 2 involved searching the databases (Table 2).

Table 2 - Database search strategies

Boolean operator	BDTD	CAPES	Embase	ERIC	Lilacs	PubMed
telemedicine OR *telehealth* AND *medical student* OR *undergraduate medical education* OR *medical school*	04	1.781.546	2.210.136	03	257	545.854
telemedicine AND *medical school*	04	68.099	12.466	03	257	4.582
telemedicine AND *medical student*	03	67.928	1.242	03	339	393
telemedicine AND *undergraduate medical education*	03	67.204	156	00	95	71
telemedicine AND *undergraduate medical education* AND *curriculum*	00	71	63	00	65	71

Source: Elaborated by the authors

A total of 270 articles were found and after reading the articles[8,9,10] only 26 articles met the study criteria (Table 3). Microsoft Excel® and Zotero software were used to tabulate the articles.

Table 3 - Summary of studies

Author	Title	Country	Year	Theme	Journal
Ahmed et al.[11]	Blended learning using augmented reality glasses during the COVID-19 pandemic: the present and the future	Canada	2021	Telemedicine during the pandemic	Can J Surg
Almino et al.[17]	Telemedicina: um Instrumento de Educação e Promoção da Saúde Pediátrica	Brazil	2013	Integração da Telessaúde no Currículo da Educação Médica	REVISTA BRASILEIRA DE EDUCAÇÃO MÉDICA
Arantes[30]	Análise de atividades de telemedicina e telessaúde desenvolvidas em instituição pública de saúde e desenvolvimento de relatório de atividades para ações futuras	Brazil	2019	Integração da Telessaúde no Currículo da Educação Médica	BDTD
Barzegar et al.[28]	Advantages and Challenges of Virtual Outpatient Education: A Review Article	Iran	2022	Technology mediated learning	Acta Medica Iranica
Booth et al.[24]	Teaching undergraduate medical students virtual consultation skills: a mixed-methods interventional before-and-after study	United Kingdom	2021	Technology mediated learning	BMJ Open 2022
Budakoğlu et al.[32]	Telemedicine curriculum in undergraduate medical education: a systematic search and review	Turkey	2021	Integrating Telehealth into the Medical Education Curriculum	Health Technol
Cain et al.[10]	Telemedicine implementation in family medicine: Undergraduate clerkship during COVID-19 pandemic	United States	2020	Telemedicine during the pandemic	ASME-Medical education
Cantone et al.[25]	Insomnia Telemedicine OSCE (TeleOSCE): A Simulated Standardized Patient Video-Visit Case for Clerkship Students	United States	2019	Technology mediated learning	The AAMC Journal of Teaching and Learning Resources

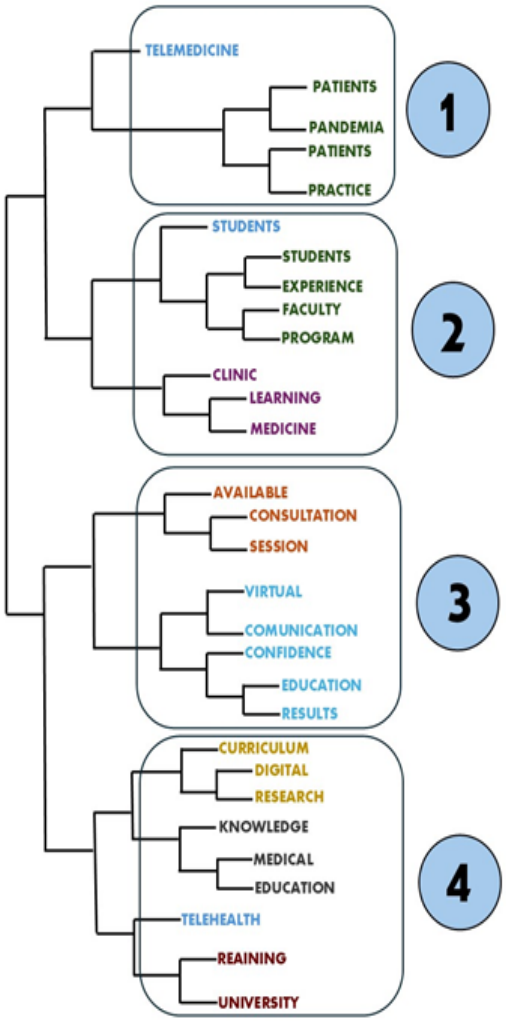
Cooney et al.[33]	Our New Reality: A Needs Assessment for Telemedicine Goals of Care Training in Undergraduate Medical Education (QI418)	United States	2022	Integrating Telehealth into the Medical Education Curriculum	Journal of Pain and Symptom Management
Cubo et al.[31]	Telemedicine Enables Broader Access to Movement Disorders Curricula for Medical Students	United States	2017	Integrating Telehealth into the Medical Education Curriculum	Tele-Education & Movement Disorders
Felthun et al.[13]	Empirical analysis comparing the tele-objective structured clinical examination and the in-person assessment in Australia	Australia	2021	Telemedicine during the pandemic	J Educ Eval Health Prof
Findyartini et al.[18]	Cultivating patient-centered care competence through a telemedicine-based course: An explorative study of undergraduate medical students' self-reflective writing	Indonesia	2023	Telemedicine during the pandemic	Frontiers in Public Health
Gunner et al.[26]	Teaching webside manner: development and initial evaluation of a video consultation skills training module for undergraduate medical students	United Kingdom	2021	Technology mediated learning	MEDICAL EDUCATION ONLINE
Henschen et al.[14]	Teaching Telemedicine in the COVID-19 Era: a National Survey of Internal Medicine Clerkship	United States	2021	Telemedicine during the pandemic	J Gen Intern Med
Iancu et al.[35]	Twelve tips for the integration of medical students into telemedicine visits	Reino Unido	2021	Integrating Telehealth into the Medical Education Curriculum	MEDICAL TEACHER
Iancu et al.[12]	Unmuting medical students' education: Utilizing telemedicine during the COVID-19 pandemic and beyond	United States	2020	Telemedicine during the pandemic	Journal of Medical Internet Research
Jonas et al.[34]	An Interdisciplinary, Multi-Institution Telehealth Course for Third-Year Medical Students	United States	2019	Integrating Telehealth into the Medical Education Curriculum	Academic Medicine
Kumra et al.[27]	Telemedicine Clinical Skills Needs Assessment in Early Medical Students	United States	2022	Technology mediated learning	Family Medicine
Liu et al.[29]	A Web-Based Telehealth Training Platform Incorporating Automated Nonverbal Behavior Feedback for Teaching Communication Skills to Medical Students: A Randomized Crossover Study	Australia	2016	Technology mediated learning	Journal of Medical Internet Research
Mulcare et al.[23]	Advanced Communication and Examination Skills in Telemedicine: A Structured Simulation-Based Course for Medical Students	United States	2020	Students' experience of clinical learning through Telemedicine	MedEdPORTAL
Palmer et al.[19]	The feasibility and acceptability of administering a telemedicine objective structured clinical exam as a solution for providing equivalent education to remote and rural learners	United States	2015	Students' experience of clinical learning through Telemedicine	Rural Remote Health
Pitt et al.[16]	Novel Educational Responses to COVID-19: What is Here to Stay?	United States	2020	Telemedicine during the pandemic	ACADEMIC PEDIATRICS
Quevedo et al.[20]	Telemedicina como herramienta de enseñanza de la endocrinología en estudiantes de medicina	Chile	2019	Students' experience of clinical learning through Telemedicine	Rev Chil Endo Diab
Safdieh et al.[15]	Curricular response to COVID-19: real-time interactive telehealth experience (RITE) program	United States	2020	Telemedicine during the pandemic	MEDICAL EDUCATION ONLINE
Unrue et al.[21]	Effect of a standardized patient encounter on first year medical student confidence and satisfaction with telemedicine	United States	2020	Students' experience of clinical learning through Telemedicine	J Osteopath Med
Vogt et al.[22]	Telemedicine in medical education: An example of a digital preparatory course for the clinical traineeship – a pre-post comparison	Germany	2022	Students' experience of clinical learning through Telemedicine	GMS Journal for Medical Education

Source: Elaborated by the authors

Meta-analysis and summarization of results

For this phase, NVIVO 14 software was used, which carries out a qualitative and quantitative analysis of the data and allows the results to be categorized using the 30 most frequent words. A word cloud and cluster analysis were created (Figure 3).

Figure 3 - Representative cluster analysis of 32 articles according to the research protocol



Source: Adapted from Nvivo 14.

The cluster analysis revealed four categories:
1- Telemedicine during the pandemic.
2- Students' experience of clinical learning through telemedicine
3- Technology-mediated learning
4- Integration of Telehealth into the Medical Education Curriculum.

RESULTS AND DISCUSSION

Nvivo 14's cluster analysis made it possible to categorize into four categories.

Telemedicine during the pandemic

The Covid-19 pandemic has brought several challenges in the area of medical education, driving the adoption of telemedicine as an innovative solution. Cain et al.[10] highlighted the success of telemedicine in teaching, mentioning the satisfaction and confidence of students in virtual environments. Ahmed et al.[11] investigated the use of augmented reality as a way of overcoming the physical limitations imposed by the pandemic, suggesting the exploration of new technologies. Iancu, Kemp and Alam[12] discussed the guidelines of the American Association of Medical Colleges, recommending restrictions on student participation in direct patient care during the pandemic period.

The research conducted by Felthun et al.[13] revealed that telemedicine did not significantly impair the quality of students' clinical assessments, despite some limitations found in the evaluation of the physical examination. Henschen et al.[14] observed that although many institutions had not yet formally integrated telemedicine into their curricula before the pandemic, it was quickly adopted even with the suspension of practical educational activities.

The study by Safdieh et al.[15] described a comprehensive initiative at one college that involved several medical disciplines and the use of telemedicine to highlight the collaborative role of students in patient care during this challenging time.

Pitt et al.[16] concluded that the transformations caused by the pandemic in the field of medical education, such as the inclusion of virtual experiences like simulations and teleconsultations, will have a significant impact on the future of medical education. These studies together show how telemedicine has not only worked as an emergency solution but has also triggered lasting changes in the way medicine is taught, highlighting the importance of digital technologies in contemporary medical training.

Students' experience of clinical learning through telemedicine

The study carried out by Almino et al.[17] at the Federal University of Ceará, in Cariri, focused on the use of telemedicine in the area of pediatrics. The study highlighted the importance of this approach, as well as the challenges faced, especially with regard to the need to improve the quality of transmissions. Findyartini et al.[18] investigated the impact of telemedicine on students' professional training and on communication between doctor and patient during the pandemic.

Palmer et al.[19] highlighted the value of telemedicine for clinical assessments, while Quevedo et al.[20] reported high student satisfaction with this approach. Unrue et al.[21], in turn, found an increase in student confidence after receiving training in telemedicine. Finally, Vogt et al.[22] and Mulcare et al.[23] concluded that telemedicine training enables students to carry out virtual consultations and is a valuable complement to medical education.

Technology-mediated learning

In the study by Booth et al.[24], the inclusion of telemedicine in the medical curriculum was associated with an increase in students' confidence in essential aspects of medical practice, such as conducting virtual consultations, taking detailed clinical histories and implementing appropriate therapeutic approaches in a virtual environment. This finding suggests that exposure to and continuous practice with telemedicine can strengthen students' skills in an increasingly digitalized healthcare setting.

Cantone et al.[25] used a methodology called tele-Objective Structured Clinical Examinations (teleOSCE), which simulated a virtual care environment, revealing that students showed great interest in receiving further instruction on telemedicine and recognized the differences between virtual and face-to-face consultations.

Gunner et al.[26] implemented a telemedicine module and observed a significant improvement in students' understanding of this methodology after participating in it. Kumra et al.[27] identified deficiencies in skills related to telemedicine, especially in performing physical examinations.

Finally, Barzegar et al.[28] stressed the importance of investing in equipment and infrastructure to improve telemedicine teaching, while Liu et al.[29] observed an improvement in students' performance in face-to-face consultations after receiving telemedicine training.

Integrating Telehealth into the Medical Education Curriculum

The article in question carries out a thorough analysis of the integration of telemedicine into educational activities in Botucatu/SP, with an emphasis on regional differences and the need to improve technological infrastructure for more efficient implementation.[30]

The research also highlights the importance of telemedicine in low-income countries such as Cameroon, where challenges such as limited connectivity affect the effectiveness of distance learning.[31] The inclusion of telemedicine in the medical curriculum is evaluated, revealing a gap in the preparation of students for digital clinical practice, despite the growing interest and need.[32,33]

Studies by Jonas et al.[34] and Iancu et al.[35] emphasize the importance of comprehensive practical and theoretical training to better prepare future doctors for an increasingly advanced and technologically interconnected clinical scenario.

Limitations of the study

When analyzing the literature on medical education during the COVID-19 pandemic, some limitations in the use of telemedicine were identified. These limitations include selection bias, an excessive focus on the United States and a reliance on self-reported data, which restricts its generalizability. In addition, there is a lack of detailed analysis of technical aspects, variations between specialties and the impact of the physical examination, as well as the psychological and ethical issues faced by students.

Based on this review, it is clear that more comprehensive research is needed to better understand how telemedicine will affect students' clinical practice in the future.

CONCLUSION

This systematic review highlights the increasingly important and expanding role of telemedicine in medical education, highlighting the numerous advantages it offers. The COVID-19 pandemic has accelerated the adoption of telemedicine, emphasizing its value as a complementary tool to face-to-face teaching. It has become a transformative factor in the preparation of future doctors, adapting them to a constantly evolving practice environment. However, studies also point to challenges, such as the need to invest in infrastructure and specific training for students. Telemedicine is being consolidated as an essential component in medical training, requiring careful integration into curricula to take advantage of its benefits and overcome obstacles. It is therefore encouraged that medical education institutions commit to improvements in training and resources, preparing students for an increasingly digital medical landscape. Future research should focus on the effective integration of telemedicine into curricula, with the aim of preparing doctors for contemporary demands.

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