

Pedagogical strategies in medical education to the challenges of Covid-19: scoping review

Estratégias pedagógicas na educação médica ante os desafios da Covid-19: uma revisão de escopo

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ABSTRACT

Introduction: The challenges brought by the continuity of the university teaching-learning process in the face of the measures to combat the pandemic of COVID-19 made the debate on the use of information and communication technologies (ICT) in medical education more important. Several strategies were used by teachers worldwide to continue their teaching activities.

Objective: to investigate the strategies and uses of ICT in medical education in the face of the COVID-19 pandemic.

Method: Five databases were systematically assessed, using the terms “COVID-19”, “medical education”, “higher education” and “students”, in Portuguese, English and Spanish, resulting in 321 initial citations, with 18 final references after applying the inclusion and exclusion criteria.

Result: Four key topics were identified in the literature: (1) Challenges for Medical Education prior to COVID-19; (2) Challenges in migrating to remote education; (3) Strategies to overcome challenges related to the learning environment; and (4) Strategies to overcome challenges related to assessments and exams.

Conclusion: The use of ICT in medical education in the context of the COVID-19 pandemic showed to be especially important, with considerations regarding the improvement in areas that were already used, the migration of some more articulated areas and experiences in clinical and procedural disciplines. There was also concern about the impacts of using ICT to replace the in-person presence of students in medical learning environments.

Keywords: COVID-19; Higher Education; Medical Education; Distance Learning; Scoping Review.

RESUMO

Introdução: Os desafios à continuidade do processo ensino-aprendizagem universitário ante as medidas de combate à pandemia da Covid-19 tornaram mais importante o debate sobre o uso de tecnologias de informação e comunicação (TIC) no ensino médico. Diversas estratégias foram empregadas no mundo por docentes para a continuidade das atividades pedagógicas.

Objetivo: Este estudo teve como objetivo investigar as estratégias e os usos de TIC no ensino médico ante a pandemia de Covid-19.

Método: Examinaram-se sistematicamente cinco bases de dados, nas quais se empregaram as expressões e os termos “covid-19”, “ensino médico”, “educação superior” e “estudantes” em português, inglês e espanhol, o que resultou em 321 citações iniciais, com 18 referências finais após a aplicação de critérios de inclusão e exclusão.

Resultado: Quatro temas-chave foram identificados na literatura: 1. “Desafios para o ensino médico anteriores à Covid-19”; 2. “Desafios na migração para o ensino a distância”; 3. “Estratégias para a superação de desafios relacionadas ao ambiente de aprendizagem virtual”; e 4. “Estratégias para a superação de desafios relacionadas às avaliações”.

Conclusão: No contexto da pandemia de Covid-19, o emprego de TIC no ensino médico se mostrou importantíssimo, pois se encontraram quatro estratégias, entre as quais se destacaram o aprimoramento em áreas em que as TIC já eram utilizadas, a migração de algumas áreas mais articuladas e experiências em disciplinas clínicas e procedurais. Também houve preocupação sobre os impactos do uso de TIC em substituição da presença de estudantes nos ambientes de aprendizagem médicos.

Palavras-chave: Covid-19; Ensino Superior; Educação Médica; Ensino a Distância; Scoping Review.

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INTRODUCTION

Important worldwide changes have been caused by the new coronavirus (Coronavirus of Severe Acute Respiratory Syndrome 2 - SARS-CoV-2). On March 11, 2020, a pandemic was declared, with 118,000 recorded cases and 4,000 deaths¹ caused by COVID-19. Considering that social isolation is the most important strategy employed in this health emergency, changes occurred in all social fields, including universities and, among them, in medical education. The COVID-19 pandemic caused disruption to hospital routines as a whole, health services, medical schools and other important learning environments for students, in addition to the importance that health professionals have in society to preserve lives². The systematic cancellation of in-person classes and replacement by those mediated by distance technology has raised major questions regarding medical education for the carrying out of pre-clinical and clinical disciplines^{2,3}.

The use of information and communication technologies (ICTs) in medical education is not a new thing brought by COVID-19, since it has been used since the end of the 20th century⁴, with extensive studies on its own protocols and pedagogical debates about these pedagogical strategies⁵. However, this is not a resource employed in all sectors of medical education, since the in-person model, centered on content and the development of clinical skills, is still prevalent⁵. Nevertheless, experiences have been recorded in the literature on medical education mediated by ICTs, including in advanced stages of the course, such as medical internship⁶.

This scoping review aims to investigate which ICT use strategies are employed in medical education in the face of the challenges of the COVID-19 pandemic.

METHOD

A scoping review was carried out using a manual from the Joanna Briggs Institute⁷, which presupposes the synthesis of results and thematic under development. It is aimed at mapping what is relevant in the literature of the field of interest, a relevant option considering the challenges for medical education caused by the COVID-19 pandemic. The identified research question was

- What strategies are used in medical education in the face of the COVID-19 pandemic?

Aiming to systematize the writing of the manuscript, we decided to use the recommendations of PRISMA-SrC, a checklist with 21 specific items to improve the quality of scoping reviews⁸.

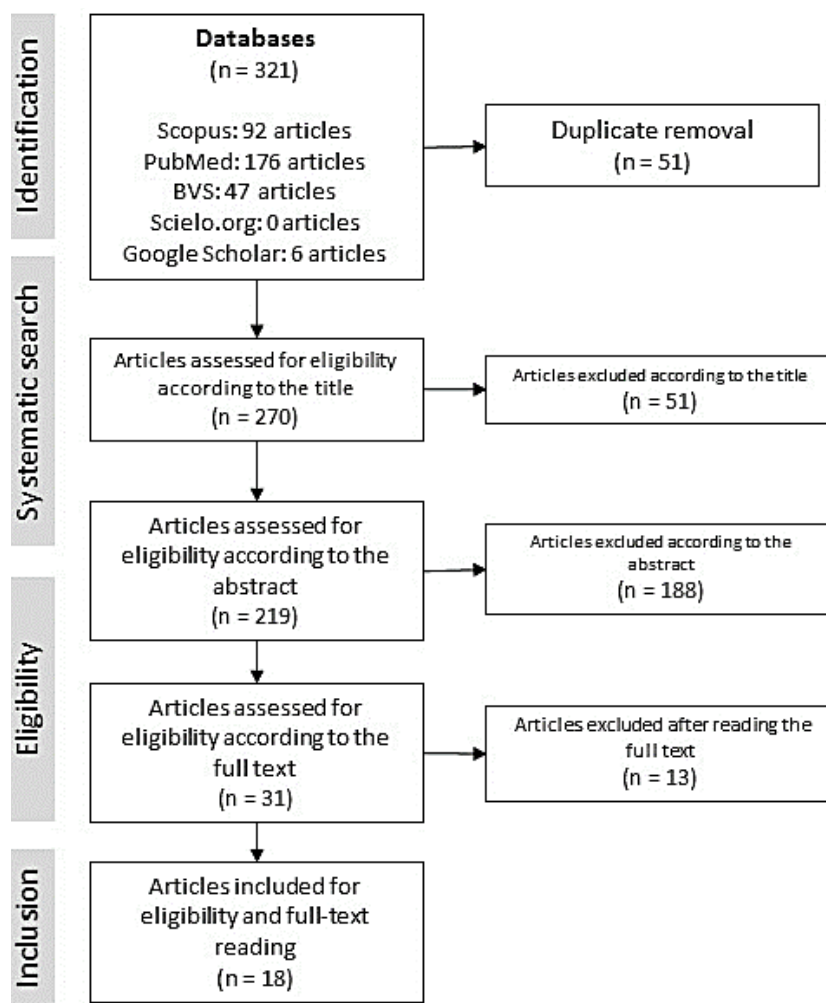
The searches were carried out in Portuguese, Spanish and English, from July 14 to 31, 2020. Four scientific databases were used: Scopus, PubMed, BVS, Scielo; and the Google Scholar portal for the grey literature mapping. The following search key was used in Scopus: (TITLE-ABS-KEY (COVID-19) AND TITLE-ABS-KEY ("medical education") AND TITLE-ABS-KEY (student) OR TITLE-ABS-KEY ("high education")) AND (LIMIT-TO (SUBJAREA,"MEDI")). Two members of the research team independently performed all the steps: search, selection by titles, summary and full-text reading. In case of disagreements, a third party was invited to perform the evaluation.

The inclusion criteria consisted of: focus on medical education; to include at least one teaching strategy used after the beginning of COVID-19, original articles, reports of experiences and comments based on educational initiatives. The exclusion criteria comprised: articles related to the perception of students and/or teachers about the pandemic, articles on preference assessment, studies on the clinical aspects of COVID-19, studies strictly about student biosafety; strictly theoretical considerations, studies that did not clearly show what resources were used to deal with the challenges of the COVID-19 pandemic, articles with considerations only, without pathways or interventions, on teachers' mental health, on students' mental health.

For the analysis of the included articles, thematic mapping was carried out with a previous survey of the key topics presented in the results section of the articles, grouping, identification of links between the points and synthesis, classifying and reclassifying the produced material according to the scoping review question.

RESULTS

A total of 321 articles were obtained after the searches performed in the databases, of which 18 were included in the review, after selection by the research team, as depicted in the following figure.

Figure 1. Flowchart of the review

The following table shows the bibliometric data of the included studies.

Table 1. Bibliometric characteristics of the included studies

Authors	Country	Keywords	Type of article	Journal	Publication month	Focus of the article
Birch et al. ⁹	United Kingdom	Medical students, COVID-19, medical school examinations, online examinations, open-book examination	Original article	Medical Education Online	June/20	Changes in the teaching and assessment of medical students at King's College London
Mukhtar et al. ¹⁰	Pakistan	COVID-19, Education, Medical, Undergraduate, Online learning	Original article	Pakistan Journal of Medical Sciences	May/20	Recommendations on distance learning during the COVID-19 pandemic in Pakistan
Singal et al. ¹¹	India	Anatomy education, Body donation, COVID-19, Pandemic, Virtual classes	Original article	Morphology	May/20	Discuss the effects and solutions to the challenges of teaching anatomy during the COVID-19 pandemic
Chao et al. ¹²	United States	Virtual surgical education, undergraduate medical education, COVID-19, telemedicine, surgical video capture	Original article	Journal of Surgical Education	June/20	Development of virtual activities in surgical discipline

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Table 1. (Continuation) Bibliometric characteristics of the included studies

Authors	Country	Keywords	Type of article	Journal	Publication month	Focus of the article
Rosa et al. ¹³	Peru	Educación médica, Educación a distancia, Infecciones por coronavirus, COVID-19, América Latina	Original article	Revista Cubana de Educacion Medica Superior	May/20	Debate on the main types of distance learning in medical courses in the context of COVID-19
Mishra et al. ¹⁴	United States	Coronavirus disease-2019, Online education, Ophthalmology education, Virtual curriculum	Original article	Ophthalmology	July/20	Describe the transition from ophthalmology education to a virtual curriculum during the COVID-19 pandemic
Gomez et al. ¹⁵	United States	Medical student education, Radiology education, Remote learning, COVID-19	Original article	Academic Radiology	June/20	Offer of virtual radiology diagnosis classes due to the COVID-19 pandemic
Roskvist et al. ¹⁶	New Zealand	COVID-19, Students, Curriculum, Educational, Electronic learning, General practice, Medical, Models.	Original article	Education for Primary Care	May/20	Online general medicine internships in national response to the COVID-19 pandemic
Krawiec et al. ¹⁷	United States	Assessment in health professions education, COVID-19, Undergraduate medical education	Original article	Cureus	June/20	Virtual case-based modules for teaching in the pediatric internship in the context of the COVID-19 pandemic
Ko et al. ¹⁸	United States	Not mentioned	Experience report	Journal of Neuro-ophthalmology	June/20	To address telehealth in neuro-ophthalmology, including current challenges and opportunities in the context of the COVID-19 pandemic
Szmuda et al. ¹⁹	Poland	2019 nCoV, Coronavirus, COVID-19, Internet, SARS-CoV-2, YouTube quality	Original article	Reviews in Medical Virology	June/20	Use of YouTube videos in distance learning pedagogical strategy on COVID-19
Huddart et al. ²⁰	United Kingdom	Not mentioned	Experience report	Medical Education Adaptations	May/20	Educational strategy using Twitter® on COVID-19.
Finn et al. ²¹	United Kingdom	Not mentioned	Experience report	Medical Education	May/20	Educational strategy using Twitter® on COVID-19.
Kumar et al. ²²	India	Dermatology practice in shadow of COVID, Changing dermatology practice post COVID	Brief Communication	Dermatologic Therapy	April/20	Online activities for teaching dermatology in the context of the COVID-19 pandemic
Mathieson et al. ²³	United Kingdom	Medical education, Assessment, Open-book examination, COVID-19	Brief Communication	Medical Education Online	June/20	In-person medical examinations for the online modality in the context of the COVID-19 pandemic
Hofmann et al. ²⁴	United States	Not mentioned	Experience report	Medical Education Adaptations	May/20	Adaptation of bedside consultations using videoconferencing during the COVID-19 pandemic

Continue...

Table 1. (Continuation) Bibliometric characteristics of the included studies

Authors	Country	Keywords	Type of article	Journal	Publication month	Focus of the article
Chandra et al. ²⁵	United States	Not mentioned	Experience report	Medical Education Adaptations	June/20	Clinical calls allowing live interaction with patients and the development of interpersonal and communication skills.
Rose ²⁶	United States	Not mentioned	Brief Communication	JAMA	March/20	Describe how COVID-19 can affect learning environments in Medicine and its possible implications for the future of medical education

Four key topics were identified in the literature: (1) Challenges for Medical Education prior to Covid-19; (2) Challenges in migration to distance learning; (3) Strategies to overcome challenges related to ICTs; and (4) Strategies for overcoming challenges related to evaluation strategies.

Medical Education Challenges prior to COVID-19

Most of the included studies pointed out that the discussion on how to structure the medical curriculum and its centralization in a paradigm considered to be poorly articulated with the ICT developments has been debated for a long time, but the issue became more categorical after the need to migrate to online activities^{9,11}. Moreover, the centrality of the teacher and the clinical space in the training, and the students' position of little protagonism in the teaching-learning process were characteristics evidenced in the articles, such as the difficulty of migrating advanced disciplines in the courses to other types rather than the experience in wards and outpatient clinics⁹. An interesting example refers to the discipline of Anatomy, considered the "basis" of medical education, which even with virtual resources and simulations, still finds great resistance to discontinuing the teaching with cadavers¹¹. The professional performance of future doctors is a concern of the academic community, considering the volume of material and spaces necessary for the training of this professional, since in addition to anatomical knowledge, there are developments of technical skills that have few alternatives rather than being present at didactic-pedagogical activities^{9,11}.

The need to migrate to distance learning has generated great pressure, both on students – concerned with the development of skills – and on educators, who are being forced to venture into unknown territory, for instance, through the digitalization of classrooms^{14,15}, despite the increasingly present use of electronic resources both in general medical

practice and in educational spaces¹⁷. Notwithstanding the advanced and powerful technology at universities, including hardware and software, significant advances are still needed to allow effective online learning¹⁰, in addition to changing the educational paradigm allowing student participation, which is still very dependent on the classroom and teaching guidance¹⁰.

In this sense, it is important to observe that it is common for people to seek health information on platforms such as YouTube®, which is often used as a source of education for greater knowledge about diseases¹⁹. At the same time, there have been advances for some years in areas such as teledermatology, an alternative that is readily viable as a measure to solve some aspects of the in-person disciplines in the field²².

Challenges of migration to distance learning

A very important issue that has been raised deals with the possibilities and impossibilities of migration into the virtual space, at least more immediately, with an important division highlighted between the preclinical disciplines, the clinical-theoretical disciplines and the internship^{10,12,13}. Additionally, only the first ones and those with a theoretical focus would have a greater vocation for migrating to the virtual space rapidly¹⁰, since several skills that are typical of clinical practice are not achieved in the virtual modality. This also seems to be related to the clinical act itself, which demands the presence of both the professional and the patient, in addition to medical training itself¹¹.

There are massive limitations for clinical experiences and those at the surgical environment, in addition to office visits, as well as the impossibility for some surgical specialties to be migrated to distance learning¹². While preclinical subjects are easier due to less interaction with the patient, better access to virtual educational material, use of platforms and problem-based learning, clinics have the possibility of migration, provided they use virtual reality simulators and simulated

patients¹³, with due restrictions on both the construction of clinical knowledge and the acquisition of skills^{14,15,20}.

Regarding the developed and employed ICTs, there are major challenges in resource-constrained environments, including extensive lack of availability, incorrect diagnosis resulting from poor photo quality, inadequate online patient medical data, communication gaps between the doctor and patients undergoing treatment and problems inherent to the performance of investigations, which can generate irreparable educational damage²².

Strategies to overcome challenges related to the virtual learning environment

Regarding the strategies used for didactic-pedagogical activities, the literature points to the use of video conference platforms, which have been widely used for education and telemedicine¹⁰. With the pandemic, it was necessary to diversify its use, for instance with virtual meetings held according to problem-based teaching^{10,12,13}. These platforms are highly diversified in distance learning modalities through the use of ICTs¹³. It is strongly recommended the teaching of small groups, which facilitates interactivity^{13,14,26}. The use of the flipped classroom is recommended as a pedagogical strategy, with the teaching staff mediating the contents and information that students must access and dedicate themselves to the study before class²⁶.

Regarding the platforms for the Virtual Learning Environment, the following were mentioned: Microsoft Teams®, Google Meet®, Edmodo®, Moodle®, and Blackboard®^{10,15}, while the videoconference platforms are: Zoom®, Skype® for companies, WebEx® and Adobe Connect®^{10,14,15}. Twitter® has also been used as a space for interaction between students and teachers, especially for solving doubts and medical problems, with a wide interaction^{15,20}. The pre-recording of classes, the use of asynchronous chat and even scheduling synchronous times for supervision and educational-pedagogical support¹⁵ have been used.

Regarding the pedagogical strategies for virtual activities, the use of a mind map of the exam, differential diagnosis and management summary stands out, with links to resources to be employed in clinical cases¹⁶, as well as asynchronous discussion forums¹⁶; a symposium that facilitates social interactions and the teacher's presence¹⁶; a learning portfolio that facilitates aspects of personal goals and reflects the organizational domain¹⁶; virtual case presentation by the students themselves¹⁷; virtual discussion rounds¹⁷; and support for students through synchronous and asynchronous monitoring on social media by specialists^{18,21}. Online seminars and video conferences based on problem solving, usually

accompanied by research results or a long dialogue with the patient, were also reported as strategies^{22,23}.

In addition to the subjects with the highest theoretical workload, online platforms are also being used for some clinical activities, such as the use of Zoom® for bedside visits¹⁷, as well as the recurrence to other electronic sources of contact with the patient, trying to decrease the impacts on the development of clinical skills¹⁷. The use of instant messaging for virtual health services, public messages on behavioral modification, epidemiological screening and access to virtual health providers were already in use¹⁸.

We found virtual dissection experiments¹¹; use of anatomy¹¹, pathology¹² and radiology¹⁵ image banks. Additionally, endoscopy, laparoscopy and robotic surgery are also widely used in many surgical disciplines and allow surgical visualization by those who are not directly participating^{12,14}. Another interesting strategy was the virtual surgery transmitted using a GoPro® camera and real-time, two-way audiovisual communication between the student and the surgical team¹². In another experiment, mobile applications validated for components of the neuro-ophthalmic examination were used for the teaching of ophthalmology¹⁸. The need for teachers to receive support to carry out virtual teaching and clinical preceptorship is reinforced¹⁴.

It is possible to evaluate, manage and care for patients through a video capture device and safe transmission during procedures and the provision of care in a telehealth environment¹², just like video surgical review sessions were used with preceptors¹⁴ and clinical case sessions were mediated by online platforms through interactive remote workshops and case sessions¹⁵.

There have been experiences of visits by a doctor who fixed an iPad Pro and ran the videoconference application²⁴; as well as students' contact with patients using Zoom®²⁵, laboratory sessions, simulations and bedside ultrasonography sessions, as well as clinical instructions with standardized patients and in authentic patient care environments²⁶.

Strategies to overcome challenges related to evaluations

A very patent concern in the literature referred to the evaluation of the teaching-learning process, since traditionally there is a great focus on memorization, with tests that are focused on content and, in the face of the pandemic, the exams also started to be taken on online platforms^{10,26}, which required a change of approach^{22,23}.

Several interesting online assessment strategies were found, including oral assessment through video conference and close communication with students¹², oral presentations¹², asynchronous assessments with bibliography consultation⁵, video

recordings of presentations on clinical cases^{15,18}, evidence-based medicine exercises when evaluating treatments¹⁴, open-book tests²³, and randomized questions in the virtual learning environment with an established maximum time for its completion²³.

In disciplines that predict the development of clinical skills, there have been considerable advances to allow migration to virtual learning environments, such as the use of an electronic report in which the clinical supervisor assesses the students' skills^{16,19}; the use of an instrument to evaluate clinical skills¹⁵, online discussion forums and presentations based on cases, assessing critical reflection and the use of literature¹⁶; construction of simulated interactive cases, which can be completed asynchronously^{16,18}; mind maps with links to important documents, podcasts, videos and other resources, and a final section for critical self-reflection and connection to clinical settings¹⁶. One activity that stood out was asking students to evaluate the quality of information on YouTube® videos when compared to those that exist in terms of Evidence-Based Medicine¹⁹.

In a more integrated way with clinical practice, practical exams were also found in video conference, where real patients were being replaced by scenarios and images of virtual cases²². In another study, preceptors supervised and listened to Zoom®-mediated conversations between students and patients and provided real-time feedback and comments via the software's chat function and intervened, when necessary. After the call, the students helped to document these call-backs. The preceptors assessed the students' performance using the same assessment tools as in the traditional internship²⁴.

DISCUSSION

The removal of students from clinical internships can have significant implications for the future planning of the workforce²⁷. However, the COVID-19 pandemic made issues that were already debated in medical teaching more evident, such as the role of the student, the focus on training through clinical experience and the challenges generated by a traditional model – such as the medical model – in the face of the contemporary world and technological advances. Also, the centrality of the students' role and not the teachers' in the teaching-learning process became clearer as an important issue for the pedagogical decisions of medical courses²⁸.

At the same time, the articles point out that there are great differences in the general disciplines of the health sciences, the specific medical pre-clinic ones and the medical clinics, leading to the understanding that different measures should be taken, thinking about possibilities of integral change for the use of ICTs, mixing, reducing the in-person load and even postponing, if deemed significant for training, considering five approach possibilities: continue, postpone, adapt, discard, add other forms²⁹.

The use of video conferences is a possibility to compensate for the abandonment of clinical classes held daily. A webcam and a microphone become important for classroom work³⁰. Mixed learning, defined as the combination of conventional classroom learning and asynchronous or synchronous teaching, has increased rapidly and is now widely used in medical education³⁰. Additionally, the use of webinars, discussion forums, clinical study clubs, social media in general, and other forms that allow interaction between students, teachers and medical experts³¹.

The issue of training the teachers to use ICTs, as well as the development of infrastructure resources, has been defended by the literature for a long time, becoming even more important in the context of the COVID-19 pandemic. At the same time, several strategies for overcoming challenges related to the learning environment, evaluations and exams were adopted in an interesting manner by the teachers in the articles included in this study, bringing inspiration for their immediate implementation and for future developments.

Due to the emergence of COVID-19 and its broad effect on society, which required the reconfiguration of teaching worldwide, the present study has the potential to present what was possible to be published in the international scientific literature regarding the strategies employed to continue medical education in the face of the pandemic limitations. However, the limitations are evident, since the impact of COVID-19 is a recent one, and there has been no time for all experiments in this field to be published in the literature, including the time necessary for more robust studies to be developed, synthesized as a scientific publication, submitted, evaluated and approved by peers, in addition to the publication process in scientific dissemination vehicles. Nevertheless, the findings of the present scoping review are important as a guide for future actions and adaptations in terms of medical education during the COVID-19 pandemic, and future studies are required to see whether these strategies will be modified, or even if others will appear as medical courses are faced with the challenges brought on by the health and educational context.

CONCLUSION

In this scoping review, the reported experiences of medical education during the Covid-19 pandemic suggest the need to adapt the training focused on the presence of the student in clinical-laboratory environments, for a situation mediated by ICTs. In this sense, the old challenges of medical education in the face of changes in the contemporary world, such as the existence of the possibility of teleconsultation, started to be resignified as possibilities of certain learning aiming to minimize the losses arising from the social distancing

required as a sanitary measure. The role of the student in the teaching-learning process must also be rethought, with a certain centrality in autonomy, given the characteristics of remote teaching. In a way, it can be concluded that the educational strategies employed in medical education in the face of the COVID-19 pandemic are related to four possible paths:

- Maintain the pedagogical strategies that were already used online, such as activities and classes previously mediated by technology;
- Adapt classes, exercises and clinical simulations that were held as in-person activities and then became possible through online technology mediation;
- Adapt clinical visits and consultations, with mixed strategies, in which a professional takes part in the in-person contact with patients and transmits (and sometimes interacts) to students via online technology;
- Postponing to the future the elements that are irreplaceable – both clinical and in procedures, which has a practical and a contact aspect, in addition to the humanization issue.

To some extent, there are possible approaches to more clinical and contact areas with cases and medical procedures, but there is a strong and important question about the extent to which these adaptations can be used without damaging the development of skills and competences of future medical professionals.

AUTHORS' CONTRIBUTION

Rodrigo Otávio Moretti-Pires and Dalvan Antônio de Campos conceived the review and developed all phases, from the bibliography search to the progressive selection of articles, as well as the creation of the first version of the manuscript. Zeno Carlos Tesser Junior worked with article selection when there were differences to be solved. João Batista de Oliveira Junior, Bárbara de Oliveira Turatti and Daniel Canavese de Oliveira reviewed the results. All authors contributed to the submitted version.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest related to this study.

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