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Tele-simulation in health teaching and learning: a scoping review

Prática da telessimulação no ensino e aprendizagem em saúde: revisão de escopo

Práctica de la telesimulación en la enseñanza y el aprendizaje en salud: revisión del alcance

Fabiana Cristina Pires Bernardinelli[I], Juliana da Silva Garcia Nascimento[II], Kleiton Gonçalves do Nascimento[I], Gustavo Correa de Amorim[I], Sheila Aparecida da Silva[I], Suzel Regina Ribeiro Chavaglia[I]

[I]Universidade Federal do Triângulo Mineiro. Uberaba, Brazil; [II]Universidade de Uberaba. Uberaba, Brazil

ABSTRACT

Objective: to map the practice of tele-simulation in health teaching and learning to develop clinical competences. **Method:** this scoping review followed the recommendations of the Joanna Briggs Institute and Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews in a search of 13 information sources in November 2021. **Results:** of the 1901 studies found, 18 composed the final sample. Two categories were developed: classifications of tele-simulation; and contemporary trends in the practice of tele-simulation. **Conclusions:** tele-simulation was found to be predominantly synchronous and there was a balance between observational and mobile tele-simulation. The scenarios ranged from management of seriously ill patients to evaluation of medical personnel's affective skills. Instructional design stages comprised preparation, participation, and tele-debriefing, supported by high-fidelity simulators and videoconferencing platforms for transmission.

Descriptors: Health Personnel; Students, Health Occupations; Education, Distance; Simulation Training; Clinical Competence.

RESUMO

Objetivo: mapear a prática da telessimulação no ensino e aprendizagem em saúde para desenvolver competências clínicas. **Método:** revisão de escopo realizada conforme recomendações do Instituto Joanna Briggs e *Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews*, com busca realizada em novembro de 2021 em 13 fontes de informação. **Resultados:** dentre os 1901 estudos, 18 compuseram a amostra final. Elencaram-se duas categorias: classificações da telessimulação e tendências contemporâneas na prática da telessimulação. **Conclusões:** identificou-se preponderância na adoção da telessimulação sincrônica e um equilíbrio entre a prática telessimulada observacional e móvel. Os cenários abrangem o manejo de pacientes graves, na avaliação das habilidades afetivas do profissional médico. O *design* instrucional abrange as etapas de preparação, participação e *teledebriefing*, com o apoio de simuladores de alta fidelidade e plataformas de videoconferência para transmissão.

Descritores: Pessoal de Saúde; Estudantes de Ciências da Saúde; Educação à Distância; Treinamento por Simulação; Competência Clínica.

RESUMEN

Objetivo: mapear la práctica de la telesimulación en la enseñanza y el aprendizaje de la salud para el desarrollo de habilidades clínicas. **Método:** revisión del alcance realizada según recomendaciones del Instituto Joanna Briggs y *Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews*, cuya búsqueda fue realizada en noviembre de 2021, en 13 fuentes de información. **Resultados:** entre los 1901 estudios, 18 conformaron la muestra final. Se enumeraron dos categorías: clasificaciones de telesimulación y tendencias contemporáneas en la práctica de la telesimulación. **Conclusiones:** se identificó una preponderancia en la adopción de telesimulación sincrónica y un equilibrio entre la práctica de telesimulación observacional y móvil. Los escenarios abarcan el manejo de pacientes críticos, en la evaluación de las habilidades afectivas del profesional médico. El diseño instruccional cubre las etapas de preparación, participación y *teledebriefing*, contando con el apoyo de simuladores de alta fidelidad y plataformas de videoconferencia para la transmisión.

Descriptores: Personal de Salud; Estudiantes del Área de la Salud; Educacíon a Distancia; Entrenamiento Simulado; Competencia Clínica.

INTRODUCTION

The accelerated development of health practices in contemporary times has required a focus on patient safety and knowledge for the proper management of new technologies[1]. In response to this demand, a variety of innovative pedagogical modalities emerged with the intention of enhancing the clinical skills of students and health professionals, with emphasis on simulation[2,3].

Simulation is characterized as a widely used teaching and learning strategy which is capable of replicating real clinical situations in a safe and controlled environment, with the intention of meeting planned objectives and optimizing the achievement of expected results[3-6].

Correspondent author: Suzel Regina Ribeiro Chavaglia. E-mail: suzel.ribeiro@yahoo.com.br
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Among the simulation types used in the health field configured by the clinical, hybrid, multimodal and virtual modalities[6], the adoption of virtual simulation, and more specifically telesimulation, has expanded worldwide today, especially given the educational challenges caused by the COVID-19 pandemic period[7].

Telesimulation is a process in which telecommunication and simulation resources are combined to provide education, training and/or assessment to learners in an off-site location, overcoming distance and time barriers, as well as allowing for significant institutional savings and rapid knowledge dissemination[8]. However, even though telesimulation has shown potential to improve access to simulation-based education, there are several aspects of this strategy that still require scientific deepening and the production of additional studies capable of clarifying best practices[7,9]. For example, the findings of American studies conducted in the years 2021[7] and 2017[9] point out the need to investigate the technical feasibility of telesimulation, its logistical issues, and compare it with other simulation approaches and evaluate the limitations of communication platforms available[9], as well as the most appropriate way of considering objectives and methodologies, thereby enabling the debriefing and evaluation of this innovative educational strategy in order to optimize its successful implementation[7].

Taking into account that the COVID-19 pandemic demanded immediate adjustments in the context of education and in view of the possibility of new waves of the disease, along with the suspension of face-to-face classes, it is justified to encourage adoption of telesimulation as a pedagogical strategy to develop clinical skills in students and health professionals, constituting a condition which requires understanding how to properly establish telesimulated experiences[10,11].

Thus, a preliminary search was performed in September 2021 to explore this context regarding possible existing scoping and systematic reviews on the subject in the following information sources: US National Library of Medicine National Institutes Database Search of Health (Medline/PubMed®), Scopus, Embase and Latin American and Caribbean Literature in Health Sciences (LILACS), Catalog of Theses and Dissertations in the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES) and in the Open Science registry Framework, noting the absence of these types of studies on telesimulation and reinforcing the need for its production.

Therefore, it is important to analyze evidence on telesimulation to fill the remaining scientific gaps and clarify the use of this strategy for remote health education[12]. To do so, the following question was elaborated: how has telesimulation been practiced in contemporary teaching and learning of students and health professionals to develop clinical skills?

This study aimed to map telesimulation practice in teaching and learning in health to develop clinical skills.

METHOD

This is a scoping review supported by the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation[13] and the Joanna Briggs Institute Review manual[14]. The research protocol was registered in the Open Science Framework (https://osf.io/ecpg5).

Nine steps were completed, namely: (1) Definition and alignment of title, objective and review question; (2) Definition of inclusion criteria; (3) Description of the planned approach to research with the structuring of the search strategy; (4) Screening and selection of evidence; (5) Data extraction; (6) Evidence synthesis; (7) Analysis of results; (8) Presentation of results; and (9) Summary of evidence regarding the purpose of the review[15].

The first step addressed the definition and alignment of the title and objective of the research with the review question, elaborating it through the elements of the mnemonic Population – Concept – Context (PCC)[14,16], defining itself as the acronym "P" (population): health area students (undergraduate and graduate students) and health professionals; the acronym "C" (concept): telesimulation practice in teaching and learning in health; and acronym "C" (context): the development of clinical skills (cognitive, psychomotor and affective skills in the field of health). Thus, the following question was obtained: How has telesimulation been practiced in the contemporary teaching and learning of students and health professionals to develop clinical skills?

Next, the following inclusion criteria were defined in the second stage: primary research, literature reviews, experience reports, technical reports, dissertations, theses and editorials capable of answering the research question, without delimiting time frame and language, published electronically. Manuals, books, letters to the editor, abstracts published in annals, comments, essays and previous notes were excluded.

Then, a description of the planned research approach was carried out in the third stage with the structuring of the search strategy performed in November 2021 in the following conventional information sources: Medline/PubMed®, Scopus, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, ERIC, LILACS; and also in the sources directed to gray literature: Catalog of Theses and Dissertations of the *Portal de Periódicos da CAPES*,

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Europe E-Theses Portal (DART), Electronic Theses Online Service (EThOS), *Repositório Científico de Acesso Aberto de Portugal* (*RCAAP*), National ETD Portal and Theses Canada.

The following health descriptors available on the Health Sciences Descriptors Portal (DeCS) in the Virtual Health Library (BVS) and the controlled descriptors of the Medical Subject Headings (MESH) were used: "Students of Health Sciences", "Health Personnel", "Simulation Training"; "Clinical Competence" and the keywords: "Telesimulation" and "Virtual Simulation".

The studies were identified by combining the elements of the PCC strategy, Boolean operators and search codes, specific for each source, since each work responds to different commands in a unique way, which implies adapting the strategy. Also, the keywords "Virtual Simulation" and "Telesimulation" were adopted in order to direct the search to the intended object of study. It should be noted that the keyword "Telesimulation" was used in its English and Portuguese versions in non-conventional information sources, since such libraries do not accept the use of advanced search strategies, as shown in Figure 1.

Information sources, descriptors and keywords	**Search strategy**
Medline/PubMed®	("*Students, Health Occupations*"[*All Fields*] OR "*Health Occupations Students*"[*All Fields*] OR "*Health Occupations Student*"[*All Fields*] AND "*Health Personnel*"[*All Fields*] OR "*Personnel, Health*"[*All Fields*] OR "*Health Care Professionals*"[*All Fields*] OR "*Health Care Professional*"[*All Fields*] AND "*Simulation Training*"[*All Fields*] OR "*Training, Simulation*"[*All Fields*] OR *Telesimulation*[*All Fields*] OR "*Virtual simulation*"[*All Fields*] AND "*Clinical Competence*"[*All Fields*] OR "*Competency, Clinical*"[*All Fields*])
Scopus	*TITLE-ABS-KEY*(({*Students, Health Occupations*} *OR* {*Health Occupations Students*} OR {*Health Occupations Student*} OR {*Occupations Student, Health*} OR {*Occupations Students, Health*} OR {*Student, Health Occupations*}) AND ({*Health Personnel} OR {Personnel, Health} OR {Health Care Professionals} OR {Health Care Professional}*) AND ({*Simulation Training*} OR {*Training, Simulation*} OR *Telesimulation OR* {*Virtual simulation*}) AND ({*Clinical Competence} OR {Competency, Clinical*}))
Embase	("Health *Student" AND "Health Care Personnel" AND "Simulation Training"* OR T*elesimulation OR "Virtual Simulation"* AND "*Clinical Competence"*)
CINAHL	SU((*"Students, Health Occupations"*) AND (*"Health Personnel"*) AND (*Telesimulation OR "Virtual simulation*") AND (*"Clinical Competence"*))
ERIC	(*"Graduate Study*" AND *"Health Personnel" AND Simulation* OR *Telesimulation OR "Virtual simulation*" AND *Competence)*
Web of Science	AK=((*"Students, Health Occupations" OR* "*Health Occupations Students*" OR "*Health Occupations Student*" OR "Occupations Student, Health" OR "*Occupations Students, Health*" OR "*Student, Health Occupations*" AND "*Health Personnel" OR "Personnel, Health" OR "Health Care Professionals" OR "Health Care Professional"* AND "*Simulation Training"* OR "*Training, Simulation*" OR *Telesimulation OR "Virtual simulation*" AND *"Clinical Competence" OR "Competency, Clinical"*))
LILACS	Português: (("Estudantes de Ciências da Saúde") AND ("Pessoal de Saúde") AND ("Treinamento por Simulação" OR Telessimulação) AND ("Competência Clínica")) Inglês: ((*"Students, Health Occupations") AND ("Health Personnel") AND* ("*Simulation Training* OR *Telesimulation*) AND (*"Clinical Competence"))* Espanhol: ("*Estudiantes del Área de la Salud*" AND "*Personal de Salud*" AND "*Entrenamiento Simulado*" OR *Telesimulación* AND "*Competência Clínica*")
CAPES	Use of the keyword: *Telessimulação* (https://catalogodeteses.capes.gov.br/catalogo-teses/)
DART	Use of the keyword: *Telesimulation (*https://www.dart-europe.org/basic-search.php.)
EThOS	Use of the keyword: *Telesimulation* (https://ethos.bl.uk/SearchResults.do)
RCAAP	Use of the keyword: *Telessimulação* (https://www.rcaap.pt/)
National ETD Portal	Use of the keyword: *Telesimulation* (http://www.netd.ac.za/?query=telesimulation&action=search)
Theses Canadá	Use of the keyword: *Telesimulation* (https://www.bac-lac.gc.ca/eng/services/theses/Pages/list.aspx?AW_S=telesimulation)

CINAHL: Cumulative Index to Nursing and Allied Health Literature; *LILACS: Literatura Latino-Americana e do Caribe em Ciências da Saúde*; *CAPES: Catálogo de Teses e Dissertações do Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*; DART: Europe E-Theses Portal; EThOS: Electronic Theses Online Service; *RCAAP: Repositório Científico de Acesso Aberto de Portugal*.
FIGURE 1: Presentation of information sources, descriptors, keywords and search strategies. Uberaba, MG, Brazil, 2021.

The screening and selection of evidence was carried out in the fourth stage by first considering the literature identified in conventional sources characterized by primary and secondary manuscripts with the aid of a free web review

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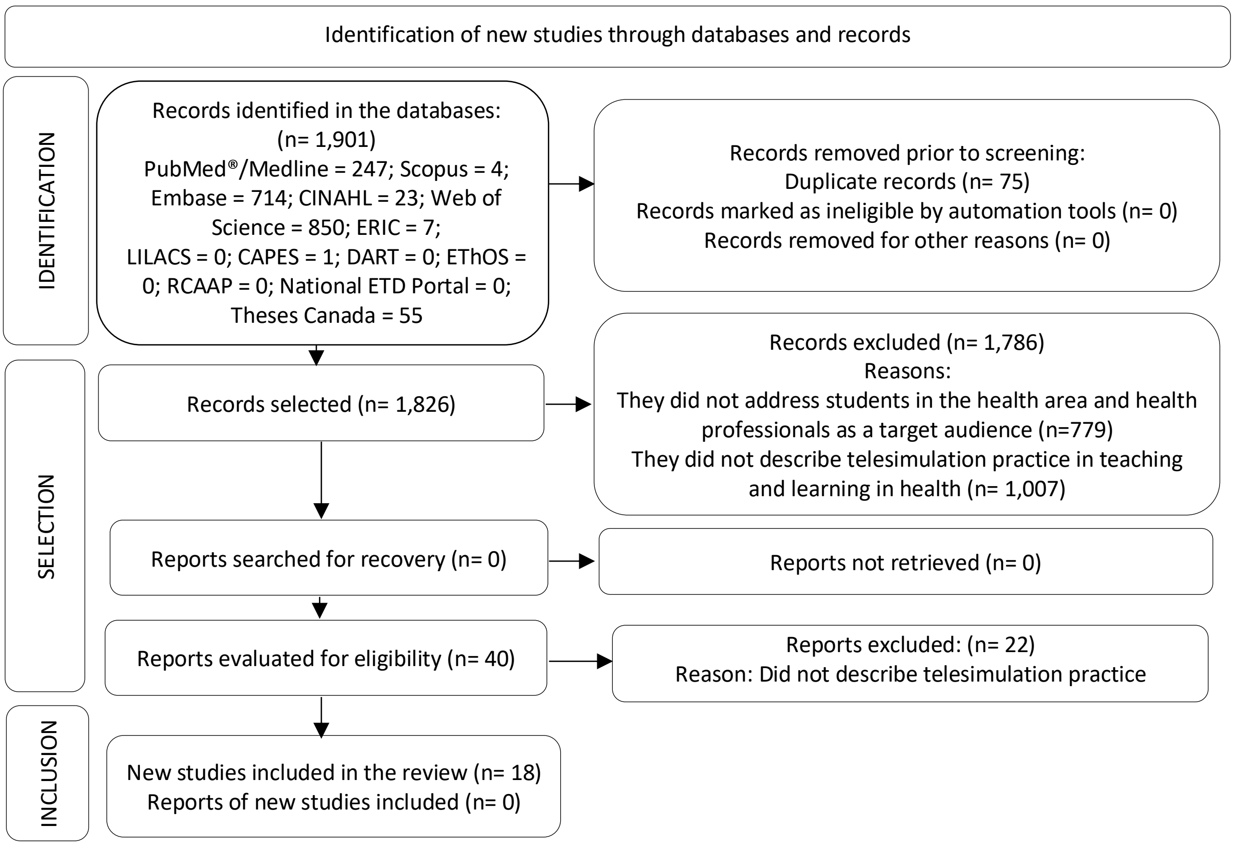
application named Rayyan Qatar Computing Research Institute (Rayyan QCRI), which eliminates duplicate articles and streamlines the initial screening using a reliable semi-automation process[17].

The manuscripts were first selected by reading titles and abstracts by two independent researchers, specialists in simulation. A total of 41 articles were selected among the researchers, which were then sent to a third researcher who was responsible for deciding whether or not to include them in the sample.

A manual selection of gray literature was also performed by reading titles and abstracts (also by two researchers), and then the reading in full of the total collection selected to define the final sample. A search was conducted in the reference list of the studies that composed the sample in order to identify possible inclusions; however, no new articles were inserted. The selection flow that led to the identification of 1901 studies and 18 that made up the final sample is shown in Figure 2.



CINAHL: Cumulative Index to Nursing and Allied Health Literature; *LILACS: Literatura Latino-Americana e do Caribe em Ciências da Saúde*; *CAPES: Catálogo de Teses e Dissertações do Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*; DART: Europe E-Theses Portal; EThOS: Electronic Theses Online Service; *RCAAP: Repositório Científico de Acesso Aberto de Portugal*.
FIGURE 2: Flowchart for identification, selection and inclusion of studies, prepared based on the recommendation of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). Uberaba, MG, Brazil, 2021.

Next, information was extracted from the manuscripts in the fifth and sixth stages, and their synthesis relevant to the research question was performed through a validated instrument[18] and adapted for the present study considering the following criteria: author, year of publication, country of origin, objective, type of study, telesimulation procedure/outcomes.

Then, the studies were categorized in the seventh stage through Thematic Analysis[19] in three steps: (1) pre-analysis, developed through a floating reading of the evidence and organization of the converging information; (2) exploration of the material, characterized by grouping units of similar records; and (3) data treatment, defined by structuring and describing the categories. Finally, the obtained outcomes were presented in the eighth and ninth stages, summarizing the evidence in relation to the desired purpose.

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RESULTS

Figures 3 and 4 present the characterization of the 18 studies included in the sample.

Authors / year of publication / Country of origin	**Objective and study type**	**Telesimulation procedure**	**Conclusion**
Yang et al., 2021[20]. United States.	Describe a telesimulation implementation.	Actors played the roles of father and nurse in the telesimulation. The image of a pediatric patient was projected. A facilitator conducted pre-briefing and teledebriefing. One group of students participated in the scenario and another observed.	Ninety percent (90%) of the students felt comfortable and more knowledgeable after the telesimulation.
Diaz; Walsh, 2021[12]. United States.	Descriptive study.	The main criteria for telesimulation are: (1) needs assessment; (2) learning outcomes; (3) equipment; (4) practice; (5) pre-briefing; (6) facilitators; (7) teledebriefing; (8) feedback.	Telesimulation is evolving and can be considered an interactive and exciting way to learn.
Thomas et al., 2021[7]. United States.	Analyze the criteria for developing telesimulation.	Recommendations consist of: (1) selecting the telesimulation classification; (2) consider boundaries; (3) identify learning objectives; (4) identify audio-visual materials; (5) prepare the faculty; (6) prepare students; (7) allow “timeouts”; (8) establish team roles; (9) prepare the debriefing; (10) engage silent participants; (11) share learning resources; (12) collect feedback.	Although telesimulation does not replace face-to-face training, it can serve as a pedagogical alternative.
Sanseau et al, 2021[21]. United States	How to use TeleSimBox to perform telesimulation. Technical report.	The telesimulation addressed a case of neonatal shock. *In situ* medical students and resident students participated remotely. The clinical case was performed five times by groups of 4 participants per session.	Feedback from a face-to-face facilitator and a remote expert was key to the learning process.
Mileder et al., 2021[22]. Austria	Investigate the feasibility of telesimulation.	Telesimulation addressed communicating bad news. Nursing students were simulated patients and 141 interns were divided into seven groups, each with an instructor, interacting with the patient in pairs. A teledebriefing was performed. The activity was rated as good to excellent.	Telesimulation is an innovative tool for teaching communication skills.
O’Era et al., 2021[23]. Canada.	Prospective observational pilot study - pre and post intervention.	A total of 101 nursing students provided care for a family with telesimulation. There was a pre-briefing/briefing, scenario and teledebriefing. A telecommunication tool was used to connect students, patients and facilitators. The simulated patients played roles of family members. Fifty-six percent (56%) of the students appreciated the strategy.	Telesimulation supported students’ ability to practice their decision-making.
Kurji et al., 2021[24]. Pakistan.	Describe the implementation of a telesimulation. Experience report.	A telesimulation module provided its theoretical component on communicating bad news via PowerPoint, along with an online communication challenge. Nursing students were invited to be simulated patients. The 141 trainees were divided into seven discussion groups, each with an instructor. Students were divided into pairs to interact with the simulated patient. Faculty and interns took notes of their observations for the teledebriefing.	Telesimulation is an innovative and useful tool for teaching communication skills.
Gutierrez-Barreto et al., 2021[25]. Mexico.	Identify the barriers to implementing telesimulation in medical graduation. Descriptive study with a qualitative approach.	The study sample consisted of 18 professors, 26 standardized patients and 407 students. There was a pre-briefing (10 minutes), simulated scenario (20 minutes) and teledebriefing (30 minutes). The simulation addressed a standardized patient and a videoconferencing platform. The scenario consisted of a prenatal consultation. The teledebriefing was carried out.	A taxonomy of five telesimulation barriers was structured: knowledge; installations; financing; attitude and participants. A description of the barriers can improve the telesimulation quality.
Berkman; McGuire, 2020[26]. United States	Present a telesimulation approach. An intervention study.	The intervention was carried out via Skype. Facilitators assisted apprentices and standardized patients were trained for the approach. A total of 40 sessions with 79 teams were conducted at 24 remote sites. Participants felt prepared to approach patients.	Telesimulation is feasible and valuable for students and is cost-effective.

FIGURE 3: Characterization of the studies which composed the scoping review sample – Part 1. Uberaba, MG, Brazil, 2021.

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Naik et al., 2020[27]. United States.	Evaluate the effectiveness of a telesimulation. An intervention study.	A telesimulation was developed using a locally operated high-fidelity simulator. Vital signs were displayed on a monitor and a test lung positioned over the dummy's chest, connected to a mechanical ventilator. A portable camera was used to provide images and each group of students performed virtual assistance. A teledebriefing took place.	Students found telesimulation useful and similar to a traditional simulation.
McCoy et al., 2019[11]. United States	Evaluate the feasibility of telesimulation. Viability study.	The telesimulation was based on a scenario of a mass accident in the pre-hospital environment. Content and study materials were delivered using telecommunication resources. Standardized patients and high-fidelity mannequin simulation were combined. A teledebriefing was conducted. All 32 participants were favorable of telesimulation.	The success of a medical emergency triage course using telesimulation was demonstrated.
Jewer et al., 2019[28]. Canada	Evaluate the effectiveness of telesimulation. An intervention study.	The participants were evaluated with a written test before the intervention, immediately after and after a week. Psychomotor performance was assessed by analyzing recorded videos of the chest tube insertion scenario and satisfaction was verified.	Mobile telesimulation-based training can be an effective strategy for procedural skills. Remote training at the mobile unit has comparable results with face-to-face training.
Hayden et al., 2018[29]. United States	Describe the implementation of a telesimulation. A descriptive study.	More than 50 students performed the telesimulation, including nurses, nurses, radiology technicians and doctors. There were 12 telesimulation sessions in which the instructor provided the case and moderated the teledebriefing. Students and instructors connected through a software program. An instructor observed the students face-to-face.	Telesimulation can provide training with less time and resources than face-to-face simulation.
McCoy et al., 2017[8]. United States	Compare the effectiveness of telesimulation versus face-to-face simulation. A clinical, randomized study.	A total of 32 students were randomized into a control group submitted to traditional simulation, and an intervention group submitted to tele-simulation. All students received a pre-briefing/briefing. The intervention group observed the scenario through a live television connection to the internet.	There was no significant difference regarding knowledge of groups and preference for modalities. Although both modalities have positive effects, telesimulation provides benefits in the absence of face-to-face resources.
Beissel et al., 2017[30]. France	Test the feasibility of implementing a telesimulation. An intervention study.	Eight anesthesiology residents from the United States and France participated in the session via Skype™ with instructors. Two high fidelity mannequins were used for the session. A teledebriefing was performed. The scenarios were difficult airway management in the intraoperative environment and local anesthetic toxicity. Each scenario involved two to three residents, monitored locally.	Telesimulation can be integrated into anesthesiology residents' curricula - a valuable educational adjunct.
Laurent et al., 2016[31]. Canada	To investigate whether ultrasound-guided regional anesthesia can be learned with telesimulation. An intervention study.	For four to five recruited anesthetists from different locations; ultrasound machines were made available and the trainees were connected via Skype™. Four online sessions and one offline lecture were held to teach an ultrasound-guided supraclavicular block. Participants were assessed onsite and offsite. Scores were significant in both assessments.	Ultrasound-guided regional anesthesia can be taught remotely through telesimulation.
Mikrogianakis et al., 2011[32]. Canada	Determine whether telesimulation can be used to teach the intraosseous technique. An intervention study.	Simulators located in Toronto, Canada and the other in Gaborone, Africa were used by instructors and 22 medical trainees, in real time. Cognitive and psychomotor skills and perceptions were evaluated. The trainee demonstrated their skill using an intraosseous infusion system, scored locally and via the internet. The average score on the post-test was 10 to 15 out of 15 questions.	Physicians reported a significant improvement in their comfort and knowledge. This modality offers potential for teaching other procedural skills at a distance.
Okrainec; Henao; Azzie, 2010[33]. Canada	To determine the effectiveness of telesimulation for teaching laparoscopic surgery. A randomized clinical trial.	A total of 16 surgeons from two African centers participated in a telesimulation for teaching laparoscopic surgery. Two simulators and Skype™ software were used. The intervention group underwent one remote training per week. The control group received DVD training and instructed to practice surgery at least once a week. Participants in the intervention group had statistically significant mean psychomotor scores higher than those in the control group.	Telesimulation is an effective method for teaching Laparoscopic Surgery in an economical way.

FIGURE 3: Characterization of the studies which composed the scoping review sample – Part 2. Uberaba, MG, Brazil, 2021.

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Most of the studies are recent, from 2020[26,27] and 2021[7,12,20-25], all international, highlighting American[7,8,11,12,20,21,26,27,29] and Canadian[23] scientific production[28,31-33], supported by intervention research[22,26-28,30-32]. Two categories were elaborated: telesimulation classifications and contemporary trends in telesimulation practice.

The first category addressed the main types of telesimulation in teaching and learning in health. Telesimulation can be classified into three aspects: (1) According to the synchronicity between instructor and learner, divided into synchronic (both experience the activity, online, in real time, simultaneously)[7,8,11,12,20-32] and asynchronous (the learner experiences part of the telesimulated activity offline through pre-recorded videos)[33]; (2) According to the nature of the student's participation, consisting of: observational telesimulation (the learner remotely observes the clinical scenario performance and participates in the teledebriefing)[7,8,11,12,20,23-25,27] and telesimulation mobile (the trainee can train their psychomotor skills by receiving the simulators and materials needed locally). Mobile telesimulation can be performed in the following ways: with a remote "leader" instructor and the learners at their homes[22,33]; with a remote "leader" instructor and support instructors at the training site with the learners[21,26,29-32]; and through a mobile telesimulation unit with instructors next to the students and a remote "leader" instructor[28]; (3) According to the number of educational strategies used during telesimulation - hybrid telesimulation (articulates other educational strategies with telesimulation)[27,31].

Thus, most telesimulated activities are the synchronic type[7-9,11,12,20-22,24-28,30-32]. There is equivalence in adoption of observational[7,8,11,12,20,23-25,27] and mobile[21,22,26,28-33] telesimulation. On the other hand, the type of mobile telesimulation which has been prevailing is that performed remotely with a "leader" instructor, concomitantly with support instructors at the training site[21,26,29-32].

The second category addressed the panorama of telesimulated practice and its main approaches in contemporary times, namely: (1) themes of telesimulated clinical scenarios characterized by: Management of critically-ill patients[8-9,11]; neonatal resuscitation[21,22]; fundamentals of laparoscopic surgery[33]; intraosseous technique[32]; regional anesthesia guided by ultrasound[31]; management of difficult airways in the intraoperative environment and local anesthetic toxicity[30]; chest drain insertion[28]; mechanical ventilator management in COVID-19[27]; approaching parents of critically-ill pediatric patients for research consent[26]; therapeutic nursing communication with family in the community[23]; communication of bad news[24]; neonatal consultation[25]; pediatric patient care during COVID-19[20]; (2) target audiences, comprising: medical professionals[7-9,11,28,30-33]; medical students[20-22,25,27,28]; paramedics[11]; nurses[9,11,22-24]; radiology technicians[9]; and health professionals[26]; (3) telesimulation stages and time spent, highlighted by the preparation stage characterized by the initial phase of telesimulation aimed at preparing learners to experience or observe the proposed telesimulated scenario. It is divided into: (A) Pre-simulation: characterized by sending references and materials for prior study by the learner and skills training, if necessary. Time: 15 days prior to running the scenario[24,27,31,33]. (B) Pre-briefing/briefing: moment before executing the scenario, in which the telesimulation facilitators present the telesimulated environment, the rules, the objectives of the learners, the clinical case, and the roles of the learners. Time: 10 to 15 minutes[7,8,12,20,23-25,27]. Participation step defined by: the execution moment of the telesimulated clinical scenario, by simulated patients (actors), standardized patients (trained community patients) or apprentices – students and/or professionals who will experience the scene, while the rest observe. Time: 15 to 20 minutes[8,9,20-28,30]. Finally, teledebriefing: analytical moment of online reflection/discussion about the experience. Time: 30 to 40 minutes[8,11,12,20,22-27,30].

In addition, the (4) types of instruments adopted characterized by the simulator/mannequin[8,9,11,21,22,27,28,30,31,33] were defined: simulated patient[20,23,24]; standardized patient[11,25,26] and simulator fidelity characterized by: high fidelity[8,11,27]; medium fidelity[20]; low fidelity[22]; (5) Telesimulation transmission mechanisms: SkypeTM® software[26,30,31,33]; Live TV connection to the internet[8]; Join.me®[11]; EyeSight®[11] software platform; Zoom online®[23]; Microsoft Teams®[24] platform; Via Webex®[22]; TeleSimBox®[21]; other videoconferencing platforms[9,20,25,27]; (6) Assessed skills: cognitive skills[8,22,24,28,32]; psychomotor skills[28,30,31,33]; affective skills[8,11,20-27-28,33].

The main theme that permeates the telesimulated clinical scenarios is the management of critically-ill patients[8,9,11], aimed at medical professionals[7-9,11,28,30-33]. The preparation, participation and teledebriefing steps are performed to establish a telesimulation instructional design[7-9,11,12,20-33].

High-fidelity simulators[8,9,11,21,22,27-28,30,31,33] are adopted on a large scale[8,11,27] and Skype™® software for virtual transmission[26,30-31,33]. Finally, an assessment of the learners' affective skills is highlighted[8,11,20-27.28,33].

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DISCUSSION

From the mapped results, the contemporary scenario of telesimulation practice in teaching and learning in health was understood, highlighting criteria not yet clarified by the literature, such as a description of its classifications and components, which constitute findings capable of conferring originality and advancement in the existing knowledge about telesimulation.

Although the telesimulation in health theme has been recently explored[7,12,20-27], it is already possible to identify a solid production of intervention studies in the international context with the purpose of evaluating its effectiveness[8,11,22,26-28,30-33].

When a research topic is emerging, descriptive studies which support understanding of the study object are usually first developed, then later with manuscripts capable of verifying the effectiveness and impact of its outcomes in different contexts[34]. Thus, the existing scientific collection on telesimulation can signal the effectiveness of this modality and help in choosing the best educational practices, especially in pandemic times[8,11,28,30].

There was a preponderance of synchronous telesimulation[7,8,11-12,20-28,30-32]; in this context, an American study which aimed to compare the effectiveness of face-to-face simulation with telesimulation stated that synchronous observational telesimulation can present equivalent benefits in learning to face-to-face simulation[8].

The preference for adopting synchronous telesimulation, which considers the simultaneous presence of instructors and students during the remote activity, can be justified by the enhancement of monitoring and attention directed to the needs of learners by facilitators[22-24,26].

On the other hand, there was equality in the use of observational[7,8,11,12,20,23-25,27] and mobile[21,22,26,28-33] telesimulations, possibly due to the good economic conditions of educational institutions addressed by the international literature, as they are able to obtain a larger and better trained teaching staff and also ensure the availability of simulators, anatomical parts and other materials for the psychomotor training of learners in mobile telesimulation[7].

This statement is corroborated by a Mexican study which described possible barriers to implementing telesimulation and considered the economic element fundamental to make the mobile nature of this strategy viable given the high costs of materials, software programs, simulators, installations and payment of all the personnel involved, which are all challenging conditions in the educational context of developing countries[25].

There was a prevalence of simulated scenarios aimed at the care of critical patients for medical professionals, which is a trend that raises reflection on adopting telesimulation, its viability and effectiveness, in other educational and professional areas[30-33]. With regard to telesimulated teaching in nursing, a Canadian study on therapeutic family communication concluded that telesimulation can enhance clinical decisions in nursing and strengthen decision-making, thereby configuring it as a promising teaching strategy in this profession[23].

This same study[23] still considers that the telesimulated educational practice can mean a future possibility in nursing; however, full of technological and human challenges, mainly because it requires the continuous training of a faculty capable of promoting this strategy, as well as its inclusion in the political-pedagogical plans of undergraduate courses.

The same steps which compose a clinical simulation are present in the instructional design of telesimulation, differing only in the adoption of teledebriefing. Teledebriefing is considered a fundamental step for the pedagogical success of telesimulation, since it is at this moment that learners expose their feelings online and remotely before the simulated experience, analyze the events, articulating them with the theoretical references relevant to the theme and synthesize knowledge through a structured reflection with the support of an instructor[7].

Although more than 30 methods and 10 debriefing techniques have already been identified in the literature in the last decade, there is still a shortage of studies focused on the development of clinical competences in health and nursing based on this process[35], mainly with regard to teledebriefing, its potentialities and challenges[12].

Regardless of whether a face-to-face or virtual debriefing practice is carried out, the telesimulation instructor/facilitator must be based on a structured method and an adequate debriefing technique to achieve the intended learning objectives[35].

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One finding that requires attention is that the studies included in the sample on telesimulation only characterize the fidelity of the simulator used, but do not describe the fidelity of the proposed clinical scenario. Thus, a review published with the intention of organizing concise guidelines for creating scenarios identified 20 articles that corroborate the importance of defining the fidelity of the scenario based on three aspects: environmental and equipment fidelity (they form the physical fidelity , a measure of the degree of sensory similarity between the simulated and the real environment) and psychological fidelity (the participant's perception of the simulated environment), and consider (in isolation) the fidelity of the simulator, a parameter which only covers the physical fidelity, and is not able to subsidize the fidelity level of the scenario[36].

Furthermore, it should be noted that it is fundamental to adapt the fidelity level of the scenario to the learning objectives, since excessively produced scenarios are expensive and can produce excessive fascination, dispersing the student's attention. On the other hand, low-fidelity scenarios can make it difficult for participants to immerse themselves in the activity[36].

A variety of platforms for online transmission of telesimulation was mapped; however, it is necessary to assess which technology is available to participants, the speed and capacity of the internet, video and audio resources and interfaces, which may interfere with their involvement and require that telesimulation facilitators create curricula and scenarios capable of promoting equal participation for the success of the proposed strategy[12].

The use of online platforms and technological assets in a telesimulation also requires preparation by the faculty, instructors/facilitators, their alignment and training, and above all, conducting tests for the execution and transmission of the clinical scenario before the telesimulated experience with the participants; after all, technology will be of no use without the human dexterity necessary for the correct handling/usage[7].

Emphasis for the assessment of clinical skills in health was placed on the behavioral and affective scope of learners. It is highlighted that due to the fact that participants follow the execution of the simulated scenario without performing it, it is possible to assess cognitive (knowledge) and affective (feelings/perceptions) skills in observational telesimulation, different from when adopting mobile telesimulation, which provides training and assessment of the student's psychomotor skills, even remotely[7].

Therefore, it is fundamental to know the telesimulation classifications in order to consciously and effectively use the most appropriate strategy in view of the learning objectives that one intends to achieve and evaluate, since it is inconsistent to aim for an evaluation of psychomotor skills in an observational telesimulation, or to demand an analysis of the development of clinical competences, since this condition requires an articulation of knowledge, skills and attitudes, which constitute criteria that are not always achievable depending on the type of telesimulation applied[25,37].

Still, it is understood that there is an incipience in the literature of appropriate instruments for assessing clinical skills in health in telesimulation, and that this gap has been, to date, remedied through qualitatively assessing the learner's perception of the telesimulated experience, mainly considering the conduction of interviews[7,12,25].

Study limitations

The limitation of this review is centered on the lack of clarity in the methodological description of certain articles included in the sample of this scoping review regarding the practice of telesimulation, which made it difficult to map the findings; however, it did not harm the synthesis of this knowledge.

This study contributes to advances in the areas of research, care and teaching in health and nursing by presenting a current overview of telesimulation use, capable of supporting research that intends to develop telesimulation protocols and clinical trials, and whose outcomes guide the choice of best practices in this area.

CONCLUSION

This scoping review mapped the contemporary practice of telesimulation in health, identifying a trend towards adopting synchronic telesimulated experiences and a balance between observational and mobile telesimulation practice. There was a preponderance of scenarios on the management of critically-ill patients aimed at medical professionals. The telesimulated instructional design stages are preparation, participation and teledebriefing, transmitted by online videoconferencing platforms. There is a wide use of high-fidelity simulators and assessment of affective aspects of learners.

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