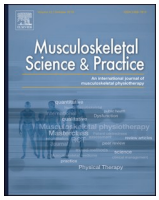
Musculoskeletal Science and Practice 75 (2025) 103244

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.elsevier.com/locate/msksp



Original article

Defining core competencies for telehealth in healthcare higher education: A Delphi study

Maria Fernanda A. Jacob [a], Junior V. Fandim [a], Felipe J.J. Reis [b,f,h], Jan Hartvigsen [c,g], Paulo H. Ferreira [d], Bruno T. Saragiotto [a,e,*]

[a] Masters and Doctoral Programs in Physical Therapy, Universidade Cidade de São Paulo, Sao Paulo, Brazil
[b] Physical Therapy Department, Instituto Federal do Rio de Janeiro (IFRJ), Rio de Janeiro, Brazil
[c] Center for Muscle and Joint Health, Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark
[d] Discipline of Physiotherapy, Faculty of Health Sciences, The University of Sydney, Sydney, Australia
[e] Discipline of Physiotherapy, Graduate School of Health, University of Technology Sydney, Sydney, Australia
[f] Pain in Motion Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium
[g] Chiropractic Knowledge Hub, Odense, Denmark
[h] School of Physical and Occupational Therapy, Faculty of Medicine, McGill University, Montreal, Canada

ARTICLE INFO

Keywords:
Telehealth
Consensus
Curriculum
Competences
Higher education

ABSTRACT

Background: While technology brings many opportunities for optimizing and improving health services, the lack of professionals trained in telehealth poses an important obstacle. Despite the existance of core competency frameworks for some healthcare professions, there is currently no consensus or guidelines on the core competencies that telehealth professionals should possess within the context of a higher education curriculum. This can hinder the potential benefits of healthcare service delivery.
Objective: To establish a consensus on the core competencies in telehealth that should be integrated into higher education curricula for healthcare professionals.
Methods: A three-round international eDelphi study was conducted. The panel comprised of a diverse group of experts in telehealth, clinicians, lectures and professors, administrators, and teaching coordinators. In the first round, an international steering committee developed a list of competencies that were presented to the panel members and they were asked to rate their level of agreement and suggest additional competencies. The consensus was established based on the competencies that achieved a high level of agreement (>75%) by the end of the third round.
Results: We included 100 panellists from 18 different countries. By the end of the third round, we reached a consensus for 47 core competencies in a telehealth curriculum organized into 12 domains: principles of telehealth; care planning and management; assessment, diagnosis, and treatment; adequacy of the environment; professionalism; legal aspects; patient privacy; patient safety; access and equity; patient preference; technology; applicability of telehealth.
Conclusion: We identified the core competencies in a telehealth curriculum organized into 12 domains to be used as a foundation for training future health professionals.

1. Introduction

Telehealth has become an increasingly important component of healthcare delivery, especially after the Coronavirus disease (COVID-19) pandemic. The advantages of telehealth include reductions in direct and indirect costs for patients (Dorsey and Topol, 2016), optimized management of patients with chronic diseases (Flodgren et al., 2015), increased frequency of communication between clinician and patient,

Abbreviations: COVID-19, Coronavirus disease; WHO, World Health Organization; CREDES, Conducting and REporting DElphi Studies.

* Corresponding author. Discipline of Physiotherapy, Graduate School of Health, University of Technology Sydney, 100 Broadway, Ultimo, 2007, Australia.
E-mail addresses: mafejacob@hotmail.com (M.F.A. Jacob), junior_fandim@hotmail.com (J.V. Fandim), professorfelipereis@yahoo.com.br (F.J.J. Reis), jhartvigsen@health.sdu.dk (J. Hartvigsen), paulo.ferreira@sydney.edu.au (P.H. Ferreira), Bruno.TirottiSaragiotto@uts.edu.au (B.T. Saragiotto).

https://doi.org/10.1016/j.msksp.2024.103244
Received 5 March 2024; Received in revised form 11 November 2024; Accepted 3 December 2024
Available online 9 December 2024

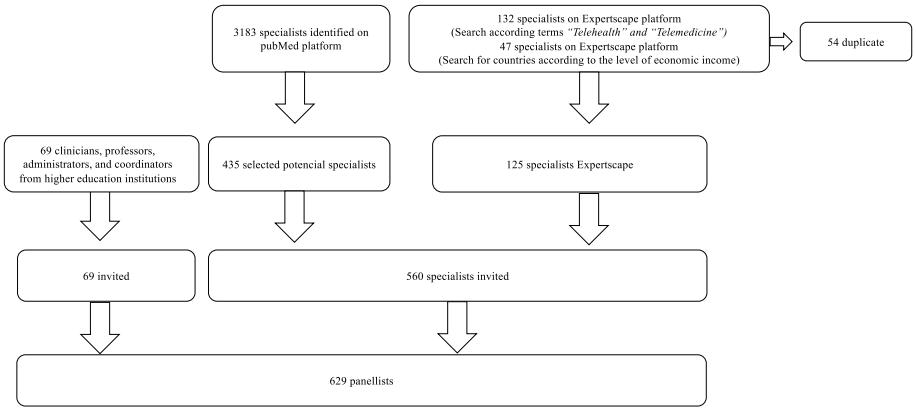


Fig. 1. Flowchart of the specialists identified.

and greater access to care (Banbury et al., 2014). However, several barriers remain, such as difficulty with internet access (Fernandes et al., 2022a), lack of digital literacy (Dharmasri et al., 2020; Wollsching--Strobel et al., 2021), lack of access to technology (Dharmasri et al., 2020), diminished feeling of connection between clinician-patient (Eriksson et al., 2011), concerns about patient privacy in the virtual environment (Jelin et al., 2012), lack of digital competence required for telehealth, and few higher education initiatives focused on telehealth training (Nazeha et al., 2020; Konttila et al., 2019; Kulju et al., 2024). Recent systematic reviews have demonstrated the increasing importance of telehealth in healthcare delivery (Konttila et al., 2019; Kulju et al., 2024; Herath et al., 2017; Hui et al., 2021; Budakoğlu et al., 2021)

University educators report that the COVID-19 pandemic was a catalyst for them to implement telehealth in their educational programs (Davies et al., 2022; Cottrell and Russell, 2020). The World Health Organization (WHO) has published an action plan on eHealth to promote universal health coverage, support training plans for future health professionals, and encouraging new disciplines in the academic curricula of higher education institutions to train professionals to work with telehealth (World Health Organization (WHO), 2016). Despite these efforts, the shortage of trained professionals remains a challenge to providing quality telehealth services. Lack of confidence, self-efficacy, and knowledge in telehealth among service providers has been shown to limit its use and acceptance, highlighting the need for structured and standardized training (Chan et al., 2023; Fernandes et al., 2022b). As a result, the digital skills of health professionals became one of the key points emphasized by the WHO to advance the delivering of telehealth (Organization, 2015).

Currently, higher education curricula for healthcare professionals are underdeveloped in the area of digital health (Budakoğlu et al., 2021; Edirippulige and Armfield, 2017; Gartz and O'Rourke, 2020). Systematic reviews have demonstrated that digital competence education can lead to improvements in knowledge, skills, attitudes, and self-efficacy (Konttila et al., 2019; Kulju et al., 2024; Chan et al., 2023; Jiang et al., 2024). However, there is still a lack of standardization in teaching methodologies and telehealth competencies, reviews indicating that there is currently no consensus on telehealth competencies within the context of higher education curricula (Nazeha et al., 2020; Konttila et al., 2019; Kulju et al., 2024; Hui et al., 2021; Budakoğlu et al., 2021; Chan et al., 2023; Edirippulige and Armfield, 2017; Gartz and O'Rourke, 2020; Jiang et al., 2024; Waseh and Dicker, 2019; Chike-Harris et al., 2021). Therefore, standardized telehealth training within higher education is urgently needed to prepare healthcare professionals for the increasing demand for telehealth services.

Given the gaps in confidence, self-efficacy, and knowledge, as well as the lack of consensus on telehealth competencies, it is essential to establish a standardized framework. The objective of this study is to reach a consensus on the core competencies in telehealth that should be integrated into higher education curricula for healthcare professionals using an international eDelphi study.

2. Methods

2.1. Study design

A three-round international modified eDelphi study was conducted. This study followed the recommendations of the Conducting and REporting DElphi Studies (CREDES) (Jünger et al., 2017) and the proposed guidelines for the development of opinion using the Delphi method (Sinead Keeney, 2011; Trevelyan and Robinson, 2015). The Ethics Committee of the *Universidade da Cidade de São Paulo* approved the study (51221021.0.0000.0064), and registered with the Open Science Framework (DOI 10.17605/OSF.IO/MD5JW). The process ensured that panellists remained anonymous throughout the study (Hanafin, 2004).

In this paper, we define 'telehealth' as the provision of healthcare services using information and communication technologies (ICT), such as videoconferencing software.

Two research authors (MFJ and BTS) coordinate day-to-day management and do not act as panellists during the study.

2.2. eDelphi development

An international steering committee composed of experts in telehealth was established to initiate, support, and guide the study. The steering committee developed the initial list of core competencies by reviewing existing frameworks from multiple healthcare disciplines (Budakoğlu et al., 2021; Edirippulige and Armfield, 2017; Chike-Harris et al., 2021; Jonas et al., 2019; Bulik and Shokar, 2010; Davies et al., 2021; Ali et al., 2015; Galpin et al., 2021; van Houwelingen et al., 2016). The initial list of core competencies was subsequently organized into eleven domains: telehealth principles, care planning and management, assessment, diagnosis and treatment, suitability of the environment, professionalism, legal aspects, patient privacy, patient safety, access and equity, patient preference, and technology.

The closed-ended questions developed with 47 competencies across 11 domains. In addition to the closed questions, the questionnaire had an open question for panellists to provide their suggestions and opinions.

2.3. eDelphi panel

In order to compose the panel, we selected panellists within the following eligibility criteria: (i) Any gender and without geographic restriction; (ii) Able to speak English; (iii) Experts in telehealth and telemedicine research through searches on the Expertscape website; (iv)

Table 1
Characteristics of the panellists in the Delphi panel.

Panellists	Round 1 (n = 100)	Round 2 (n = 85)	Round 3 (n = 80)
Age			
Mean age (in Years), mean (SD)	41 (10)	41 (10)	41 (10)
Gender			
Female	63 (63%)	51 (60%)	47 (55%)
Male	37 (37%)	34 (40%)	33 (39%)
Country of work			
Brazil	46 (46%)	37 (44%)	33 (41%)
Australia	20 (20%)	17 (20%)	17 (21%)
United States of America	8 (8%)	6 (7%)	7 (9%)
Denmark	3 (3%)	3 (4%)	2 (3%)
Italy	3 (3%)	3 (4%)	3 (4%)
South Africa	3 (3%)	3 (4%)	3 (4%)
Argentina	2 (2%)	2 (2%)	2 (2%)
Canada	2 (2%)	2 (2%)	2 (2%)
India	2 (2%)	1 (1%)	1 (1%)
Netherlands	2 (2%)	2 (2%)	2 (2%)
Spain	2 (2%)	2 (2%)	2 (2%)
Belgium	1 (1%)	1 (1%)	1 (1%)
Botswana	1 (1%)	1 (1%)	1 (1%)
Germany	1 (1%)	1 (1%)	1 (1%)
Israel	1 (1%)	1 (1%)	1 (1%)
Nepal	1 (1%)	1 (1%)	1 (1%)
Singapore	1 (1%)	1 (1%)	1 (1%)
United Kingdom of Great Britain and Northern Ireland	1 (1%)	1 (1%)	0 (0%)
Ethnic Group			
White (European descent)	60 (60%)	52 (61%)	51 (64%)
Latino (Latin American, Hispanic descent)	27 (27%)	22 (26%)	20 (25%)
Black (African, Afro-Caribbean descent)	5 (5%)	5 (6%)	3 (4%)
South Asian/South Asian descent[a]	5 (5%)	4 (5%)	4 (5%)
East/Southeast Asian [b]	2 (2%)	1 (1%)	1 (1%)
Indigenous (First Nations, Métis, Inuk/Inuit descent)	0 (0%)	0 (0%)	0 (0%)
Middle Eastern[c]	0 (0%)	0 (0%)	0 (0%)
Other (East Asia + South Asian)	1 (1%)	1 (1%)	1 (1%)
Area of work (Current Position/Highest level of education)			
Researcher and lecturer at higher education	37 (37%)	33 (39%)	30 (38%)
Clinician	37 (37%)	28 (33%)	29 (36%)
Researcher	19 (19%)	18 (21%)	15 (19%)
Administrator (e.g., coordinator, director) or lecturer only at higher education	7 (7%)	6 (7%)	6 (8%)

[a] East Indian, Pakistani, Bangladeshi, Sri Lankan, Indo-Caribbean descent.
[b] Chinese, Korean, Japanese, Taiwanese descent or Filipino, Vietnamese, Cambodian, Thai, Indonesian, other Southeast Asian descent.
[c] Arab, Persian, West Asian descent (e.g., Afghan, Egyptian, Iranian, Lebanese, Turkish, Kurdish.

Researchers who published at least one randomized controlled trial or a systematic review, as first or last author in the last five years, using the search terms: “telemedicine” and “telehealth”; (v) Clinicians with previous experience (at least 6 months) working with telehealth or remote care at a distance (vi) Higher education administrators (e.g., coordinator, director); and higher education lecturers (no prior experience teaching telehealth required).

We selected the first experts on the Expertscape platform in worldwide, using the search term “telehealth” and also the first experts on the Expertscape platform using the search term “telemedicine”. We then selected experts by continent and after that by low- and middle-income economy countries and selected the first experts presented by the expertscape platform in each of these countries.

Based on a previous Delphi study in healthcare, samples range from 23 to 603 panellists (Yamato et al., 2015; Silva et al., 2019). We selected potential authors that appeared in the Expertscape and PubMed. Invitations were sent to 560 potential panel panellists via email.

In addition, to compose our panel, we selected clinicians (with telehealth experience), higher education lecturers, administrators, and coordinators through posting on social media such as Instagram, LinkedIn, and Twitter. We asked all selected panellists to nominate one or more panellists they considered relevant to the study using snowball sampling (Glajchen et al., 2018). Although a snowball sampling method was used, the steering committee ensured that the initial selection of panellists was representative of diverse healthcare professions and geographic regions.

2.4. Procedures of the modified eDelphi

A pilot test was conducted on a small sample (n = 10) of the International Steering Committee to identify any potential issues with the questionnaire and study design. Panellists in the pilot test provided feedback on content, question clarity, and operational logistics of the eDelphi.

The Delphi panel was asked to rate each of the 47 competencies across the eleven domains. An electronic survey developed in an online software program, TypeForm® platform, was administered iteratively over three rounds. Round 1 was open for 8 weeks, round 2 open for 8 weeks and round 3 open for 6 weeks. To encourage completion, five reminder emails were sent over that period to non-responders. Each round took approximately 10–20 min to complete.

2.5. Round 1

In round 1, panellists received a questionnaire with closed questions relevant to teaching telehealth containing curricular competencies. The judgment, of the closed questions, was analyzed by level of agreement using a 5-point Likert scale with the following scores: (1) Completely disagree (2) Disagree (3) Neutral (Neither agree nor disagree) (4) Agree (5) Completely agree. (Supplementary material 1).

The open-text responses were analyzed by grouping similar responses and assigning them to the most relevant domain as determined by the steering committee.

Competencies from the closed questions that achieved more than 75% agreement (Diamond et al., 2014) (high agreement) among panellists were highlighted and taken back to round 2 so that panellists could reconsider their responses, along with competencies that scored from 74% to 50% (moderate agreement). Competencies scoring from 49% to 0 (low agreement) were excluded. For a better understanding of the results of the first round, the item rankings were arranged according to the level of agreement from the highest to the lowest. The open question opinions were raised in round 1 and presented to all panellists in a quantitative way in round 2 in a closed questionnaire.

2.6. Round 2

In the second round, the panellists received the results of the closed questions, with high and moderate agreement reached in round 1, together with the domains and competencies suggested in the open question of the first round in a closed questionnaire, which they judged quantitatively regarding the degree of agreement, through of the 5-point Likert scale. Competencies that reached more than 75% agreement among panellists were highlighted in terms of reaching a consensus (Diamond et al., 2014). Competencies that scored from 49% to 0 of agreement were excluded. Competencies that scored 74%–50% were presented again to panellists for quantitative judgment in the third round.

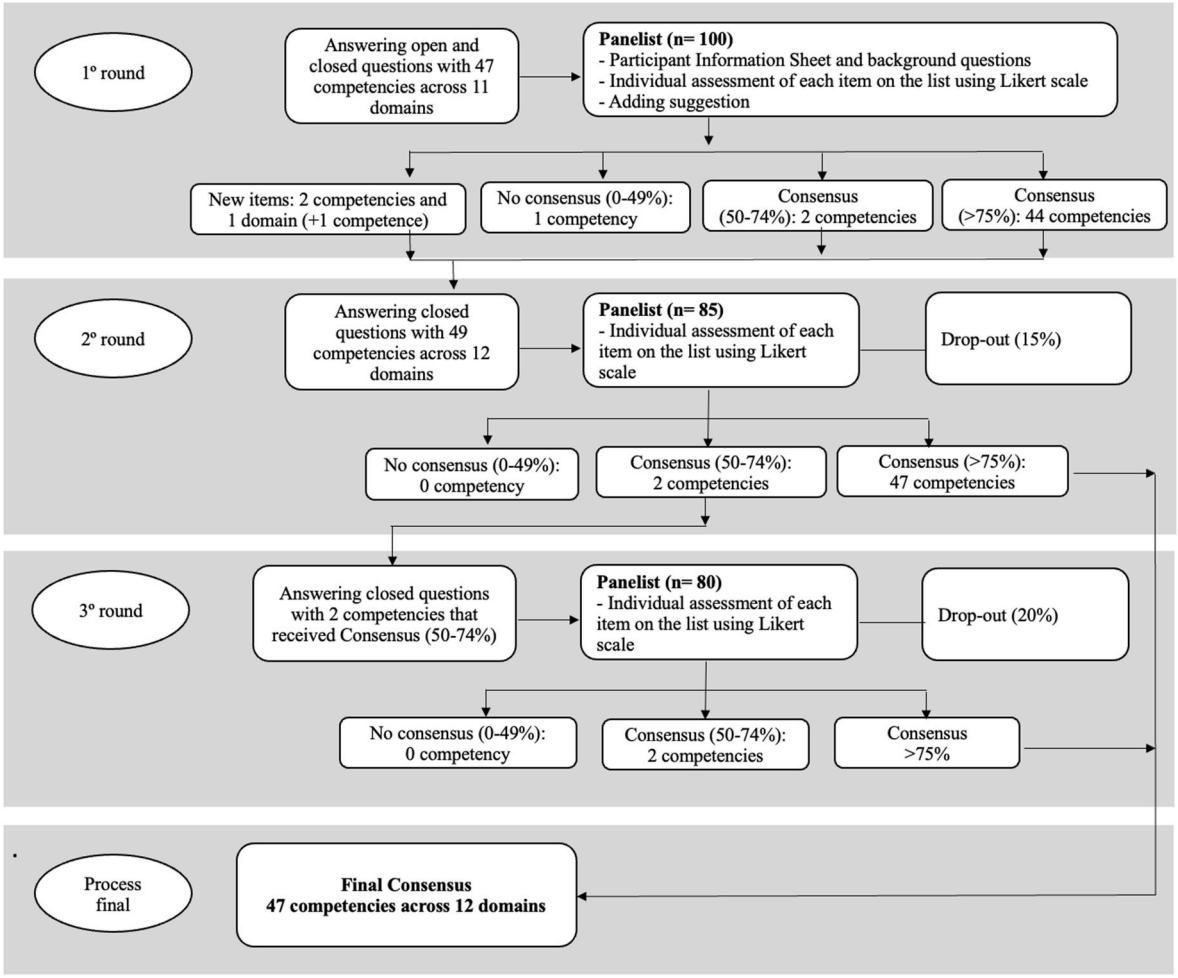


Fig. 2. Flowchart of the 3 rounds of the modified Delphi study.

2.7. Round 3

In round 3, panellists received high agreement results that reached a consensus and judged only the moderate agreement competencies in a closed questionnaire. The competencies that reached more than 75% of agreement between the panellists, entered the highlighted competencies regarding the reach of a consensus. Competencies that scored from 0 to 49% of agreement and from 50% to 74% were excluded.

At the end of the third round, we reached a reliable consensus through the Delphi process based on the quantitative results. If consensus was not reached, we would present the disagreement responses in order to provide informative insights and highlight differences in perspectives regarding the telehealth curriculum.

2.8. Data analysis

The data obtained in the three rounds were stored in an Excel Office® spreadsheet. Descriptive statistics, including means and standard deviations, were used to describe panellists' demographic characteristics.

We performed descriptive data analysis with measures of central tendency (mean) in the three rounds, on the scores (4) Agree and (5) Strongly agree, of the 5-point Likert scale of each section of the closed questions, to find the level of consensus. To calculate the level of consensus, the sum of the panel members' scores was divided by the total possible score (i.e., 100% very important) and then values were converted into percentages.

The ranking of statements was presented from the highest to the lowest value achieved in the average scores. We established a cut-off point for consensus after the second and third rounds; consensus was defined with competencies of agreement above 75%, based on previous Delphi studies (Diamond et al., 2014). All descriptive analyses using Microsoft® Excel version 16.65 software for macOS.

3. Results

Fig. 1 provides a summary of the process of identifying all panelists. We identified 629 panellists, and 100 completed the eDelphi survey in round 1.

The 100 panellists were based on 18 different countries, 63% women and 37% men (Table 1). In round 2 we got 85 panellists and in round 3, 80 panellists. Regarding the area of work, in round 1, 37% panellists were researchers and lectures at higher education, 37% clinicians, 19% researchers and 7% administrators (coordinators or directors) or lecturer only in higher education.

3.1. Delphi rounds 1 to 3

Initially, 89% of panellists believed that telehealth needs to be taught as part of the mandatory health education curriculum, and 79% of panellists consider that telehealth should be a subject taught in all higher education health care courses (Medicine, Physiotherapy, Nurse, Nutrition, Speech therapy, Psycology, Pharmacy, Occupation Therapy, Dentistry, Social Work, Physical Educator). A summary of each eDelphi round is provided in Fig. 2.

Regarding the telehealth domains presented to panellists in round 1,

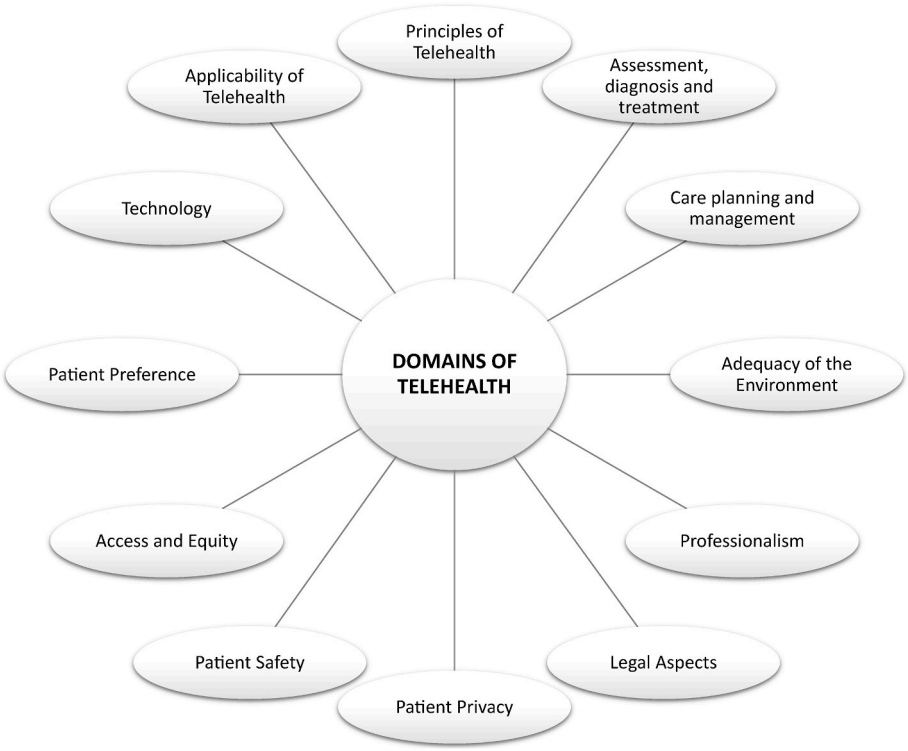


Fig. 3. Domains of telehealth curriculum.

the only competence that was excluded for not reaching the necessary consensus was "history of telehealth", within the domain "principles of telehealth" (49% agreement).

The competencies "Time saving" from the "Patient preference" domain and "Hardware operation enabling telehealth delivery" from the "Technology" domain reached moderate agreement (67% and 71%, respectively) (see Fig. 3). All other competencies achieved high agreement (>75%).

Of the eleven domains presented in Round 1, one more domain was added for Round 2, totaling 12 domains. The domain suggested by the panellists and included in round 2 was "applicability of telehealth" with the competence "practical placement opportunities".

Considering the suggestions of the panellists, presented in Round 1, the following competence was added to the domain "Care planning and management": "Have a clear process to establishing communication, consent and privacy at the beginning of each telehealth session". In the domain "Assessment, diagnosis and treatment" the competence "Methods for remote patients monitoring" was added.

In round 2, the competencies "Time saving" from the "Patient preference" domain and "Hardware operation enabling telehealth delivery" from the "Technology" domain reached moderate agreement (62% and 74%, respectively). All other competencies achieved high agreement (>75%).

We presented in round 3 only the competencies of moderate agreement, "Time saving" and "Hardware operation enabling telehealth delivery", to be judged. However, at the end of round 3 these two competencies were excluded (70% and 74%, respectively) from the final result of the consensus reached by the panellists.

In the final round, the participants reached consensus on 12 domains to be addressed in telehealth education, covering 47 competencies (Table 2).

4. Discussion

4.1. Main findings

The competencies presented in round 1 achieved high agreement, except for "history of telehealth" in the "principles of telehealth" domain. A new domain was added in round 2, and two competencies were added to existing domains based on panellists' suggestions. In round 2, two competencies reached moderate agreement, but they were eventually excluded in round 3. Overall, the panellists reached a consensus on 12 domains and 47 competencies. This framework provides recommendations on the competencies needed to compose a telehealth curriculum in health care higher education.

4.2. Strengths

This study has several strengths. First, the panel was carefully selected to ensure representativeness, comprising a diverse group of panellists from different healthcare professions and from different countries. This allowed for a comprehensive and global perspective on the competencies required to implement a telehealth curriculum. Second, the high level of agreement (>75%) in 44 of the 47 competencies presented in round 1 highlights the consensus reached among panellists, demonstrating the robustness of the study. Finally, the inclusion of three new suggested competencies provided a more comprehensive and up-to-date framework for telehealth curriculum, indicating the flexibility and responsiveness of the study to changes in the field.

It is important to note that this study is unique in compiling core competencies for a telehealth curriculum across all healthcare professions. Additionally, no Delphi study was found that involved panellists from both low-, middle- and high-income countries to suggest a consensus on telehealth competencies. While some studies sought consensus on competencies needed in specific areas, such as medicine, physiotherapy, or nursing (Davies et al., 2021; Ali et al., 2015; Galpin et al., 2021; Erickson et al., 2015), this study achieved a consensus across all health care professions, enhancing the growing importance of

Table 2
The core competencies framework in Telehealth curriculum at health care higher education.

Domain 1	**Principles of telehealth**
1	Differences and similarities between virtual and face-to-face assistance, including risks and benefits
2	Patient triage and screenings
3	Objectives of the telehealth offer
4	Evidence-based practice in telehealth
5	Definition and terminology
6	Description of the financial impact of telehealth care for the health system, the provider and the patient
Domain 2	**Care planning and management**
1	Development of a patient care plan, checking whether the approach should be mixed, face-to-face care combined with telehealth
2	Stimulation of patient self-management and self-care
3	Obtaining patient information, for example the address, if you need an emergency service
4	Patient instructions related to the appointment, such as office hours, technical details (lighting, camera position), professional contact information and platform settings used
5	Have a clear process for establishing communication, consent and privacy at the beginning of each telehealth session.
Domain 3	**Assessment, diagnosis and treatment**
1	Preparation of a treatment plan and delivery of treatment via telehealth
2	Practical classes with the development of simulated and real care, promoting the clinical experience of telehealth
3	Applicability of services via synchronous or written materials and/or asynchronous videos
4	Qualification of the student to perform assessment, clinical examination and diagnosis of the patient in the virtual environment
5	Methods for remote patient monitoring
Domain 4	**Adequacy of the Environment**
1	Setting the physical environment for lighting so that the patient visualizes the therapist
2	Influence of noise in the therapist's and patient's environment
3	Camera use instructions: angles and framing
4	Usage etiquette instructions, such as: tone of voice, eye contact, body language, greetings and closings, attention to interruptions, professional attire
5	Instruction of the service location, such as: clean space, no distractions
Domain 5	**Professionalism**
1	Align expectations and goals of care between therapist and patient
2	Creating safe care through listening and trusting with the patient
3	Empathetic communication, creating a therapist-patient relationship, bonding with the patient, caregivers and family members
Domain 6	**Legal Aspects**
1	Patients' rights in accepting or refusing telehealth
2	Understanding Federal and Local Laws in Providing Telehealth Service
3	Understanding Federal and Local Laws Regarding Telehealth Service Reimbursement
Domain 7	**Patient Privacy**
1	Need to obtain patient consent if there are videos or photos of the service
2	Generate patient privacy during telehealth
3	Confidentiality of information registered in the virtual service and how to store it
Domain 8	**Patient Safety**
1	Identification of the risks, benefits and limitations of the patient when receiving care via telehealth
2	Patient safety risks when receiving care via telehealth, identifying the patient's health conditions and the physical environment
3	How to deal with emergencie and referral of the patient to the emergency room
4	Understanding data security requirements in the use of telehealth platforms, storage of patient data in compliance with federal, state, and professional agencies
5	Patient instructions for setting up the physical environment for care.
6	Identification of patient companions, if you need help in the assessment or care, and ensure safety when necessary
7	Recording in medical records of telehealth care
Domain 9	**Access and Equity**
1	Equity in patient care, considering any possible disability of the patient (eg, speech, gait, mobility)
2	Considerations regarding cultural, social and digital literacy barriers in virtual service
3	Equity in patient care, assessing socioeconomic gaps in access to virtual care
Domain 10	**Patient Preference**
1	Personalized education and patient empowerment
2	Facilitate access and monitoring of health care
3	Access to different health care providers
Domain 11	**Technology**
1	Security of the virtual environment and service platforms
2	Preparation for use and technical troubleshooting
3	Operation on existing software to provide a virtual service
Domain 12	**Applicability of telehealth**
1	Practical placement opportunities

interprofessional education (Herath et al., 2017; Broyles et al., 2013).

4.3. Limitations

One common limitation in Delphi studies is the potential for limited representativeness in the panel, which can affect the generalizability of the results. In our study, most of the participants were centred in Brazil, Australia and the United States of America, with low participation from other countries. Further studies should include a more balanced and diverse representation in their panels to enhance the external validity of the results.

4.4. Comparison with other studies

This discussion focuses on literature addressing telehealth competencies at the higher education level, rather than post-university or continuing professional development. Telehealth is a resource that permeates several disciplines within a teaching program in undergraduate health care courses (Davies et al., 2022; Cottrell and Russell, 2020; Husain et al., 2020; Harden et al., 1984; Thistlethwaite, 2015). In our study, we identified several competencies that can be integrated into an integrative curriculum across a variety of disciplines, such as developing empathic communication, creating a therapist-patient relationship, and creating a bond with the patient, caregivers, and family members (Gunderman and Alavanja, 2016; Wali et al., 2016). We suggest that these competencies (e.g., all behavior-related competencies) can be taught in the form of an integrative curriculum (Husain et al., 2020; Malik and Malik, 2011), which can solve the issue of lack of time and an overcrowded curriculum (Davies et al., 2022; Thistlethwaite, 2015; Guraya and Barr, 2018). Other competencies, such as privacy during care and confidentiality of patient information, are also competencies that can permeate other disciplines, as they are necessary attitudes that future professionals acquire in their training (Beauchamp and Childress, 1994).

The competencies "acquiring knowledge about the history of telehealth", "time-saving", and "hardware operation enabling telehealth delivery" were excluded. The first may not be necessary for all educational institutions to include in their curriculum, "time-saving" can often be inferred from the definition of telehealth itself, and hardware operation will depend on the type of technology that educational institutions have. We suggest that educational institutions take a critical look at these competencies whether they want to include in their telehealth curriculum and ensure they are relevant to the context needed.

With the growth of remote interventions, educational institutions should prioritize preparing future professionals for the practical application of telehealth. We found that the applicability of telehealth was an important domain that emerged from the panellists. Simulated calls in practical classes, telehealth clinical placements, tutorials on telehealth, monitoring calls by telephone or videoconferences, follow-up of virtual clinics, group assignments are all valuable opportunities for telehealth

practices. We observed this in other studies have consistently reported that professionals have greater confidence, acceptance, and basic skills in using telehealth after receiving such training (Fernandes et al., 2022b; Jonas et al., 2019; Brockes et al., 2017).

4.5. Implications

As telehealth continues to grow and becomes more essential to reach underserved populations regardless of location, our consensus provides a starting point for training future health professionals in telehealth. We believe our findings are relevant and can be used to guide the design and implementation of a telehealth curriculum. While certain competencies, such as empathetic communication and the therapist-patient relationship, are already core to most healthcare professional education programs, these competencies must be specifically adapted for the telehealth context. In a virtual setting, healthcare providers need to develop new strategies for building rapport, compensating for the lack of non-verbal communication, and ensuring patient trust.

It was not our purpose to rank or prioritize competencies, and we believe it is important to include a wide range of competencies to build a curriculum that ensures sufficient knowledge. Future research on validation, implementation, and effectiveness needs to be conducted to investigate whether the structure provided in this study covers the needs for training future professionals. Finally, it will be important to conduct further research to determine at which point during their undergraduate courses these competencies should be introduced.

This Delphi study is particularly relevant to musculoskeletal physiotherapy, where telehealth has increasingly been adopted for remote consultations and follow-up care. Telehealth can be integrated with in-person services by offering patients virtual assessments and ongoing management, while in-person visits can be reserved for situations requiring hands-on treatment or more detailed physical assessments. This hybrid model allows for continuity of care, particularly for patients with chronic musculoskeletal conditions, while also improving access and reducing the need for travel to healthcare facilities.

5. Conclusion

This international consensus group formed by experts, clinicians, and lecturers has identified the core competencies in a telehealth curriculum organized into 12 domains that can be used as a foundation for training future health professionals.

CRediT authorship contribution statement

Maria Fernanda A. Jacob: Conceptualization, Methodology, Formal analysis, Project administration, Writing – original draft. **Junior V. Fandim:** Methodology, Formal analysis, Data curation, Writing – review & editing. **Felipe J.J. Reis:** Conceptualization, Supervision, Writing – review & editing. **Jan Hartvigsen:** Conceptualization, Methodology, interpretation of results, Writing – review & editing. **Paulo H. Ferreira:** Supervision, interpretation of results, Writing – review & editing. **Bruno T. Saragiotto:** Conceptualization, Methodology, Formal analysis, Data curation, Project administration, Supervision, Writing – review & editing.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

None.

Acknowledgements

We would like to acknowledge all panellists of the Delphi study for their time and contributions, all members team, the institutions for their insightful input with regard to the planning and conduction of this project, and the support of the Coordination of Superior Level Staff Improvement (CAPES), Brazil.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.msksp.2024.103244.

References

Ali, N.S., Carlton, K.H., Ali, O.S., 2015. Telehealth education in nursing curricula. Nurse Educat. 40, 266–269. https://doi.org/10.1097/NNE.0000000000000149.

Banbury, A., Roots, A., Nancarrow, S., 2014. Rapid review of applications of e-health and remote monitoring for rural residents. Aust. J. Rural Health 22, 211–222. https://doi.org/10.1111/ajr.12127.

Beauchamp, T.L., Childress, J.F., 1994. Principles of Biomedical Ethics. Edicoes Loyola.

Brockes, C., Grischott, T., Dutkiewicz, M., Schmidt-Weitmann, S., 2017. Evaluation of the education "clinical telemedicine/e-health" in the curriculum of medical students at the university of zurich. Telemed. J. e Health 23, 899–904. https://doi.org/10.1089/tmj.2017.0011.

Broyles, L.M., Conley, J.W., Harding, J.D., Gordon, A.J., 2013. A scoping review of interdisciplinary collaboration in addictions education and training. J. Addict. Nurs. 24, 29–36. https://doi.org/10.1097/JAN.0B013E318282751E.

Budakoğlu, I.İ., Sayılır, M.Ü., Kıyak, Y.S., Coşkun, Ö., Kula, S., 2021. Telemedicine curriculum in undergraduate medical education: a systematic search and review. Health Technol. 1–9. https://doi.org/10.1007/s12553-021-00559-1.

Bulik, R.J., Shokar, G.S., 2010. Integrating telemedicine instruction into the curriculum: expanding student perspectives of the scope of clinical practice. J. Telemed. Telecare 16, 355–358. https://doi.org/10.1258/jtt.2010.090910.

Chan, S.C.C., Choa, G., Kelly, J., Maru, D., Rashid, M.A., 2023. Implementation of virtual OSCE in health professions education: a systematic review. Med. Educ. 57, 833–843. https://doi.org/10.1111/medu.15089.

Chike-Harris, K.E., Durham, C., Logan, A., Smith, G., Dubose-Morris, R., 2021. Integration of telehealth education into the health care provider curriculum. A Review, Telemedicine and E-Health 27, 137–149. https://doi.org/10.1089/tmj.2019.0261.

Cottrell, M.A., Russell, T.G., 2020. Telehealth for musculoskeletal physiotherapy. Musculoskelet Sci Pract 48, 102193. https://doi.org/10.1016/j.msksp.2020.102193.

Davies, L., Hinman, R.S., Russell, T., Lawford, B., Bennell, K., 2021. An international core capability framework for physiotherapists to deliver quality care via videoconferencing: a Delphi study. J. Physiother. 67, 291–297. https://doi.org/10.1016/j.jphys.2021.09.001.

Davies, L., Lawford, B., Bennell, K.L., Russell, T., Hinman, R.S., 2022. Telehealth education and training in entry-to-practice physiotherapy programs in Australian universities: a qualitative study with university educators. Muscoskel. Care. https://doi.org/10.1002/msc.1723.

Dharmasri, C.J., Griesemer, I., Arbeeva, L., Campbell, L.C., Cené, C.W., Keefe, F.J., Oddone, E.Z., Somers, T.J., Allen, K.D., 2020. Acceptability of telephone-based pain coping skills training among African Americans with osteoarthritis enrolled in a randomized controlled trial: a mixed methods analysis. BMC Muscoskel. Disord. 21, 545. https://doi.org/10.1186/s12891-020-03578-7.

Diamond, I.R., Grant, R.C., Feldman, B.M., Pencharz, P.B., Ling, S.C., Moore, A.M., Wales, P.W., 2014. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. J. Clin. Epidemiol. 67, 401–409. https://doi.org/10.1016/j.jclinepi.2013.12.002.

Dorsey, E.R., Topol, E.J., 2016. State of telehealth. N. Engl. J. Med. 375, 154–161. https://doi.org/10.1056/NEJMra1601705.

Edirippulige, S., Armfield, N.R., 2017. Education and training to support the use of clinical telehealth: a review of the literature. J. Telemed. Telecare 23, 273–282. https://doi.org/10.1177/1357633X16632968.

Erickson, C., Fauchald, S., Ideker, M., 2015. Integrating telehealth into the graduate nursing curriculum. J. Nurse Pract. 11, e1–e5. https://doi.org/10.1016/j.nurpra.2014.06.019.

Eriksson, L., Lindström, B., Ekenberg, L., 2011. Patients' experiences of telerehabilitation at home after shoulder joint replacement. J. Telemed. Telecare 17, 25–30. https://doi.org/10.1258/jtt.2010.100317.

Fernandes, L.G., Devan, H., Fioratti, I., Kamper, S.J., Williams, C.M., Saragiotto, B.T., 2022a. At my own pace, space, and place: a systematic review of qualitative studies of enablers and barriers to telehealth interventions for people with chronic pain. Pain 163, e165–e181. https://doi.org/10.1097/j.pain.0000000000002364.

Fernandes, L.G., Devan, H., Fioratti, I., Kamper, S.J., Williams, C.M., Saragiotto, B.T., 2022b. At my own pace, space, and place: a systematic review of qualitative studies of enablers and barriers to telehealth interventions for people with chronic pain. Pain 163, e165–e181. https://doi.org/10.1097/j.pain.0000000000002364.

Flodgren, G., Rachas, A., Farmer, A.J., Inzitari, M., Shepperd, S., 2015. Interactive telemedicine: effects on professional practice and health care outcomes. Cochrane

Database Syst. Rev. 2015. https://doi.org/10.1002/14651858.CD002098.pub2. CD002098.
Galpin, K., Sikka, N., King, S.L., Horvath, K.A., Shipman, S.A., 2021. Expert consensus: telehealth skills for health care professionals. Telemed. J. e Health 27, 820–824. https://doi.org/10.1089/tmj.2020.0420.
Gartz, J., O'Rourke, J., 2020. Telehealth educational interventions in nurse practitioner education: an integrative literature review. J Am Assoc Nurse Pract. https://doi.org/10.1097/JXX.0000000000000488.
Glajchen, M., Berkman, C., Otis-Green, S., Stein, G.L., Sedgwick, T., Bern-Klug, M., Christ, G., Csikai, E., Downes, D., Gerbino, S., Head, B., Parker-Oliver, D., Waldrop, D., Portenoy, R.K., 2018. Defining core competencies for generalist-level palliative social work. J. Pain Symptom Manag. 56, 886–892. https://doi.org/10.1016/j.jpainsymman.2018.09.002.
Gunderman, R.B., Alavanja, A., 2016. Education in professionalism: metrics or culture? Acad. Radiol. 23, 652–654. https://doi.org/10.1016/J.ACRA.2015.12.003.
Guraya, S.Y., Barr, H., 2018. The effectiveness of interprofessional education in healthcare: a systematic review and meta-analysis. Kaohsiung J. Med. Sci. 34, 160–165. https://doi.org/10.1016/j.kjms.2017.12.009.
Hanafin, S., 2004. Review of Literature on the Delphi Technique. National Children's Office, Dublin.
Harden, R.M., Sowden, S., Dunn, W.R., 1984. Educational strategies in curriculum development: the SPICES model. Med. Educ. 18, 284–297. https://doi.org/10.1111/j.1365-2923.1984.tb01024.x.
Herath, C., Zhou, Y., Gan, Y., Nakandawire, N., Gong, Y., Lu, Z., 2017. A comparative study of interprofessional education in global health care: a systematic review. Medicine 96. https://doi.org/10.1097/MD.0000000000007336.
Hui, K.Y., Haines, C., Bammann, S., Hallandal, M., Langone, N., Williams, C., McEvoy, M., 2021. To what extent is telehealth reported to be incorporated into undergraduate and postgraduate allied health curricula: a scoping review. PLoS One 16, e0256425. https://doi.org/10.1371/journal.pone.0256425.
Husain, M., Khan, S., Badyal, D., 2020. Integration in medical education. Indian Pediatr. 57, 842–847.
Jelin, E., Granum, V., Eide, H., 2012. Experiences of a web-based nursing intervention—interviews with women with chronic musculoskeletal pain. Pain Manag. Nurs. 13, 2–10. https://doi.org/10.1016/j.pmn.2011.08.008.
Jiang, Q., Deng, Y., Perle, J., Zheng, W., Chandran, D., Chen, J., Liu, F., 2024. Education and training of telemental health providers: a systematic review. Front. Public Health 12. https://doi.org/10.3389/fpubh.2024.1385532.
Jonas, C.E., Durning, S.J., Zebrowski, C., Cimino, F., 2019. An interdisciplinary, multi-institution telehealth course for third-year medical students. Acad. Med. 94, 833–837. https://doi.org/10.1097/ACM.0000000000002701.
Jünger, S., Payne, S.A., Brine, J., Radbruch, L., Brearley, S.G., 2017. Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: recommendations based on a methodological systematic review. Palliat. Med. 31, 684–706. https://doi.org/10.1177/0269216317690685.
Konttila, J., Siira, H., Kyngäs, H., Lahtinen, M., Elo, S., Kääriäinen, M., Kaakinen, P., Oikarinen, A., Yamakawa, M., Fukui, S., Utsumi, M., Higami, Y., Higuchi, A., Mikkonen, K., 2019. Healthcare professionals' competence in digitalisation: a systematic review. J. Clin. Nurs. 28, 745–761. https://doi.org/10.1111/jocn.14710.
Kulju, E., Jarva, E., Oikarinen, A., Hammarén, M., Kanste, O., Mikkonen, K., 2024. Educational interventions and their effects on healthcare professionals' digital competence development: a systematic review. Int. J. Med. Inf. 185, 105396. https://doi.org/10.1016/j.ijmedinf.2024.105396.
Malik, A.S., Malik, R.H., 2011. Twelve tips for developing an integrated curriculum. Med. Teach. 33, 99–104. https://doi.org/10.3109/0142159X.2010.507711.
Nazeha, N., Pavagadhi, D., Kyaw, B.M., Car, J., Jimenez, G., Tudor Car, L., 2020. A digitally competent health workforce: scoping review of educational frameworks. J. Med. Internet Res. 22, e22706. https://doi.org/10.2196/22706.
Organization, W.H., 2015. eLearning for Undergraduate Health Professional Education: a Systematic Review Informing a Radical Transformation of Health Workforce Development. World Health Organization.
Silva, P.V., Costa, L.O.P., Maher, C.G., Kamper, S.J., Costa, L. da C.M., 2019. The new agenda for neck pain research: a modified Delphi study. J. Orthop. Sports Phys. Ther. 49, 666–674. https://doi.org/10.2519/jospt.2019.8704.
Sinead Keeney, H.M., 2011. Felicity hasson, conducting the research using the Delphi technique, the Delphi technique in nursing and health research, 69–83. https://doi.org/10.1002/9781444392029.ch5.
Thistlethwaite, J.E., 2015. Interprofessional education: implications and development for medical education. Educ. Méd. 16, 68–73. https://doi.org/10.1016/j.edumed.2015.04.007.
Trevelyan, E.G., Robinson, P.N., 2015. Delphi methodology in health research: how to do it? Eur J Integr Med 7, 423–428. https://doi.org/10.1016/j.eujim.2015.07.002.
van Houwelingen, C.T.M., Moerman, A.H., Ettema, R.G.A., Kort, H.S.M., ten Cate, O., 2016. Competencies required for nursing telehealth activities: a Delphi-study. Nurse Educ. Today 39, 50–62. https://doi.org/10.1016/J.NEDT.2015.12.025.
Wali, E., Pinto, J.M., Cappaert, M., Lambrix, M., Blood, A.D., Blair, E.A., Small, S.D., 2016. Teaching professionalism in graduate medical education: what is the role of simulation? Surgery 160, 552–564. https://doi.org/10.1016/J.SURG.2016.03.026.
Waseh, S., Dicker, A.P., 2019. Telemedicine training in undergraduate medical education: mixed-methods review. JMIR Med Educ 5, e12515. https://doi.org/10.2196/12515.
Wollsching-Strobel, M., Ehlers, J.P., Zupanic, M., 2021. [How does a patient-centered, future-oriented medical curriculum look like? The patients' view]. Z Evid Fortbild Qual Gesundhwes 167, 50–56. https://doi.org/10.1016/j.zefq.2021.09.009.
World Health Organization (WHO), 2016. eHealth in the Region of the Americas: breaking down the barriers to implementation. https://iris.paho.org/bitstream/handle/10665.2/31286/9789275119259-eng.pdf.
Yamato, T.P., Saragiotto, B.T., Lopes, A.D., 2015. A consensus definition of running-related injury in recreational runners: a modified Delphi approach. J. Orthop. Sports Phys. Ther. 45, 375–380. https://doi.org/10.2519/jospt.2015.5741.