



Orthopedics and Traumatology Skill Matrix for Musculoskeletal System Approach by Medical Graduates

Matriz de competências em ortopedia e traumatologia para abordagem do sistema musculoesquelético para graduação médica

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Abstract

Objective This study aimed to build a matrix of orthopedics and traumatology skills focusing on the musculoskeletal system for graduates of a medical course in Brazil.

Methods The study used the e-Delphi methodology to retrieve opinions anonymously. The first proposal included 42 items determined at a bibliographical review and their epidemiological relevance. This proposal was available via Google Forms, and we sent it using the instant messaging application WhatsApp. We grouped the panel of 26 specialists into three categories: Orthopedics and Traumatology professors, Primary Care doctors, and Emergency Physicians. We reached a consensus after three rounds, with at least 75% agreement between the items initially presented. We also considered the following four indicators: prerequisite, essential, desirable, and advanced skills.

Results We created a matrix with 34 musculoskeletal system-related skills, including diagnostic and management actions for all age groups.

Conclusion We devised a skill matrix in Orthopedics and Traumatology for medical graduation for complete or partial use according to the institutional curriculum.

Keywords

- ▶ education, medical
- ▶ orthopedics
- ▶ traumatology

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Resumo

Objetivo Construir uma matriz de competências em ortopedia e traumatologia, com enfoque no sistema musculoesquelético, necessárias ao egresso do curso de medicina no Brasil.

Método Utilizou-se a metodologia e-Delphi, visando captar a opinião de participantes de forma anônima. A primeira proposta contou com 42 itens, frutos de revisão bibliográfica e relevância epidemiológica, disponibilizados para os painelistas pelo *Google Forms* e enviados através do aplicativo de mensagens instantâneas *Whatsapp*. Constituiu-se um painel de 26 especialistas agrupados em três categorias: docentes de Ortopedia e Traumatologia, médicos da Atenção Primária e Emergencistas. O consenso foi obtido após a realização de 3 rodadas, com pelo menos 75% de concordância entre os itens inicialmente apresentados. Foram também considerados quatro indicadores: competências pré-requisito, essenciais, desejáveis e avançadas.

Resultados obteve-se uma matriz com 34 competências relativas à abordagem do sistema musculoesquelético, que contempla ações de diagnóstico e conduta de todas as faixas etárias.

Conclusão Foi construída uma matriz de competências em Ortopedia e Traumatologia para graduação médica com possibilidades de ser utilizada na sua íntegra ou de forma parcial, de acordo com o perfil do currículo institucional.

Palavras-chave

- ▶ educação médica
- ▶ ortopedia
- ▶ traumatologia

Introduction

Orthopedics and traumatology are the medical specialties studying, diagnosing, and treating traumatic and non-traumatic conditions affecting the musculoskeletal system (MMS). However, up to 25% of general practice consultations are MMS-related. For the World Health Organization, 2000–2010 was the “Bone and Connective Tissue Decade” to indicate the significance of musculoskeletal conditions for global health care.^{1–3}

The Brazilian National Curriculum Guidelines for the graduation course in Medicine⁴ encourage the generalist training of physicians and expose the need for the general practitioner to address the most common problems of the daily medical practice, using resources, knowledge, skills, and attitudes under different conditions to promote a quality medicine, especially for the Brazilian Unified Health System users.⁴

Many regions of Brazil do not have a specialized service to meet MMS-related demands, relying on general practitioners to manage these cases with few resources. The first care, recognition of its urgency/emergency, and the correct management of these cases determine the outcome for the patient.^{5,6}

As such, basic MMS knowledge are critical for all medical professionals.⁷ In Brazil, no proposal has been published to establish a minimum curriculum based on skills for teaching orthopedics in medical school.

Within this scope, a consensus on the skills for orthopedics and traumatology teaching during medical graduation can contribute to a better understanding of MMS conditions for future general practitioners. In addition, it also contrib-

utes to the training of professionals with knowledge and confidence in decision-making, resulting in improved quality of care for the population.^{3,8}

The Delphi technique may define this consensus. This technique generates agreement between geographically separated experts, the so-called panelists, who answer successive question rounds. It was developed in the 1950s and named after the Oracle of the Island of Delphos.⁹ It is based on the premise that the collective construction of knowledge is more fruitful than its contribution.^{9,10}

The method has the following fundamental characteristics: anonymity, allowing individuals to express their opinions with no embarrassment risk, feedback for sharing their views, and the possibility of changing positions throughout the process.¹¹ The popularization of the internet led to the e-Delphi, increasing the scope of the study and allowing the sending of online questionnaires.^{12,13}

Therefore, this study aimed to build an orthopedics and traumatology skill matrix, focusing on the musculoskeletal system, required for Brazilian medical graduates, using the e-Delphi methodology.

Materials and Methods

This primary study uses a qualitative approach based on the e-Delphi method to establish a consensus on the researched topic and define the panelists, the number of rounds, the level of agreement, and question formatting. *WhatsApp* was the resource for communication with panelists.

Most articles in the literature define consensus as an agreement of approximately 75% on a given subject in each round. Therefore, we set this value for this study.^{7,11,13}

In addition, it is recommended that the panel should have experts from different areas debating the same subject. The sample size can range from 10 to 30 participants. A larger number may cause difficulties in managing and providing feedback on responses. A smaller number may give a limited perspective on the subject. Furthermore, it is common to have a low response rate in certain rounds and to lose some panelists during the process.^{7,11}

Sample selection was non-probabilistic, per convenience, through indications from personal contacts. We invited 30 panelists working in Brazil, including 1/3 of orthopedists, 1/3 of Family and Community Medicine (FCM) practitioners, and 1/3 of emergency doctors.^{12,13}

Inclusion criteria were orthopedists teaching undergraduate medicine or medical residency, doctors from the Family Health Strategy (FHS), and Emergency Medicine physicians. All participants have a specialist title from the Brazilian Educational and Cultural Department (MEC, for its acronym in Portuguese) or specialty society. We excluded physicians who abandoned the study in any of its rounds.

The data collection instrument used for this study was structured using the Google Forms platform, and we sent response links to participants through WhatsApp messages.

We organized the questionnaire into four parts: a) Informed consent form (ICF), b) sociodemographic data, c) 41 pre-defined statements about traumatology and orthopedics contents related to the medical graduation curriculum, classified into agreement levels by the six-point Likert Scale (in which 1 means strongly disagree, 2, partially disagree, 3, disagree, 4, agree, 5, partially agree, and 6, strongly agree, to record the opinion on each statement); d) space for free comments on the question-answer round, suggesting changes in the leveling, and adding not addressed skills. After reading and compiling the answers, feedback allowed sharing opinions anonymously among the participants.¹³

The statements constructed were based on crossing the data from the leading causes of hospitalizations in orthopedics and traumatology at the Brazilian Unified Health System (SUS, for its acronym in Portuguese) in 2020, causes of absence from work per the Brazilian Social Security System within the same year, and articles on orthopedics retrieved from integrative review literature at the Scientific Electronic Library Online (SCIELO) and PUBMED bases. ►Table 1 shows the skill leveling.^{8,14-19}

From the second round onwards, questionnaire structuration used the themes selected from the previous responses. Starting at this stage, participants could not add skills, but they could modify the text and level based on the highest percentage of opinions.

The Likert scale determined positioning convergence. As in the first round, we checked responses and feedback anonymously sent by the participants, with random designation.^{9,13}

The same process occurred in the third round. Data analysis included observation of recurrences and percentages of statements in each round. Proposition inclusion occurred when response convergence in numbers 5 and 6 was equal to or greater than 75%. Proposition exclusion occurred when response convergence was equal to or greater than 75% in numbers 1 and 2. Statements that did not meet the inclusion or exclusion criteria were reworked by the first researcher and validated by another researcher considering the experts' comments and responses regarding skill presentation and leveling to reach a 75% approval rate.^{9,11}

Results

Respondents from all Brazilian regions participated in our study, with higher orthopedics distribution and predominance in the Southeast of the country (►Fig. 1).

The representation of specialties was equivalent, with a slight predominance of orthopedics and FHS (34.6%) compared with emergency doctors (30.8%) (►Fig. 2 and 3).

The first round of the questionnaire had the participation of 26 panelists (86.6%): one orthopedist, one FHS physician, and two emergency physicians did not respond.

We reached a consensus in 20 statements (48.7%). The concordance rate was higher in skills deemed prerequisite and essential. Among these statements, three reached 100% convergence (►Table 2). There was no exclusion, as the percentage of positioning 1 and 2 was insufficient.

The second round of the survey had feedback from 25 panelists (96%): one FHS physician chose to leave the study. There were 28 statements, with fragmentation and return of one previously approved and the addition of five suggestions (►Table 3).

Thirteen skills (46%) reached a consensus and were added with the proposed modifications. The leveling changes for

Table 1 Skill leveling

Skill leveling	Description
Prerequisite	Skills expected from a graduate student at the end of the basic cycle
Essential	Skills expected from a student at the end of medical school
Desirable	Skills expected from a differentiated general practitioner who can advance beyond core skills
Advanced	Skills expected from a professional proficient in more complex competencies acquired through additional training

Source: Adapted from the Sociedade Brasileira de Medicina de Família e Comunidade¹⁷ and Lynch et al.⁸

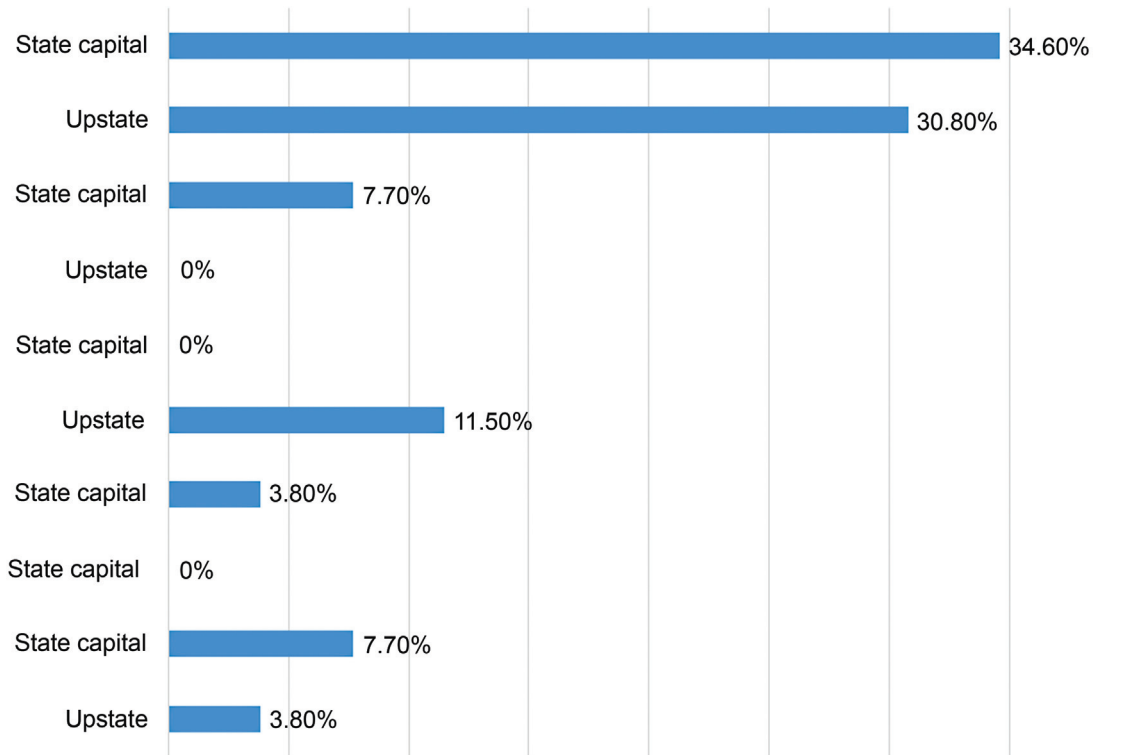


Fig. 1 Frequency distribution of the gender variable by specialty of research participants (n = 26). Source: Prepared by the authors.

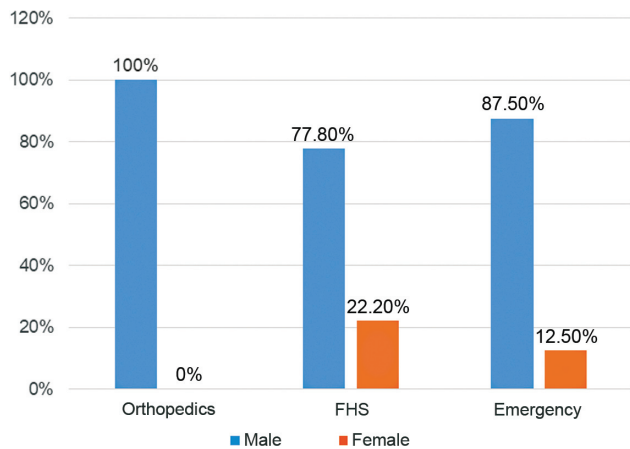


Fig. 2 Frequency distribution of the gender variable by specialty among research participants (n = 26). FHS, Family Health Strategy. Source: Prepared by the authors.

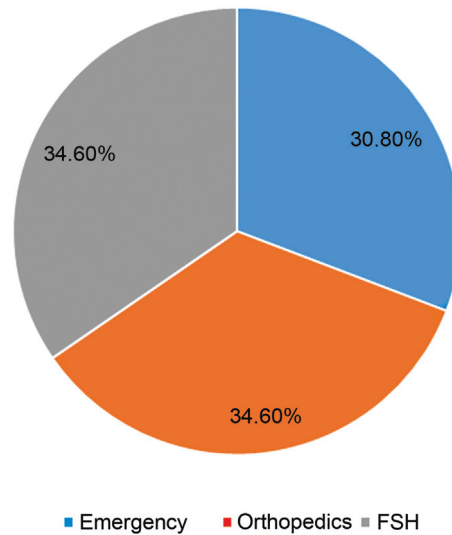


Fig. 3 Frequency distribution of the specialty variable (n = 26). FHS, Family Health Strategy. Source: Prepared by the authors.

desirable and advanced skills did not favor convergence. There was no 100% agreement, and no skill was excluded (► **Table 3**).

The third round had 24 participants since one orthopedist chose not to respond. Thus, the sample was balanced, with eight experts from each area. However, the study was interrupted due to the perceived persistence of responses about certain propositions. The minimum convergence of 75% occurred only for two statements.

Fifteen statements were evaluated, and only two (1 and 13) reached a consensus, with a suggestion to change statement 13 to a “desirable” level (► **Table 4**).

At the end of three rounds of questionnaires, we compiled a matrix of 34 skills in Orthopedics and Traumatology to be addressed during medical graduation (► **Tables 2, 3 and 4**). ► **Table 5** shows skills with no consensus.

Table 2 Result of the first Delphi round: consensual statements

STATEMENT	CONSENSUS
PREREQUISITE LEVEL	
To apply the basic anatomy of the osteoarticular system in medical practice	96.1%
To apply the basic vascular and neurological anatomy of the upper and lower limbs in medical practice	92.3%
To apply the basic physiology of bone tissue in medical practice	84.7%
To apply basic physiology of the muscular system in medical practice	92.4%
ESSENTIAL LEVEL	
To perform anamnesis and physical examination focused on the general semiology of the musculoskeletal system per the patient's complaints	96.2%
To correctly request radiological views of the affected site and to differentiate normal radiological anatomy from potential alterations	80.7%
To request and interpret main laboratory tests in Orthopedics and Traumatology	92.3%
To recognize an open fracture and provide the correct referral, taking the necessary initial measures	96.2%
To understand the concept of dislocation and recognize it as urgent	100%
To recognize the signs and symptoms of a compartment syndrome, referring the patient as an emergency	100%
To diagnose an open-book fracture-dislocation (HIP), taking necessary measures for vital functions support and referring the patient	96.2%
To detect the signs and symptoms of osteoarticular infections (osteomyelitis and septic arthritis) and refer the patient as an emergency	100%
To make judicious use of the main drugs prescribed in orthopedics and traumatology	96.1%
To know non-pharmacological treatment options for treating chronic pain, including psychosocial approaches	80.7%
To guide ergonomic measures to prevent orthopedic problems	76.9%
To diagnose and refer the patient in cases of osteoarthritis, especially in knees, hips, and spine	77%
DESIRABLE LEVEL	
To diagnose and provisionally manage proximal humeral and distal radial fractures in elderly patients	76.9%
To diagnose and refer cases of transtrochanteric and femoral neck fractures	84.6%
To recognize and evaluate patients with symptoms consistent with carpal tunnel syndrome	76.9%
ADVANCED LEVEL	
To perform a knee joint puncture	76.9%

Discussion

Research structuring to converge opinions from panelists from three different areas on the same topic reached the proposed objective. The compiled Orthopedics and Traumatology skill matrix for medical graduation is structured and comprehensive. The tendency to identify with the specialty led each panelist to issue an opinion limited to their expertise, and the points in common constituted the consensus.^{11,12}

The sample loss rate in the first round was below literature reports, which estimate a loss of approximately 20% in this stage.

Martins et al.³ applied a test to assess musculoskeletal skills in students from the first to the fifth year of an undergraduate medical course. Third-year students had the best results in basic anatomy questions, with a decreased performance in the following classes.

Another study by Fialho et al.²⁰ to assess the prevalence of musculoskeletal symptoms in an emergency unit and the frequency of description of the musculoskeletal physical examination in these cases pointed out that musculoskeletal complaints are frequent in the evaluated emergency unit, but their symptom assessment is insufficient. The authors point out that this result may be related to a lack of medical training; as such, medical schools must emphasize training so that young doctors are better prepared to deal with these common diseases.

Still on MSS assessment and knowledge by medical students, Bockbrader et al.²¹ highlighted that besides the physical examinations, professionals in the area must have the experience to assess musculoskeletal ultrasound findings. However, a study from these same authors revealed the lack of familiarity of these professionals for this assessment.

Skills leveled as "prerequisites" constitute the group in which orthopedic studies should begin, as they open space

Table 3 Result of the second Delphi round: consensual statements

STATEMENT	CONSENSUS
PREREQUISITE LEVEL	
To correctly request radiological views for the affected location	84%
To correctly evaluate cases of low back pain, making a differential diagnosis list of potential causes and indicating appropriate follow-up	92%
To carry out initial treatment of wounds on upper and lower limbs and provide the correct referral in cases of suspected tendon and peripheral nerve injuries	84%
DESIRABLE LEVEL	
To provide temporary immobilization of the injured limb to control pain, comfort, and transport the patient; to indicate, create, and correctly apply immobilizations (splints)	84%
To evaluate radiographic examinations and differentiate normal radiological anatomy from potential alteration, i.e., suspect radiographic changes even without precisely defining the diagnosis	84%
To educate the patient in cases of osteoporosis	80%
ADVANCED LEVEL	
To provide initial care for polytrauma patients	84%
To perform differential diagnosis for the main inflammatory arthropathies	76%
To identify characteristic injuries in cases of suspected abuse	78%
To educate children and adolescents regarding spinal deformities: hyperkyphosis, hyperlordosis, and scoliosis	76%
Suspect fractures in the most commonly affected bones in newborns (birth injury): clavicle, humerus, and femur	84%
To recognize the pattern of supracondylar fractures of the humerus and diaphyseal fractures of the forearm and wrist in children and adolescents and provide initial care	80%
Recognize the patterns of tibial shaft fractures and ankle epiphysiolysis in children and adolescents and provide initial care	80%

Table 4 Result of the third Delphi round: consensual statements

STATEMENT	CONSENSUS
PREREQUISITE LEVEL	
To provide initial care in cases of amputation (care at the trauma site, conservation, and correct packaging of the amputated limb) and refer the patient	79.2%
ADVANCED LEVEL	
To provide primary care in humeral shaft fractures, forearm bone shaft fractures, distal radial fractures, and scaphoid fractures in adults	78.8

Source: Prepared by the authors.

for students to recover knowledge of the basic cycle and application in medical practice.^{3,7}

In this sense, the general practitioner should have a higher index of diagnostic suspicion of these traumas based on the recognition of characteristic patterns in a simplified way. Their inclusion occurred because they are among the most frequent in the global burden of musculoskeletal diseases. There is an additional because, based on this assumption, even excluded skills referring to fracture patterns can be

developed during the medical career. This leads to a question: Must all these items necessarily be present? The answer is yes, because they are leveled as “desirable and advanced” skills, and, therefore, they are not priorities. However, if there is enough time for training, they can substantially improve health service provision.^{1,3,14,22,23}

The 13 skills that did not reach consensus were “advanced” skills, mostly related to non-traumatic conditions. The panelists may have understood that these skills were more specific topics within orthopedics and its subspecialties (→ **Table 5**).²⁴

Content volume is a limitation of this study since it requires more time for the panelists to evaluate. This fact can translate into adversity for the matrix implementation. Despite referring to the rational use of time, it does not indicate the moment for degree application.

New studies could address the practical applicability of this matrix and its effectiveness, as well as describe the experience of professors and students during the process and the outcomes from its implementation.

Conclusion

We built an Orthopedics and Traumatology skill matrix for potential total or partial use per the medical curriculum.

Table 5 Skills with no consensus

	Skills
Advanced	To perform the initial approach to a patient complaining of torticollis
	To perform the initial approach to a patient with a knee sprain
	To perform the initial approach to the most prevalent myofascial pains
	To perform the initial approach to a patient with an ankle sprain
	To suspect benign, malignant, and metastatic bone tumors per radiographic findings
	To perform initial care in cases of patellar, tibial plateau, and metatarsal fractures in adults
	To know the physical examination maneuvers for detecting developmental hip dysplasia in children
	To know the conditions requiring electroneuromyography as a supplementary test
	To differentiate the main congenital foot deformities in children
	To differentiate the main knee deformities in children and adolescents
	To address primarily adult patients complaining of shoulder pain
	To recognize cases of painful pronation, educate parents, and refer the patient
	To correctly indicate physical therapy and/or exercises to prevent and rehabilitate the main musculoskeletal conditions

Source: Prepared by the authors.

Ethics Committee

This study does not require an approval by the ethics committee since it does not involve human beings.

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Conflict of Interests

The authors declare no conflict of interests.

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