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REVIEW

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Teaching strategies for clinical reasoning in Brazilian medical schools – an integrative review

Estratégias de ensino do raciocínio clínico nos cursos de medicina do Brasil – revisão integrativa

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ABSTRACT

Introduction: Clinical reasoning is considered one of the main skills that must be developed by medical students, as it allows the establishment of diagnostic hypotheses and directs investigative and diagnostic strategies using a rational approach. Although educators have traditionally focused the teaching method on the analytical model, many medical professors face the challenge in their daily lives of finding new strategies to help their students develop clinical reasoning.

Objective: To carry out an integrative literature review to identify the strategies used in the teaching-learning process of clinical reasoning in Brazilian medical schools.

Method: The methodology used consists of six steps: 1. creation of the research question; 2. definition of inclusion and exclusion criteria; 3. list of information to be extracted; 4. evaluation of included studies; 5. interpretation of results and 6. presentation of the review.

Results: Most studies indicate that the teaching of clinical reasoning is carried out through discussions of clinical cases, incidentally, in different disciplines or through the use of active methodologies such as PBL, TBL and CBL. Only three studies presented at conferences disclosed experiences related to the implementation of a mandatory curricular discipline specifically aimed at teaching clinical reasoning. The teaching of clinical reasoning is prioritized in internships in relation to the clinical and pre-clinical phases.

Final considerations: There are few studies that analyze how clinical reasoning is taught to medical students in Brazilian medical schools. Although more studies are needed, we can observe the lack of theoretical knowledge about clinical reasoning as one of the main causes of the students' difficulty in developing clinical reasoning.

Keywords: Clinical Reasoning; Clinical Decision-Making; Clinical Skill; Differential Diagnosis; Physical Examinations and Diagnoses.

RESUMO

Introdução: *O raciocínio clínico é considerado uma das principais habilidades que devem ser desenvolvidas pelos estudantes de Medicina, porque permite a elaboração de hipóteses diagnósticas e orienta estratégias investigativas e diagnósticas de forma racional. Embora os educadores tradicionalmente foquem o ensino no modelo hipotético-dedutivo ou analítico, muitos professores de medicina enfrentam no seu dia a dia o desafio de encontrar novas estratégias para ajudar seus estudantes a desenvolver o raciocínio clínico.*

Objetivo: *Este estudo realizou uma revisão integrativa da literatura para identificar as estratégias utilizadas no processo ensino-aprendizagem do raciocínio clínico, nas escolas médicas brasileiras.*

Método: *A metodologia utilizada consistiu em seis etapas: 1. elaboração da pergunta da pesquisa; 2. definição dos critérios de inclusão e exclusão; 3. elenco das informações a serem extraídas; 4. avaliação dos estudos incluídos; 5. interpretação dos resultados; e 6. apresentação da revisão.*

Resultado: *A maioria dos trabalhos apontam que o ensino do raciocínio clínico é realizado por meio de discussões de casos clínicos, de maneira incidental, em diversas disciplinas ou por meio do uso de metodologias ativas, como PBL, TBL e CBL. Apenas três trabalhos apresentados em congressos demonstraram experiências relacionadas à implantação de uma disciplina curricular obrigatória voltada especificamente ao ensino do raciocínio clínico. O ensino do raciocínio clínico é priorizado no internato em relação às fases clínicas e pré-clínicas.*

Conclusão: *Poucos são os estudos que analisam a maneira como se dá o processo ensino-aprendizagem do raciocínio clínico nas escolas médicas brasileiras. Embora mais estudos sejam necessários, podemos verificar a falta de conhecimento teórico sobre raciocínio clínico como uma das principais causas de dificuldade para o desenvolvimento dessa competência pelos estudantes.*

Palavras-chave: *Diagnóstico Clínico; Tomada de Decisão Clínica; Diagnóstico Diferencial; Competências Clínicas.*

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INTRODUCTION

Clinical reasoning is considered one of the main skills that must be developed by medical students[1], as it allows physicians to establish a correct or plausible diagnosis through the analysis of data obtained from the anamnesis, physical examination and complementary exams, and use investigative and diagnostic strategies through a rational approach[2]. It is known that only having enough medical knowledge about the different diseases is not enough for the correct diagnosis to be attained; it is also necessary to correctly carry out the processes that involve clinical reasoning[3].

Studies on clinical reasoning started about 40 years ago and the currently prevailing theory is that clinical reasoning occurs through a process that uses both intuitive reasoning (non-analytical) and the hypothetical-deductive process (analytical)[4]. Intuitive reasoning is the most often used for solving everyday clinical cases in which professionals, through repetitive exposure to cases, create scripts, mental representations of diseases[5], and perform the diagnosis by recognizing the pattern by which the disease manifests[2,6]. This reasoning process occurs rapidly, automatically, without the physician's perception or awareness[2]. The ability to use non-analytical reasoning increases with the physician's expertise, with a diagnosis being more likely correct when this technique is used by more experienced physicians[2]. Although it does not involve a process of deliberate reflection of analysis, intuitive reasoning is not an inferior form when compared to more analytical forms of reasoning[2]. Analytical reasoning is used in atypical or complex cases and uses the hypothetical-deductive method[5]. This model starts from a careful analysis of the relationship between the signs and symptoms and the diagnosis[2], involves greater knowledge about the different diseases, including their etiopathological mechanisms[6] and is the most often used to test the hypotheses raised during the patient's assessment[2]. Hence, as new information emerges in the patient's assessment, the physician increases or decreases the probability of each diagnostic hypothesis until they reach the final conclusion[7].

The Dual Process Theory refers to the simultaneous use by the physician of these two reasoning approaches, with a greater or lesser proportion of participation of each approach according to the case and its context. It is believed that the simultaneous use of both forms is associated with greater diagnostic competence[8] and even has implications for patient safety[9], as incorrect diagnoses can lead to the treatment of non-existent conditions, as well as delays in the appropriate therapy of an existing condition[10]. The greater the physician's experience in making diagnoses, the greater their ability to recognize which type of reasoning is the most appropriate in a given case[10].

Several authors[11,12] have also proposed that the development of clinical reasoning occurs in three phases during medical training. At the first moment, the students raise their diagnostic hypotheses by correlating the knowledge of the basic sciences with the signs and symptoms observed in the patient. As medical students progress in their training, they manage to encapsulate the knowledge of basic sciences into key concepts, which bring, within their meaning, all the pathophysiology involved in the onset of a given sign or symptom. These encapsulated concepts allow a faster diagnosis to be attained. And finally, as the student's exposure to clinical cases increases, this student's degree of expertise also increases, and they start to develop the disease scripts. The greater the experience and acquired knowledge of different diseases, the more comprehensive these scripts become and, consequently, the more accurate their clinical reasoning[11,12]. The use of disease scripts or encapsulated concepts does not mean that physicians, when advancing in their training, cease to know about or use the pathophysiological mechanisms of diseases. Schmidt and Pikers[11] state that in more complex cases, physicians with more expertise also use the knowledge of basic sciences and pathophysiological mechanisms to raise more plausible and adequate diagnostic hypotheses.

Although educators traditionally focus on the analytical model[2], many medical professors face the challenge of finding new strategies in their daily lives to help their students develop clinical reasoning[13]. After all, the greater the number of strategies a student learns to develop clinical reasoning, the greater their chance of being able to make correct diagnoses[2].

Although several studies have evaluated how clinical reasoning is developed by medical students, few studies discussed the strategies that are being used to teach clinical reasoning to the students. In this sense, the aim of this article is to carry out an integrative literature review to identify the strategies used in the teaching-learning process of clinical reasoning in Brazilian medical schools.

METHOD

This is an integrative literature review, which aimed at answering the following guiding question: "What are the strategies used for teaching clinical reasoning in Brazilian medical schools?" The methodology used in this integrative review was adapted from the one proposed by Mendes, Silveira, Galvão[14] and used by several other authors. This methodology consists of six steps: 1. creation of the research question; 2. definition of inclusion and exclusion criteria; 3. list of information to be extracted; 4. evaluation of included studies; 5. interpretation of results and 6. presentation of the review.

The search for scientific publications was carried out in three stages. First, a search was carried out in the Lilacs, Scielo, Pubmed databases and in the CAPES repository of theses using a search key for each database, as shown in Table 1. Subsequently, the annals of the Brazilian Congresses of Medical Education were reviewed in search of articles presented at Congresses that addressed the teaching of clinical reasoning. Finally, all bibliographic references of the articles selected for the study were reviewed, aiming to find additional articles that could be included in the study.

The choice of such a broad search strategy was due to the diversity of descriptors used in studies on clinical reasoning, in addition to the fact that the descriptor "Clinical Reasoning" was only adopted in 2021 and its Portuguese version has not yet been incorporated to the DASH descriptors.

Subsequently, studies in duplicate were eliminated and then the studies were evaluated through their titles and abstracts using the electronic platform Rayyan[15] to verify if they met the inclusion and exclusion criteria. Studies published in the last 10 years, in English or Portuguese and available in full and free of charge, that evaluated, discussed, tested or described strategies used by Brazilian medical schools to teach clinical reasoning were selected. Original articles, as well as review articles, theses, dissertations, communications, editorials and annals of congresses were included. Studies that did not answer the guiding question, conceptual studies on clinical reasoning and those that did not address teaching strategies were excluded. Abstracts of studies presented at the Brazilian Congresses of Medical Education that did not provide enough information to be analyzed were also excluded.

RESULTS

The search carried out according to the criteria stated in the method section identified 3,910 publications, of which 3,209 were articles, 433 were abstracts presented at congresses and 268 were theses and dissertations (Figure 1).

After the selection carried out by reading the titles and abstracts, 32 publications were selected to be read in full (15 articles and 17 theses and dissertations). After reading them in full, 4 articles and 1 thesis were included in the data analysis, in addition to 16 abstracts presented at the Brazilian Congresses of Medical Education that contained enough information to be analyzed according to the proposed question. Table 2 depicts the main findings of the studies included in this review.

Of the included articles, only one was written as an essay[16], and brings the author's opinion on the teaching of clinical reasoning. The other three articles included in the review were published in the Brazilian Journal of Medical Education (RBEM - *Revista Brasileira de Educação Médica*) and show results of qualitative research that used the interview or the 'thinking aloud' technique as a strategy for obtaining findings, in which students are encouraged to verbalize their thoughts during the clinical reasoning performance[16-18].

The abstracts presented at the congresses report experiences implemented with the objective of teaching clinical reasoning in several Brazilian universities. The thesis included in this review was presented in 2020 and shows the author's experience with the use of conceptual mapping for teaching clinical reasoning at a university in southeastern Brazil[19].

Most studies point out that the teaching of clinical reasoning is incidentally carried out predominantly through discussions of clinical cases, in several disciplines[20-25] or through the use of active methodologies both in the pre-clinical, clinical or internship phases[21,26,27]. Only three publications presented at congresses disclosed experiences related to the implementation of a mandatory curricular discipline specifically aimed at the teaching of Clinical Reasoning[24,28,29]. Only these studies show the teaching of theories involved in the development of clinical reasoning.

In this context, several extracurricular activities arise, such as academic leagues[30-32] and extension projects, such as

Table 1. Search Keys

Lilacs	(raciocínio clínico) AND ((mh:(diagnóstico clínico)) OR (mh:(tomada de decisão clínica)) OR (mh:(diagnóstico diferencial)) OR (mh:(competências clínicas)))
Scielo	(raciocínio clínico) AND ((mh:(diagnóstico clínico)) OR (mh:(tomada de decisão clínica)) OR (mh:(diagnóstico diferencial)) OR (mh:(competências clínicas)))
Pubmed	("Clinical Reasoning"[Title/Abstract]) AND ((clinical reasoning[MeSH Terms]) OR (Clinical Decision Making[MeSH Terms]) OR (Clinical Skill[MeSH Terms]) OR (Differential Diagnosis[MeSH Terms]) OR (Physical Examinations and Diagnoses[MeSH Terms]))
Capes repository	"Raciocínio Clínico"
Annals of Cobem	"Raciocínio Clínico"

Source: Prepared by the authors.

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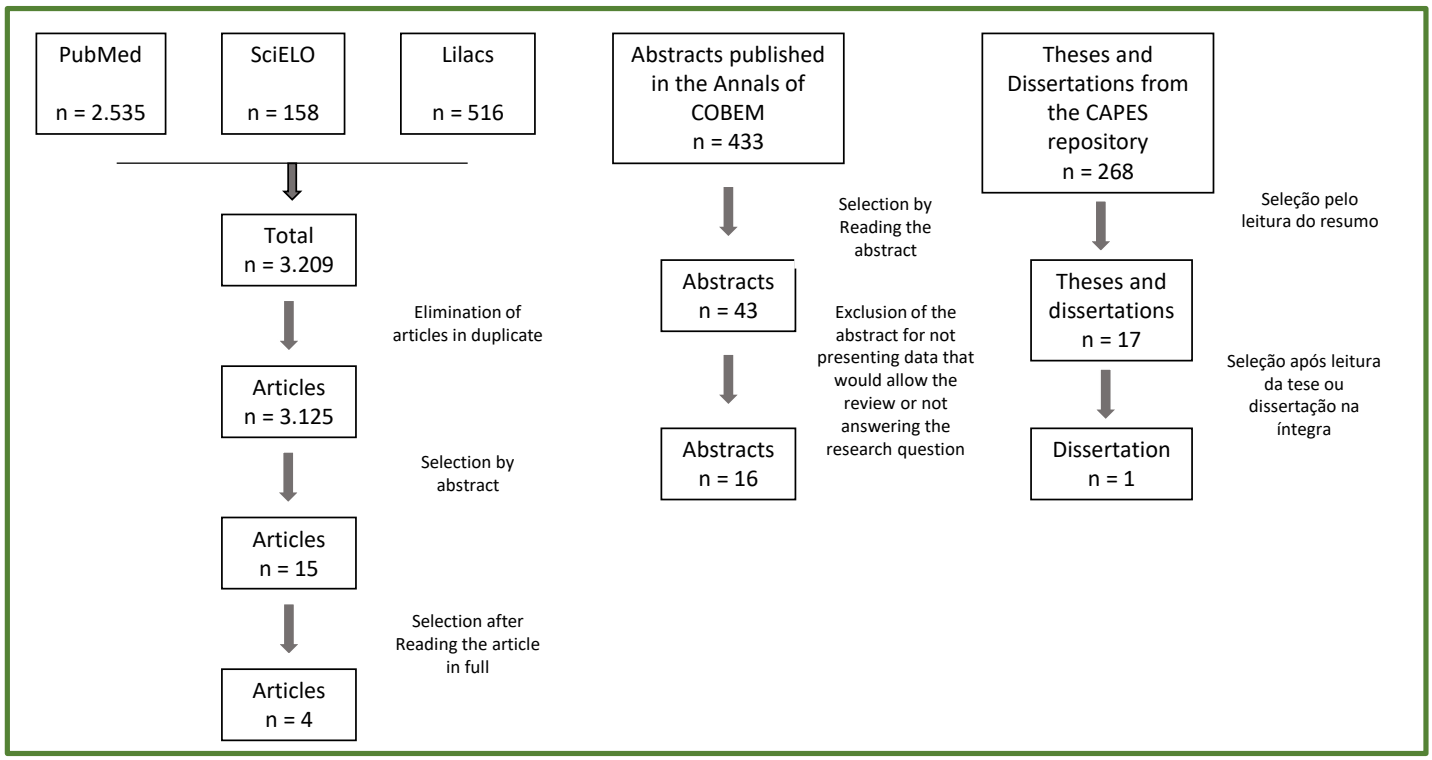
Figure 1. Results



Source: prepared by the authors.

Table 2. Main results

Author	Year	Type of Study	Place of Publication	Main results
Albuquerque et al.	2018	Experience Report	56th COBEM	Case Discussion.
Almeida et al.	2016	Experience Report	54th COBEM	Academic league: Short extension course: bases of CR.
Barillo	2020	Qualitative research	Master dissertation	Conceptual maps: Case study.
Barillo et al.	2019	Experience Report	57th COBEM	Implementation of the discipline of CR.
Diehl et al.	2019	Experience Report	57th COBEM	Use of the *Case-Based Clinical Reasoning Education* Methodology.
Fornaziero; Gordan and Garanhani	2011	Qualitative research	Revista Brasileira de Educação Médica	The teacher as a model to be followed / Discussion of cases in internship and PBL / Cognitive knowledge about diseases.
Fornaziero; Gordan and Garanhani	2012	Qualitative research	Revista Brasileira de Educação Médica	Development: Importance of basic disciplines; skill acquisition; epidemiological data and knowledge of signs and symptoms.
Gomes; Salomão and Ramos	2020	Experience Report	58th COBEM	Study group on CR with discussion of theory and cases.
Landim; Moreno-Neto and Soares	2021	Qualitative research	Revista Brasileira de Educação Médica	Lack of theoretical knowledge about CR.
Noll and Gerbase	2017	Experience Report	55th COBEM	Use of Conceptual Maps to develop and exercise CR.
Oliveira et al.	2018	Experience Report	56th COBEM	Case Discussion.

Continues...

Quadro 2. Continuation

Author	Year	Type of Study	Place of Publication	Main results
Porto	2017	Essay	Revista Médica de Minas Gerais	Segmented way of teaching / CR is learned in 4 steps.
Prado; Gordan and Diehl	2019	Experience Report	57th COBEM	Use of blog/social media.
Queiroz et al.	2018	Experience Report	56th COBEM	Discipline of CR theoretical knowledge + case discussion.
Rafael; Aragão	2018	Experience Report	56th COBEM	Use of TBL in emergencies.
Ramos et al.	2020	Experience Report	58th COBEM	Workshop: Theory and cases.
Remor et al.	2012	Experience Report	50th COBEM	Academic League: Discussion of clinical cases.
Sales; Lucas and Santos	2019	Experience Report	57th COBEM	Discipline of CR that integrates basic knowledge with signs and symptoms.
Sarris; Dornelles and Reis	2015	Experience Report	53rd COBEM	Academic League of CR: Signs, symptoms and discussion of cases.
Silveira et al.	2011	Experience Report	49th COBEM	Discussion of cases with development of DH and subsequent justification of the DH.
Souza et al.	2019	Experience Report	57th COBEM	CR workshop with case discussion.

Source: Prepared by the authors
Legend: PBL, Problem-based Learning; CR, clinical reasoning; DH, diagnostic hypothesis.

workshops and the use of blogs and social media aimed at teaching and developing clinical reasoning[33], and the teacher emerges as the model to be followed, so that students learn to develop clinical reasoning[21].

Regarding the moment when clinical reasoning is taught throughout the course, the studies showed that its teaching is prioritized during internship. During the pre-clinical and clinical phases, it is believed that active methodologies such as PBL would be enough for the development of clinical reasoning[21].

Another study points out that the teaching of clinical reasoning occurs in a fragmented way over 4 stages (learning the anamnesis, correlation of clinical findings with pathophysiological mechanisms, clinical reasoning during the anamnesis and clinical examination, confirmation of the diagnostic hypothesis), which would make it difficult for students to learn[16].

In the development of clinical reasoning, students attending the final years consider cognitive knowledge about different diseases as a determining factor for clinical reasoning to occur appropriately[21]. Students in the early years of the medical course indicate that the knowledge of basic sciences and epidemiology is important, as well as knowledge of the pathophysiology involved in the development of different signs and symptoms[17].

DISCUSSION

The development of clinical reasoning skills through both analytical and non-analytical reasoning requires exposing the student to activities that improve the acquisition of theoretical knowledge about different diseases, together with the accumulation of clinical experience and opportunities to practice clinical reasoning in diverse scenarios, such as outpatient clinics or simulation centers[9].

The aim of teaching clinical reasoning is to make the student cease being just someone who collects information through anamnesis and physical examination and become someone capable of critically interpreting the data, in addition to creating an adequate investigative and therapeutic plan[34]. In this sense, many students may have the theoretical knowledge about the different pathologies considered adequate for their training phase and still are not able to mobilize this knowledge to reason adequately in relation to a specific case[9].

The education of health professions depends on the context in which it occurs, and on factors such as the student's learning method, teaching techniques, instructional design and the very structure of the organization where the teaching is carried out, all of which are relevant factors to determine the effectiveness of the educational strategies[9].

The choice of a strategy for teaching clinical reasoning by medical schools, not only in Brazil, but worldwide, has become a major challenge, since, according to Mamede[13], students in different phases of their training benefit from diverse strategies used in the teaching of clinical reasoning. Nevertheless, the choice of teaching strategy is often based much more on the teacher's discretion than on the student's needs[13].

It can be observed that students in the early years end up using knowledge of basic sciences more explicitly, while students in more advanced stages already have this knowledge "encapsulated" into larger concepts that include pathophysiology, anatomy and other basic sciences and use one more knowledge based on the clinical presentation of diseases to develop their clinical reasoning and reach the patient's diagnosis[5]. This "encapsulation" of basic knowledge integrated with clinical knowledge leads to the development of more complex scripts, allowing an increasingly efficient clinical reasoning[8].

It is observed that regardless of whether or not there is a curricular discipline aimed at teaching clinical reasoning, most medical courses use the discussion of clinical cases as their main strategy for teaching and developing clinical reasoning. This strategy can be used since the early years, through active methodologies such as PBL (problem-based learning), TBL (team-based learning) and CBL (case-based learning). For the most part, two approaches are used to discuss the cases. In the first one, all information on the case is offered to the student, who must then provide a diagnosis. In the second type, information is released gradually, according to the students' request[10]. There is no consensus in the studies included in the present review about what would be the ideal type of case discussion to stimulate clinical reasoning learning. However, the need to adapt the level of the case difficulty to the student's learning moment is a consensus. In the early years, cases of more frequent diseases and typical presentations are the most indicated ones, progressively moving towards frequent diseases with atypical presentations and even rare cases[9].

Although reading about or discussing clinical cases does not fully reproduce the cognitive challenge involved in caring for a patient, an active way of reading and participating in discussions, in which the student seeks to solve the case as information is made available can bring benefits to the students' future cognitive and clinical reasoning development[10].

As the students move on to the clinical cycle and especially with the start of the internship, they have increasingly more contact with actual patients, thus having the possibility of increasing the repertoire of cases to which they are exposed. When students are exposed to real-life cases, they feel the pressure caused by the fact that their decisions will have an actual impact, which results in a more significant learning experience[9]. Although the contact with patients has the advantage of greater student motivation, it is important to emphasize that not all students are exposed to the same cases, which can create gaps in learning, in addition to the fact that even if two students are exposed to the same case, the reflection awakened in each of them will be different[2].

Studies have shown that at the internship, few students are exposed to patients with the most prevalent diseases. In one study, only 6% of students had contact with patients with peptic ulcers[9]. Aiming to decrease these disadvantages, many institutions are increasing the time of exposure to simulated patients, through classes carried out in realistic simulation laboratories[9]. In addition, internship supervision often occurs inadequately or without the necessary feedback[13], considering that teaching in the clinical environment poses peculiar challenges, such as the fact that the teacher has to guarantee adequate care for the patient at the same time that they need to teach the student[8]. An appropriate and timely feedback is an important component of students' skill development. When feedback is absent, incomplete or contains errors, it can have a negative impact on learning[9]. Feedback barriers in Medicine include fragmentation of care, a culture of absence of feedback among physicians, especially when there is an error, and delay between the clinical diagnosis and the performance of confirmatory tests[10].

Students point out that they see the teacher as a model to be followed, aiming to be able to develop their clinical reasoning, which is why they tend to have positive educational experiences when they receive detailed and complete explanations on how a professional is carrying out the reasoning in a given case. However, when the student just observes passively, without receiving any explanation, they will not fully develop the understanding of the reasoning used to solve a case[9].

It seems that there is an excess of confidence by educators that the development of clinical reasoning occurs through the exposure to and discussion of cases, to the detriment of the formal teaching of a discipline focused on this topic. Except for the experience reports in which a discipline or extracurricular courses were created, little or no attention was given to teaching theories involving clinical reasoning. Even the lack of knowledge about the processes involved in clinical reasoning was something reported by the students themselves[18]. Students need to have the opportunity to activate the previously acquired knowledge before meetings with patients, so that these meetings can effectively benefit the students[10].

Knowledge of the mechanisms involved in clinical reasoning can help students acquire greater confidence in

the diagnosis they are making, in addition to helping prevent errors related to biases in clinical reasoning from occurring. In this sense, one of the proposals to develop the students' clinical reasoning is the deliberate practice of reflection[1,35]. In this model, students are encouraged to think critically about their reasoning and, in a structured way, raise and justify the diagnostic hypotheses for each case, until they reach the final definition of which would be the most appropriate diagnostic hypothesis[35].

Metacognition is a process that allows reflecting on the development of thinking and reasoning[36,37], as well as allowing the assessment of the developed reasoning adequacy to the ongoing situation[3]. This way of "managing thought" can point out failures in clinical reasoning and detect errors before decisions that affect patients can be taken[36]. Although metacognition is indicated as a strategy to reduce the biases involved in clinical reasoning and diagnostic errors, the studies included in the present review did not directly address this mechanism and did not refer to the skills and experiences involved in metacognition[3].

One of the strategies employed has been the use of conceptual maps to help the development of clinical reasoning. The use of conceptual maps was proposed by John Novak[38] in the 1980s and their use has increased ever since. In clinical reasoning, its use has the advantages of aiding in the development of differential diagnoses, construction of disease scripts and the encapsulation of basic sciences into complex concepts[19].

Finally, it is important to remember that teachers must assess the student's ability to perform clinical reasoning, so that difficulties can be perceived in the early stages[39]. Teachers should not focus their evaluation solely on the student's ability to make the final diagnosis, but also evaluate the process developed by the student in the creation of their clinical reasoning and the context in which the case is presented[8].

FINAL CONSIDERATIONS

Although it is considered a crucial skill for the practice of Medicine, few studies have analyzed how clinical reasoning is taught to medical students in Brazilian medical schools.

The lack of the teaching of processes that involve clinical reasoning and, consequently, decision-making can lead to diagnostic errors, either due to unconscious biases present in clinical reasoning, or due to the lack of knowledge of techniques that can help in the evaluation of diagnostic hypotheses raised by the physician.

Most studies indicate that exposing students to the greatest possible number of cases since the early years, either through actual patients, simulated ones or case discussions, leads to the development and improvement of clinical reasoning by medical students.

Although more studies are required to characterize how the teaching-learning process of clinical reasoning occurs in Brazil, one can verify that the lack of theoretical knowledge about clinical reasoning is one of the main causes of the difficulty in making correct diagnoses.

AUTHORS' CONTRIBUTION

Fernando Tureck: study design, data analysis and interpretation, article writing and final approval of the submitted version. Samantha De Souza: analysis and interpretation of data and final approval of the submitted version. Rosa Malena Delbone de Faria: support for data analysis and interpretation, final writing of the article and final approval of the submitted version.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

1. Mamede S, Schmidt HG, Penaforte JC. Effects of reflective practice on the accuracy of medical diagnoses. Med Educ. 2008;42(5):468-75. doi: https://doi.org/10.1111/j.1365-2923.2008.03030.x.
2. Eva KW. What every teacher needs to know about clinical reasoning. Med Educ. 2005;39(1):98-106. doi: https://doi.org/10.1111/j.1365-2929.2004.01972.x.
3. Peixoto MAP, Brandão MAG, Pereira Junior GA, Campos JF, Souto JSS. Usando a metacognição para analisar um caso de erro diagnóstico em simulação de alta fidelidade. Rev Bras Educ Med. 2021;45(2):1-11 [cited 2022 dec 12]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-55022021000200217&tlng=pt.
4. Lopes DM, Bregagnollo GH, Barbosa BM, Stamm AMNF. The process of clinical reasoning among medical students. Rev Bras Educ Med. 2018;42(3):194-200 [cited 2022 dec 15]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&amp.
5. Peixoto JM, Santos SME, de Faria RMD. Processos de desenvolvimento do raciocínio clínico em estudantes de medicina. Rev Bras Educ Med. 2018;42(1):73-81 [cited 2022 oct 10]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-55022018000100075&lang=pt.
6. Bregagnollo GH, Lopes DM, Barbosa BM, Stamm AMNF. Raciocínio clínico de estudantes de medicina no ciclo básico. Rev Bras Educ Med. 2017;41(1):44-9 [cited 2022 dec 02]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-55022017000100044&lng=pt&tlng=pt.
7. Rencic J. Twelve tips for teaching expertise in clinical reasoning. Med Teach. 2011;33(11):887-92. doi: https://doi.org/10.3109/0142159X.2011.558142.
8. Audétat M-C, Laurin S, Dory V, Charlin B, Nendaz MR. Diagnosis and management of clinical reasoning difficulties: part I. Clinical reasoning supervision and educational diagnosis. Med Teach. 2017;39(8):792-6. doi: https://doi.org/10.1080/0142159X.2017.1331033.
9. Richmond A, Cooper N, Gay S, Atiomo W, Patel R. The student is key: a realist review of educational interventions to develop analytical and non-analytical clinical reasoning ability. Med Educ. 2020;54(8):709-19.
10. Rajkomar A, Dhaliwal G. Improving diagnostic reasoning to improve patient safety. Perm J. 2011;15(3):68-73.

11. Schmidt HG, Rikers RMJP. How expertise develops in medicine: knowledge encapsulation and illness script formation. Med Educ. 2007;41:1133-9.
12. Schmidt HG, Mamede S. How to improve the teaching of clinical reasoning: a narrative review and a proposal. Med Educ. 2015;49(10):961-73. doi: https://doi.org/10.1111/medu.12775.
13. Mamede S. O que a pesquisa sobre raciocínio clínico tem a dizer a preceptores e professores de áreas clínicas? Sci Med (Porto Alegre, Online). 2020;30(1):1-8 [cited 2021 dec 10]. Available from: https://revistaseletronicas.pucrs.br/index.php/scientiamedica/article/view/37350.
14. Mendes KDS, Silveira RCCP, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. Texto Context Enferm. 2008;17(4):758-64.
15. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan – a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):1-10. doi: https://doi.org/10.1186/s13643-016-0384-4.
16. Porto CC. Raciocínio clínico. Rev Méd Minas Gerais. 2017;27:1-3.
17. Fornaziero CC, Gordan PA, Garanhani ML. Clinical reasoning of medical students in a public university in Brazil. Rev Bras Educ Med. 2012;36(4):463-9 [cited 2021 nov 22]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/606104.
18. Landim DMP, Moreno Neto JL, Soares JFS. Raciocínio clínico: percepções e práticas de estudantes de medicina. Rev Bras Educ Med. 2021;45(1):1-8 [cited 2022 nov 18]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&amp.
19. Barillo SFAL. Tecnologias e propostas ativas na educação em medicina: mapas conceituais e o raciocínio clínico. Dissertação de mestrado. Universidade Católica de Petrópolis. Petrópolis 2020.
20. Albuquerque CV, da Cruz D, Cicogna JIR, Lopes TJP, Stamm AMNF. Desenvolvendo o raciocínio clínico avançado na discussão de casos. 56o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Vitória; 2018.
21. Fornaziero CC, Gordan PA, Garanhani ML. O processo de ensino e aprendizagem do raciocínio clínico pelos estudantes de medicina da Universidade Estadual de Londrina. Rev Bras Educ Med. 2011;35(2):246-53 [cited 2021 jan 03]. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&amp.
22. Gomes LO, Salomão AFS, Ramos AAM. O raciocínio clínico como forma de aprendizagem entre estudantes de medicina: um relato de experiência. 58o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Congresso Virtual 2020.
23. de Oliveira SM, de Oliveira AM, Amaral JPF, da Silva CHM, Oliveira LM, Sato YAS. Sessão ética-anatomoclínica: a importância do raciocínio clínico na formação médica. 56o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Vitória; 2018.
24. de Queiroz IKF, Teixeira RMD, da Fonseca RV, Nogueira LMM, Lima FS. Raciocínio clínico como metodologia no processo de ensino-aprendizagem do estudante de medicina da Universidade Potiguar: um relato de experiência. 56o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Vitória; 2018.
25. Silveira ME, Emídio RE, Paixão LR, Cardoso RAR, e Silva ACS, Maksud FAN. Dinâmica de raciocínio clínico em discussão de casos na disciplina de semiologia. 49o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belo Horizonte; 2011.
26. Diehl LA, Soares FMC, Prado FA, Martin LMM. Case-based clinical reasoning education: relato de experiência. 57o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belém; 2019.
27. Rafael APSC, Aragão JCS. Uso do TBL na indução de raciocínio clínico. 56o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Vitória; 2018.
28. Barillo SFAL, Graever L, da Silva Júnior JC, Grandis AF, de Sá PK. Professor, como eu aprendo a raciocinar? 57o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belém; 2019.
29. de Sales ACV, Lucas IC, dos Santos LAR. Implementação da disciplina de raciocínio clínico em um curso médico: um relato de experiência. 57o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belém; 2019.
30. Almeida GSB, Gotardo DRM, Borges DFF, de Araújo MQ, Souza VS, Nogueira TQS. Curso de extensão teórico prático para desenvolvimento do raciocínio clínico na formação do estudante de medicina. 54o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Brasília; 2016.
31. Remor AAC, Stamm AMNF, Battistella C, Lopes DM, Bregagnollo GH. Frente de capacitação de uma liga acadêmica de medicina interna. 50o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. São Paulo; 2012.
32. Sarris AB, Dornelles CF, Reis ESS. Liga acadêmica de raciocínio clínico e diagnóstico diferencial: aliando prática médica à teoria em extensão universitária. 53o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Rio de Janeiro; 2015.
33. Prado FA, Gordan PA, Diehl LA. Ensino médico, internet e mídias sociais: a experiência de um blog sobre raciocínio clínico. 57o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belém; 2019.
34. Gay S, Bartlett M, McKinley R. Teaching clinical reasoning to medical students. Clin Teach. 2013;10(5):308-12. doi: https://doi.org/10.12968/hmed.2017.78.7.399.
35. Mamede S, van Gog T, Moura AS, de Faria RMD, Peixoto JM, Rikers RMJP, et al. Reflection as a strategy to foster medical students´ acquisition of diagnostic competence. Med Ed. 2012; 46:464-72.
36. Graber ML, Kissam S, Payne VL, Meyer AN, Sorensen A, Lenfestey N, et al. Cognitive interventions to reduce diagnostic error: a narrative review. BMJ Qual Saf. 2012; 21(7):535-57.
37. Croskerry P. The cognitive imperative: thinking about how we think. Acad Emerg Med. 2000; 7(11):1223-31.
38. Novak JD, Gowin DB. Aprendendo a aprender. Lisboa. Plantano Edições Tecnicas. 1996.
39. Audétat M-C, Laurin S, Dory V, Charlin B, Nendaz MR. Diagnosis and management of clinical reasoning difficulties: part II. Clinical reasoning difficulties: management and remediation strategies. Med Teach. 2017;39(8):797-801.doi:https://doi.org/10.1080/0142159X.2017.1331034.
40. Noll G, Gerbase M. Mapas conceituais como ferramenta para o desenvolvimento do raciocínio clínico. 55o Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Porto Alegre; 2017.
41. Ramos ALC, Peña SS, Leonardo F, Pessoas HA, de Almeida FE. Oficina de raciocínio clínico: das teorias ao Sparc Model. 58º Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Congresso virtual; 2020.
42. Souza GH, Paiva L, Pelucio EB, Aguiar GV, da Silva CHM. Oficina de raciocínio clínico: uma proposta do grupo PET medicina. 57º Congresso Brasileiro de Educação Médica. Associação Brasileira de Educação Médica. Belém; 2019.