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Clinical cases created by Medical students in the development of clinical reasoning: a systematic review

Casos clínicos criados por estudantes de Medicina no desenvolvimento do raciocínio clínico: uma revisão sistemática

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ABSTRACT

Introduction: Clinical reasoning, fundamental in the healthcare context, encompasses data collection and diagnostic formulation. Case-based teaching and problem-based learning integrate clinical skills and promote professional development, but the potential of the student-generated clinical case strategy is still little explored.

Objective: This systematic review aims to analyze the construction of clinical cases by students as an effective pedagogical strategy in medical education.

Method: A systematic review was conducted according to the PRISMA protocol, searching five scientific article indexers using keywords related to "clinical reasoning," "case construction" and "medical students." The screening of titles and abstracts, the full reading of selected articles, and data extraction were carried out by two independent reviewers. Demographic data, employed methodologies, and teaching strategies were collected. Results and conclusions were presented, along with an analysis of the risk of bias in the studies.

Results: Initially, 1,970 papers were identified. After screening titles and abstracts, 25 articles were selected for full reading, of which 6 were included in the systematic review. The methods for constructing clinical cases exhibited considerable diversity in form and content, involving between 11 and 315 students from the 1st to the 4th year of medical undergraduate studies, with activities spread over periods ranging from 1 day to 4 weeks. Overall, this strategy was deemed appropriate by the authors.

Conclusions: The construction of clinical cases by students represents a valuable strategy for the development of Clinical Reasoning in medical education, contributing to the training of more qualified and reflective professionals. There is evidence that it can be useful in medical training as a complementary method, rather than a substitute, for traditional teaching methods.

Keywords: Clinical Reasoning; Case Construction; Case Reports; Problem-Based Learning; Medical Education; Undergraduate Students.

RESUMO

Introdução: *O raciocínio clínico (RC), fundamental no contexto da saúde, abrange a coleta de dados e a formulação de diagnósticos. O ensino baseado em casos e a aprendizagem por problemas integram habilidades clínicas e promovem o desenvolvimento profissional, mas o potencial da estratégia de criação de casos clínicos pelos estudantes ainda é pouco explorado.*

Objetivo: *Esta revisão sistemática visa analisar a construção de casos clínicos por estudantes como uma estratégia pedagógica eficaz no ensino médico.*

Método: *Realizou-se uma revisão sistemática segundo o protocolo PRISMA, com busca em cinco indexadores de artigos científicos, utilizando palavras-chave relacionadas a "raciocínio clínico", "elaboração de casos clínicos" e "estudantes de Medicina". A triagem de títulos e resumos, a leitura integral dos artigos selecionados e a extração de dados foram conduzidas por dois revisores independentes. Coletaram-se os dados demográficos, as metodologias empregadas e as estratégias de ensino. Apresentaram-se os resultados e as conclusões, além da análise do risco de vieses nos estudos.*

Resultado: *Inicialmente, foram identificados 1.970 trabalhos. Após a triagem de títulos e resumos, selecionaram-se 25 artigos para leitura na íntegra, dos quais seis foram incluídos na revisão sistemática. Os métodos de construção de casos clínicos apresentaram grande diversidade em forma e conteúdo, envolvendo de 11 a 315 estudantes do primeiro ao quarto ano da graduação em Medicina, com atividades distribuídas ao longo de períodos variando de um dia a quatro semanas. De maneira geral, essa estratégia foi considerada adequada pelos autores.*

Conclusão: *A construção de casos clínicos por estudantes representa uma estratégia valiosa para o desenvolvimento do RC na educação médica, contribuindo para a formação de profissionais mais capacitados e reflexivos. Há evidências de que possa ser útil na formação médica como método complementar, e não substitutivo, aos métodos tradicionais de ensino.*

Palavras-chave: *Raciocínio Clínico; Construção de Casos; Relatos de Casos; Aprendizagem Baseada em Problemas; Educação Médica; Estudantes de Graduação.*

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INTRODUCTION

Clinical reasoning (CR) is an essential skill that plays a central role in the provision of healthcare. It is a complex process involving a series of stages and cognitive functions. It operates with the aim of arriving at a diagnosis, treatment and/or management plan, involving the collection of data and the formulation of hypotheses that will guide clinical decision-making[1].

RC teaching is based on teacher observation[2] and discussions of clinical cases using active methodologies[3]. Illness scripts, schemas that enable the recognition of disease patterns, are appropriated by students through repetitive exposure to clinical cases[4]. Methods such as Problem-Based Learning (PBL) and Case-Based Learning (CBL) are considered superior to traditional bedside teaching, facilitating the resolution of clinical cases and the development of concept maps[5]. These active methods promote interactive learning[6], arouse greater student interest[7]and encourage the development of skills such as teamwork and critical analysis[8].

Case narration plays a crucial role in consolidating the clinical experience of students[2] by allowing them to express CR in a structured manner[1]. The presentation of real cases provokes an enriching confrontation with the student's pre-existing theoretical knowledge[9], and it is essential that this practice is aligned with the educational objectives, in order to stimulate the curiosity and creativity of the students[10]. However, the effectiveness of this learning can be compromised by insufficient supervision and feedback[11]. In addition, doctors' workload[12] and patient data protection guidelines make it difficult to expose students to real cases.

In a recent systematic review of RC teaching, the following strategies were identified: structured reflection; self-explanation; suggestions for differential diagnoses; case presentation methods (SNAPPS); illness scripts and the Knowledge Encapsulation Framework; and Schema-Based Instruction[1]. However, the method of student case creation (SCC) was not mentioned, although some reports in the literature indicate experiences in which students formulated fictitious situations to develop CR[13]. In another recent review analysing the effectiveness of pedagogical practices to develop critical thinking, CR and clinical judgement, among 33 articles only one addressed the strategy of student-developed cases[14].

The aim of this systematic review is to analyse the available literature on SCC, based on the hypothesis that this strategy is appropriate for medical education and constitutes an impactful tool in the development of RC. The research aims to report on how the authors describe the strategy, check comparisons with other approaches and analyse the results based on the outcomes researched, including the perceptions of students and teachers.

METHOD

The objective of the study was defined using the SPIDER strategy[15], as shown in Chart 1. The following research question was developed: How has the SCC strategy been developed and appreciated by medicine teachers and students? A systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[16]. This study was registered in the International prospective register of systematic reviews (PROSPERO) under the identification number CRD42024565604.

The article search was conducted in two stages. In stage 1, the authors performed searches on 25 September 2024 in the scientific journal indexes Lilacs, SciELO, PubMed, Eric and Scopus, using a combination of subject descriptors and keywords related to "clinical reasoning", "learning", "clinical case development" and "medicine students". The keywords were extracted from the Health Sciences Descriptors (DeCS) for texts in Portuguese and Spanish and from the Medical Subject Headings (MeSH) for texts in English. The exact search terms are shown in Chart 2. There were no restrictions on time, type of publication or study design. The only filter used was language, selecting only articles in English, Portuguese and Spanish. The exact search keys for each index base are shown in Chart 3. In stage 2, all the references and citations of any article included in stage 1 were analysed in order to find additional articles that could be included in the study.

The titles and abstracts of the studies found in the searches were analysed using the Rayyan app[17], eliminating duplicates. Two pairs of reviewers (ASL/TLFF and ASL/VOA) analysed the titles and abstracts. Each pair carried out 50% of the analyses independently, resolving any conflicts by consensus between the two members of each pair. Studies published in English, Spanish or Portuguese that evaluate, discuss, test or describe strategies for teaching CR in medical education using SCC were selected for full reading. Original articles, review articles, editorials and publications from conference annals were included. Articles that dealt with CR but did not involve medicine students, such as nursing, physiotherapy, chiropractic, etc. were not included. Articles that dealt only with patient management or involved postgraduate students were also not included.

ASL and CCM independently screened the articles after reading them in full. Using the same inclusion criteria, the articles were then selected for final analysis. The articles included in the analysis were then independently reviewed by ASL and CCM, with the extraction of data that was collected and managed using the electronic data storage tool REDCap (Yale University)[18], hosted at the UFMG Tele-Education Centre

of the Hospital das Clínicas. Any discrepancies were resolved through discussion and consensus between the two authors.

The following information was extracted from each study, if applicable: author, journal, year of publication, language of the article, country of the study, institution (or university) that conducted the study, objectives of the study, methodology, study design, multicentre or single-centre study, outcomes analysed, name given to the strategy investigated, time of the activity conducted by the students, clinical problem of the case developed by the students, facilitations offered to the students during the activity (reading material, use of computer, access to internet research, tutor, previous visit to patient(s) or other), year of undergraduate training of the students, use of control group, number of participants in each group, type of analysis (qualitative, quantitative or mixed), main results, authors' conclusions, positive and negative aspects of the article and author's opinion on the strategy.

The selected studies underwent a rigorous quality assessment by two independent reviewers (ASL and CCM), using Qualsyst (Standard Quality Assessment Criteria for Primary Research Articles in Various Fields)[19]. Each study was scored based on its compliance with the established criteria, with the response options categorised as "yes" (2 points), "partial" (1 point) and "no" (0 points). This assessment covered a total of 10 criteria for qualitative studies, 14 criteria for quantitative studies and a total of 24 criteria for mixed-approach studies. For each study, a total score was calculated from the sum of the scores assigned to each criterion, which was divided by the potential total points.

A narrative synthesis of the included articles was then carried out to address the objectives of the review.

Chart 1. SPIDER Strategy.

S - sample: medical students
PI - phenomenon of interest: individual and/or collective experiences of students and tutors regarding the implementation of the strategy of student-generated clinical cases.
D - design: in experimental and/or observational case-control studies, considering comparison with the use of another strategy exposing students to clinical cases.
E - evaluation: identifying the forms of evaluation of the strategy in the various published studies.
R - type of research: mixed studies (qualitative and quantitative), observational or experimental.

Source: Prepared by the authors.

Chart 2. Selected keywords.

IN ENGLISH: medicine student; medical education; undergraduate; creat*; generat*; clinical reasoning; case reports; problem-based learning.
IN PORTUGUESE: estudantes de medicina; educação médica; feito; construído; criação; criado; gerado; raciocínio clínico; relatos de casos; aprendizagem baseada em problemas.
IN SPANISH: estudiantes de medicina; educación médica; hecho; construido, creación; creado; gerado; razonamiento clínico; informes de casos; aprendizaje baseado en problemas.

Chart 3. Search keys.

Scopus	(TITLE-ABS-KEY ("Medicine Student*" OR "Medical education" OR "Education, Medical" OR "Education, Medical, Undergraduate") AND TITLE-ABS-KEY (creat* OR generat*) AND TITLE-ABS-KEY ("Clinical reasoning" OR "Case* report*" OR "Problem-Based Learing")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "Portuguese"))
PubMed	(("Medicine Student*"[Title/Abstract] OR "Medical education"[Title/Abstract] OR Education, Medical [MeSH Terms] OR Education, Medical, Undergraduate [MeSH Terms]) AND (Creat*[Title/Abstract] OR generat*[Title/Abstract])) AND (Clinical reasoning [MeSH Terms] OR Case reports [MeSH Terms] OR Problem-Based Learning [MeSH Terms])
Eric	("Medicine Students" OR "Medical education") AND (created OR creation OR generated) AND ("Clinical reasoning" OR "Case reports" OR "Problem-Based Learning")
Lilacs	(((Estudantes de Medicina) OR (educação médica)) AND (feito OR construído OR criação OR criado OR gerado) AND ((raciocínio clínico) OR (relato de casos) OR (aprendizagem baseada em problemas)))
SciELo	((("Medical Students" OR "Estudantes de Medicina" OR "Estudiantes de Medicina" OR "medical education" OR "educação médica" OR "educación médica")) AND ("made" OR "feito" OR "hecho" OR "constructed" OR "construído" OR "construido" OR "creation" OR "criação" OR "creación" OR "created" OR "criado" OR "creado" OR "generated" OR "gerado")) AND ("clinical reasoning" OR "raciocínio clínico" OR "razonamiento clínico" OR "case reports" OR "relato de casos" OR "informes de casos" OR "problem-based learning" OR "aprendizagem baseada em problemas" OR "aprendizaje basado en problemas")

Source: Prepared by the authors.

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RESULTS

A total of 1,743 titles were found in the bibliographic databases search (stage 1). In stage 2, where the references and citations of included articles were reviewed, a further 227 titles were found, totalling 1,970 papers. After eliminating the 182 duplicates, 1,788 titles and abstracts remained to be analysed, of which 25 articles were selected for full reading. After reading the full text, six articles were included in the data analysis (Figure 1).

The quality rating of the studies according to the Qualsyst tool ranged from 0.30 to 0.98, with an average of 0.71 (Table 1). The lowest ratings were attributed due to deficiencies in the description of the methodology applied, the small number of participants, the absence of evidence related to verification procedures and reflexivity, as well as the lack of evaluation of confounding variables, information that was deficient especially in publications in the form of editorials.

Table 1 shows some of the characteristics of the six studies included in this review. In four articles, the specific theme was identified for the development of cases: diarrhoea and diabetes[20], profuse diarrhoea in children[21], dyspnoea[24] and dilated cardiomyopathy[22]. One of the articles did not mention the theme, but the study was conducted in the physiology department[23]. In another article, the theme and department were not specified[25]. In one of the articles, the students only developed laboratory test results[21]. In the other articles, the students prepared the clinical case in a more complete way, including a description of the clinical assessment[20,22,23,25]and even a care plan[24].

Of the 6 articles included, in 5 of them the authors were in favour of the SCC strategy. Only in one article did the author express an unfavourable opinion, arguing that the negative results could possibly be attributed to the lack of clinical expertise of second-year students[20].

Relevant aspects of the studies analysed are summarised below, namely: strategies in the development of SCC, objectives, outcomes analysed, results of quantitative evaluations, perceptions (of students and tutors) and the authors' conclusions.

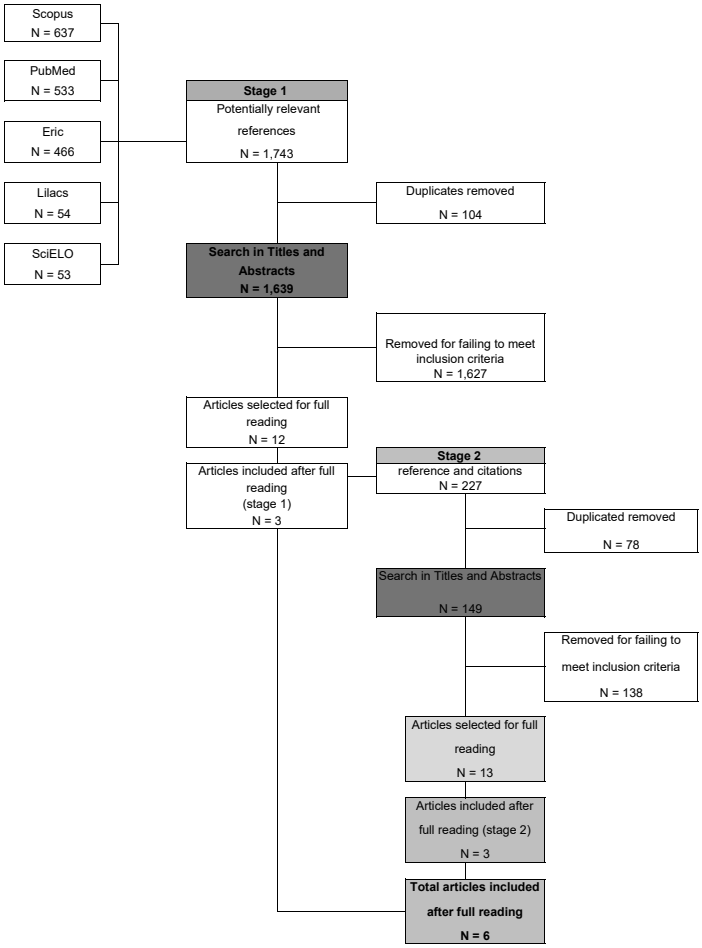
Strategies in the development of SCC

SCC strategies were implemented in different ways in the studies analysed. In one of them, second-year medicine students took part in case construction using the "case construction" method in two clinical contexts (diabetes or diarrhoea), with a crossover design to compare with traditional PBL in 4-hour sessions[20]. In another study, the Student-Generated Reasoning Tool (SGRT) was introduced to first-year students, allowing them to create fictitious laboratory test results based on a clinical case, developing pathophysiological hypotheses and justifying their conclusions. This method was compared to a control group that used the Case-Based Collaborative Learning (CBCL) strategy[21].

Three other studies involved students from different years in the construction of fictitious cases, stimulating creativity in the formulation of clinical findings, diagnoses and hypotheses[22,23,25]. One of these studies focussed on the use of an instrument based on a real clinical case, enabling pathophysiological and syndromic diagnoses to be made within the framework of appropriate clinical reasoning[25].

Recently, a new approach called Scenario-Based Learning (SBL) was tested with 315 third-year students and 29 experienced PBL facilitators. The activities, which took place over the course of one week, included synchronous sessions and independent studies, where students created complete clinical scenarios addressing the assessment of dyspnoea and differential diagnoses of cardiopulmonary diseases, discussing laboratory tests, treatment and preventive measures[24].

Figure 1. Search results according to the PRISMA protocol.



Source: Prepared by the authors.

Table 1. Characteristics of the 6 articles included and analysed in the systematic review.

AUTHOR	Rustici et al. [20]	Zagury-Orly et al.[21]	Chandrasekar et al.[22]	Peavy[23]	Idowu et al. [25]	Mamakli et al. [24]
JOURNAL	Medical education	Medical Teacher	Advances in Medical Education and Practice	Academic Medicine	Journal of Royal Society of Medicine Open	Advances in Physiology Education
YEAR	2017	2022	2018	2001	2016	2023
LANGUAGE	English	English	English	English	English	English
COUNTRY	United States of America	United States of America Canada	United States of America	United States of America	United Kingdom	Turkey
UNIVERSITY	University of Colorado	Harvard Medical School	Stanford University School of Medicine	Indiana University School of Medicine	Imperial College	Akdeniz University
TYPE OF PUBLICATION	letter to the editor	original article	original article	letter to the editor	original article	original article
DESIGN	experimental	experimental	experimental	observational	observational	experimental
MULTICENTRE?	no	no	no	no	no	no
STRATEGY	Case Construction	SGRT	CBL	PBL	PBL	SBL
TIME OF ACTIVITY	two 4-hour sessions.	exercise in one session and feedback, quiz and focus group (+- 3 weeks).	one 3-hour session.	2 sessions a week for 4 weeks.	6 sessions.	one week: 3 synchronous 2-4 hour sessions, plus unlimited extra meetings organised by the groups and independent study periods.
THEME	Diabetes and diarrhoea	diarrhoea in children	Dilated cardiomyopathy	not specified	not specified	dyspnoea
SETTING	in person	in person	in person	in person	in person	online
FACILITATIONS	tutor/facilitator	reading material; tutor/facilitator; video, case discussion as an example by specialist teachers, access to external material.	tutor/facilitator; prior explanation of the activity, predefined diagnosis.	tutor/facilitator; access to real clinical cases; meetings with the director twice a week; pre-established work schedule.	computer use; tutor/facilitator.	reading material; tutor/facilitator; platform for online meetings.

SGRT - student-generated reasoning tool; CBL -case-based learning; PBL - problem-based learning; SBL - scenario-based learning

Continue...

Table 1. Continuation.

AUTHOR	Rustici *et al.* [20]	Zagury-Orly *et al.* [21]	Chandrasekar *et al.*[22]	Peavy[23]	Idowu *et al.* [25]	Mamakli *et al.* [24]
CONTROL GROUP?	yes	yes (historical control)	no[a]	no	no	no
n STUDY GROUP	154	171	12	not specified	11	315
n CONTROL GROUP	154	168	Not applicable	Not applicable	Not applicable	Not applicable
YEAR OF STUDY	2nd year	1st year	1st year	3rd and 4th years	2nd year	3rd year
TYPE OF ANALYSIS	mixed	mixed	mixed	qualitative	qualitative	mixed
TYPE OF EVALUATION	1) script concordance test performed after development of the cases to assess knowledge and clinical reasoning 2) qualitative feedback from students and facilitators.	post-activity, with evaluation of students' views through a questionnaire.	SFPD-26 pre- and post-activity with evaluation of students' views through a questionnaire comparing their previous experience with traditional CBL methodology. TGEI, interviews with focus groups.	post-activity, with evaluation of students' views through a questionnaire.	Post-activity. The evaluation was a qualitative study that used focus group interviews to obtain the students' views.	occurred after the implementation of the SBL. Satisfaction: Measured by semi-structured feedback forms applied to students and facilitators. Student engagement: Evaluated by forms completed by the facilitators and the students themselves. Academic Performance: Assessed through written tests (MCQ and SCT). Quality of the scenarios created: Assessed using a standardised checklist.
AUTHOR'S OPINION	Negative	Positive	Positive	Positive	Positive	Positive
ARTICLE QUALITY (Qualsyst)	0.50	0.98	0.76	0.30	0.90	0.81

a) No control, but the participants' perceptions were compared with the traditional CBL strategy already known by the students.

SFPD-26 - Stanford Faculty Development Program Clinical Teaching Instrument; TGEI - Tutorial Group Effectiveness Instrument; SBL - scenario-based learning; MCQ - multiple choice questions; SCT - script concordance test.

Source: Prepared by the authors.

Objectives and Outcomes analysed

The main objective of the studies analysed was to assess the effectiveness of the SCC strategy in developing RC, sometimes comparing it with traditional methods such as PBL and CBL. The main hypothesis suggested that writing clinical cases based on diagnoses would strengthen RC learning[20-22]. Furthermore, the studies aimed to provide students with opportunities to acquire and improve communicative competences relevant to their future careers, encourage the acquisition of skills associated with continuing education and allow detailed investigations into specific areas of medicine, from molecular aspects to socio-economic implications of illnesses[23]. Students' views on the new case-scripting process and team assessment were explored in an attempt to identify innovations that could improve the course[25], as well as to assess the mechanisms by which the strategy contributes to the development of RC[21] and the effectiveness of SCC models in improving academic performance, classroom engagement and student and facilitator satisfaction[24].

The outcomes investigated in the studies generally included the students' performance in assessments and their and the facilitators' responses to questionnaires on the perceived effectiveness of the method, conducted after the cases had been developed. Among the outcomes analysed were the effectiveness of the tutorial group, the interaction between students and teachers and perceived development of CR[21,22]. The study by Mamakli et al.[24] assessed the satisfaction of those involved after the implementation of the SBL strategy, using semi-structured feedback forms and written tests, which included multiple choice questions (MCQ) and script concordance tests (SCT). The quality of the scenarios created was measured using a standardised checklist[24]. Qualitative feedback has also been considered in other studies[20,21].

Results of quantitative evaluations

In the study by Zagury-Orly et al.[21], the use of the SGRT tool was superior in the development of CR compared to CBCL. Students exposed to SGRT obtained better results in specific questionnaires in relation to pathophysiological reasoning. The improvement became more evident after the team discussion[21]. In another study[20], there was no significant difference in student performance between the methods, but "case construction" was considered more challenging: 68% of the students felt that case construction provided a good, very good or excellent opportunity for learning, while 64% felt that this format was a little more difficult or a lot more difficult than the traditional format[20]. In an analysis of the results of an SCC strategy, SBL was compared with previous data obtained in PBL modules, with the observation of better academic results compared to previous performance[24].

Students' perceptions

In one article, it was observed that students reported greater satisfaction with the SBL module compared to the PBL method[24]. In all the works, several positive views of the SCC approach were highlighted. Students valued the sharing of clinical experiences during group work, the efficient use of time and the relevance of the guidance received from experienced tutors. Assessment was seen as an incentive for learning, and critical feedback from both colleagues and tutors was considered well organised and beneficial. The SCC strategy favourably impacted the learning of new skills, promoting teamwork, collaborative learning and creative thinking[21,22,25], as well as improving reasoning skills related to case presentation[20]. The students reported that creating laboratory results increased their awareness of the topic and helped identify gaps in knowledge, allowing for a deeper exploration of the pathophysiology of clinical cases[21]. They also identified that the intervention, when compared to the traditional CBL method, increased the corrective feedback offered by tutors, achieving greater ownership of the case content, involvement in CR and understanding of clinical nuances[22].

However, negative aspects of the strategy were also reported. The students' lack of clinical experience and the absence of team members during patient visits impacted on their performance. The inexperience of tutors and the difficulty in obtaining fair evaluations within the team were cited as disadvantages, as was competition, which is detrimental to collaborative work[25]. Moreover, the approach required significant time and effort, making group learning more challenging, and it failed to adequately reproduce the clinical assessment of "real patients"[20]. Reduced interaction between students and teachers and less use of audiovisual resources were identified as shortcomings, with suggestions that more interspersed feedback and additional guidance on the aetiological elements of the diagnosis would be beneficial[22].

Tutors' perceptions

In the study by Mamakli et al.[24], tutor satisfaction with SBL did not differ significantly from that of PBL. There were also no significant differences in the engagement observed by the facilitators in relation to the methods[24]. The opinion of the facilitators was mixed in the study by Rustici et al.[20], highlighting both strengths (improved ability to write a history and physical examination data, greater depth in the CR) and weaknesses (limited depth in the CR, too much material for the time available). Groups that constructed in-depth cases in line with what is observed in typical patients found the intervention more beneficial[20].

Authors' conclusions

The evaluation of the SCC strategy showed divergent opinions among authors. One author considered the approach to be negative for second-year medicine students, arguing that its complexity would be more suitable for students with more clinical experience, allowing for the development of more detailed cases[20]. In contrast, the majority of authors highlighted the positive aspects of SCC. Peavy et al.[23] reported significant faculty enthusiasm and growing student interest in the subject, while the implementation of SBL, even in an online format during the pandemic, was well received, showing effectiveness in engagement and satisfaction, contributing to deeper learning[24].

DISCUSSION

The literature is scarce when it comes to describing and evaluating the strategy for developing CR through the use of SCC in undergraduate medical training. Although this

strategy is theoretically in line with the contemporary trend in medical education, which includes problem-based learning, student-centred teaching and competence-building, only six articles were found on the subject, two of which were editorials[20,23] and four original articles. In general, the articles included were low-quality studies, four experimental[20-22,24] and two observational[23,25], with small samples, except for the study by Mamakli et al.[24] which involved 315 participants. Only two studies used a control group for comparison, one with an historical control group[21] and the other with an internal crossover control[20]. None of the studies were randomised or multicentre. The medical students taking part in the study were at different points in their training: First year[21,22], second year[20,25], third year[24] or third and fourth year of the undergraduate program[23]. Despite the low quality of most of the articles found, only one of them was unfavourable in relation to the strategy[20], possibly due to the precocious stage – second year – of the students who took part in the activity.

The included studies that set out to describe and analyse the SCC strategy, the central theme of this review, revealed different designs in their exploration of the tool. There were different ways of offering materials to students during the tasks, with a big difference in the length of the activity and the number of sessions. The themes used to build the clinical cases had different approaches, and in two of the articles[23,25] they were not even specified. Different ways of evaluating the results of the tool by students were described, using non-validated questionnaires for different objectives and different analysed outcomes. The authors presented their methodologies for preparing cases for medical students, ranging from a simple construction of laboratory test results[21] to complete clinical cases with clinical history, physical examination, test results, differential diagnosis and care plan[23,24]. In a similar study, but involving postgraduate medical students, a case-writing course was held in which an active learning environment was created in which students directed their own learning process in small groups facilitated by lecturers. This approach allowed students to apply basic science concepts to develop interdisciplinary clinical cases and promote communication skills, problem-solving and continuous learning[26].

Students often solve cases prepared by teachers[10], but they rarely play the role of case writers in the context of PBL. The act of writing allows students to clarify their learning experiences and express their thoughts, developing cognitive aspects that apply to the development of CR[25,26]. Dynamic educational approaches, such as competency-based education, which refers to the ability to select and acquire the knowledge, skills and attitudes needed to deal with specific situations effectively, enable individuals to deal with challenges autonomously and responsibly, valuing the development of the individual as an active builder of knowledge and enabling them to tackle ethical challenges[27]. The SCC strategy allows students to move away from the role of passive recipients of information and into the position of agents in the reconstruction of knowledge, in a practice that emphasises the development of schemas, experimentation, research and the active search for knowledge[27].

The objectives of the studies on the SCC strategy were diverse: to promote the development of communication skills useful in their careers, developing skills related to continuing education; to assess performance in pathophysiological reasoning; to investigate specific areas of medicine, considering molecular aspects and the socio-economic impact of the diseases under analysis; and to assess the perceptions of students and tutors about clinical case writing and teamwork, analysing group dynamics, the role of the tutor and the importance of feedback in learning.

The SCC strategy showed positive aspects, with superior results compared to traditional PBL, especially in the assessment of pathophysiological reasoning, and was valued by students for promoting teamwork and awareness of the importance of prior knowledge in analysing clinical cases, as well as stimulating creativity and the identification of knowledge gaps. Learning is most effective when new knowledge and skills are presented within the context of their practical application and related to real-world situations, reflected in clinical decisions that benefit the patient. Guidance from experienced tutors, assessment as a learning incentive and structured feedback strengthen case presentation skills, creating a safe environment for critical peer feedback. The educator's role as facilitator promotes student spontaneity[2].

The studies reviewed have several limitations that affect their conclusions. The low number of participants may distort the representativeness of opinions about a new approach to PBL[25], particularly in different cultural and curricular contexts, since all the studies were conducted in the northern hemisphere. Intervening with students in the early stages of their medical training can make it difficult for them to prepare quality clinical cases, given their limited practical experience[22]. In addition, the application of SBL in an online environment during the pandemic brought challenges, such as technical problems and difficulties in monitoring group dynamics, while the evaluation of CR through questionnaires may have been inadequate[24]. Not applying script concordance tests for the evaluations and the predominance of observational studies also limit the validity of the conclusions. However, it is difficult to execute intervention studies in this area, as imposing a single learning style can jeopardise clinical development[1].

Negative aspects of SCC include reduced listening to teachers and reduced interaction between students and teachers[22]. Some studies were published in a restrictive format, such as a letter to the editor, which compromised the depth of the information[20,23]. Inadequate tutor training, to the detriment of student instruction, and competitiveness in teamwork were also identified[25]. Training tutors is crucial for developing clinical expertise[2]. The studies presented in the review involved students in the early stages of their training and without access to real patients. Lack of practical experience with patients can limit the development of illness scripts and knowledge integration, hindering the reorganisation of reasoning and proper diagnosis[28]. SCC can be more effective if applied in advanced stages of the curriculum, when students already have greater knowledge and clinical experience[22].

The improvement of CR is essential in the training of competent doctors. It should start early, focusing not only on data collection, but also on synthesising and interpreting information, using real cases to promote active and reflective learning[22]. Students should be exposed to various clinical problems in order to build mental representations and illness scripts[2], improving diagnosis[4]. Representations, as narratives of exposed cases, are dynamic and constantly evolving. They activate prior knowledge and help to compare differential diagnoses[9]. The richer and more structured the illness scripts are in the doctor's memory, allowing them to generate a wide range of initial differential diagnoses, the better they will be able to diagnose[1,7,11]. Strategies such as self-explanation and deliberate reflection have been shown to be effective in promoting students' diagnostic competence[7,11]. Corrective feedback from the teacher, effort and guidance also help to develop expertise[29].

The use of the CBL methodology is widely recognised as an effective approach to teaching CR among medical students, even in the early stages of their training[30]. However, health education faces significant challenges, such as the rapid increase in the number of students, which is not accompanied by a proportional increase in the quality and quantity of teaching staff[31]. Supervision during clinical clerkships is often inadequate, lacking appropriate feedback, due to the particularities of teaching in clinical environments, where teachers need to balance patient care with instruction[3]. Furthermore, strict regulations, the increasing responsibility of clinical staff and data protection legislation have reduced the opportunities for direct interaction between students and real patients, highlighting the need to resort to alternative learning methods[32].

The principles of constructivism emphasise the active construction of knowledge, allowing students to develop their conceptual base by confronting pre-existing ideas with new scientific information. This approach encourages conceptual changes and the practical application of knowledge, promoting interaction between students and shared analysis mediated by the teacher, which values student autonomy[27]. Strategies that focus on developing advanced cognitive skills are fundamental for the transition from the academic environment to clinical practice[13,21]. Activities with clinical cases do not necessarily require advanced technological resources, and approaches that encourage reflection on diagnoses and underlying mechanisms are effective in improving CR[11].

Contemporary medical curricula integrate innovative educational approaches, such as PBL and mannequin simulators, which facilitate the internalisation of procedural knowledge before contact with real patients[12]. These tools promote interactivity and problem-solving in controlled environments[32] and are useful in settings with limited face-to-face teaching[33], although they do not adequately address the affective and psychomotor aspects essential to clinical training[12]. Strategies that put the student at the centre of the process and incorporate technologies such as artificial intelligence, making their activities more playful to the extent possible[34], can enhance learning and the development of clinical skills in a safe environment[31,35].

A possible limitation of this review may be related to the imprecise choice of terms for the search of articles, with the possible loss of works on the subject. In the lists of descriptors and keywords (MeSH and DeCS) there are no more specific terms related to the SCC strategy. This bias was minimised by using broader terms involving CR and medical education, with a search in five academic databases. This risk was also mitigated by manually searching for all citations and references in the selected articles.

Developing expertise is not easy and does not happen passively; it requires effort, sacrifice and honesty[2]. The group dynamics, participation of an experienced and engaged tutor, assessment, feedback and the learning of new skills with the development of creative thinking all play essential roles in student training, each with their own distinct challenges and benefits[25]. Learning is maximised when students are encouraged to create content. The development of cases by the students is feasible and can represent an effective additional approach, complementing traditional CR teaching methods. The early introduction of CR and case creation is seen as a valuable educational practice. Repetition in the process of preparing cases can better prepare students not only to understand the content, but also to share knowledge with their colleagues[22].

Future research should investigate the effectiveness of different approaches to teaching CR and the feasibility of implementing them in medical curricula, in order to support more informed educational decisions by health professional

trainers. Further studies need to be formulated, preferably multicentre, controlled experimental studies with a larger number of participants and at various stages of the course, involving not only medical students but also other health professionals in their training.

CONCLUSION

The SCC strategy for the development of CR has been presented in few studies in the medical literature. However, it has proved promising and suitable as an active methodology and for competency-based training. The methodologies described in the various articles reviewed could be improved. This will make it possible to evaluate the SCC strategy, which seems to be useful in medical training as a complementary method, rather than a substitute for traditional teaching methods.

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CONTRIBUTION OF THE AUTHORS

Arnaldo Santos Leite contributed to the conception of the study, methodology, data collection, writing of the manuscript and revision. Vítor de Oliveira Alves and Thiago Lúcio Ferreira Félix contributed to the data collection, writing the manuscript and revision. Carolina Coimbra Marinho contributed to the methodology, data collection, writing of the manuscript and revision.

CONFLICT OF INTEREST

We declare no conflict of interest.

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DECLARATION OF DATA AVAILABILITY

Research data is available in the body of the document

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