

Chapter

Advancing Clinical Excellence: Cultivating Critical Thinking and Clinical Reasoning in Medical Education

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Abstract

Critical thinking (CrT) and clinical reasoning (CR) are crucial skills for medical professionals. They serve as cornerstones for diagnostic excellence and patient safety, while significantly contributing to patients' sense of well-being. As the healthcare landscape becomes increasingly complex, the ability to think critically and reason clinically has never been more important. This chapter explores the interplay between CrT and CR in medical education, addressing the significant challenges in teaching these complex competencies that extend beyond mere knowledge acquisition. It examines how students must simultaneously master core medical knowledge while developing reasoning abilities in uncertain clinical situations. This narrative review identifies effective educational approaches—including case-based, problem-based, and simulation-based learning—while acknowledging curriculum constraints and assessment difficulties. It highlights how variations in teaching methods and faculty expertise impact learning outcomes, and addresses the gap between classroom instruction and clinical application. The discussion emphasizes the crucial role of faculty development in teaching these competencies effectively, noting how variations in educator expertise significantly impact CR training outcomes. By proposing solutions to face these implementation challenges, this chapter offers recommendations for curriculum revision, enhanced faculty training, and the development of standardized assessment methods. It advocates for fostering a culture of inquiry, reflection, and evidence-based practice throughout medical training, while highlighting the need for future research to develop reliable evaluation tools and quantify the long-term impact of these educational strategies. This exploration provides educators and institutions with insights to cultivate these critical competencies in future medical professionals, ensuring clinical excellence in an evolving healthcare landscape.

Keywords: critical thinking, clinical reasoning, medical education, curriculum development, educational innovation

1. Introduction

Critical thinking (CrT) and clinical reasoning (CR) are indispensable competencies in healthcare, directly impacting diagnostic accuracy, patient safety, and clinical excellence [1]. However, many educational institutions struggle to effectively cultivate these competencies, often relying on traditional didactic methods emphasizing knowledge acquisition over application. In clinical practice, the lack of critical reasoning skills has been linked to diagnostic errors, which account for a significant proportion of adverse patient outcomes [2]. Furthermore, as healthcare becomes increasingly complex, clinicians face mounting pressure to integrate evidence-based practices with patient-centered care, requiring advanced cognitive and decision-making abilities [3].

Critical thinking encompasses the ability to analyze information systematically, evaluate evidence, recognize patterns, and make well-reasoned judgments [4]. In healthcare settings, these skills are fundamental to clinical reasoning, which involves the complex cognitive process of collecting and analyzing patient data, generating and testing hypotheses, and formulating evidence-based care plans [5]. Research has demonstrated that strong CrT and CR abilities are associated with reduced diagnostic errors and improved patient outcomes [6]. Moreover, these skills have been shown to enhance healthcare professionals' ability to adapt to complex and uncertain clinical situations, with clinical reasoning now recognized as a core competency essential for safe and effective patient care [7].

Clinical reasoning stands at the core of professional practice in healthcare [8–10], serving as a keystone in most health professions' competence frameworks worldwide. Effective clinical reasoning not only contributes to high-quality clinical care and accurate diagnosis but also reduces cognitive biases and medical errors [11–13]. The systematic development of these competencies through deliberate reflection correlates with improved clinical performance and diagnostic accuracy [14].

While CrT provides the foundational skills for analyzing complex situations and making ethical, patient-centered decisions [15], CR applies these principles specifically within the medical context, integrating clinical knowledge with decision-making processes. Clinical excellence emerges from this integration, characterized by comprehensive knowledge, ethical practice, patient-centered care, effective communication, teamwork, and a commitment to continuous improvement [16].

Though closely related, CrT and CR encompass different scopes, components, and applications [17]. CR focuses specifically on patient care, while CrT provides broader analytical frameworks applicable across various healthcare scenarios [18]. However, despite their recognized importance, the development of these skills often remains underemphasized in medical curricula. The integration of CrT and CR education is particularly vital in light of increasing complexities in healthcare, including diverse patient populations, rapidly evolving technology, and the rise of evidence-based medicine.

This narrative review explores the synergy between CrT and CR, emphasizing their role in clinical excellence. It synthesizes strategies to cultivate CrT and CR, addressing implementation barriers and proposing future directions for medical education. The chapter further identifies gaps, implementation challenges, and future directions, offering a comprehensive analysis while providing actionable recommendations for educators and institutions, advocating a paradigm shift in medical education to prioritize critical reasoning as essential for developing competent healthcare professionals.

2. Methodology

This chapter employs a narrative literature review to explore diverse perspectives and integrate the findings from empirical studies, theoretical frameworks, and expert opinions. Narrative reviews provide a broad and critical synthesis of the existing literature on a topic, allowing the author to present a personal perspective. Thus, a semi-structured literature search was used, along with less rigid inclusion/exclusion criteria compared to systematic or scoping reviews. Literature searches were conducted across PubMed, Scopus, Web of Science, and Google Scholar to include additional relevant publications and gray literature. Keywords used included “*critical thinking*,” “*clinical reasoning*,” “*medical education*,” “*teaching strategies*,” and “*curriculum development*”. In this chapter, inclusion criteria encompassed peer-reviewed English publications (2000–2024) addressing educational interventions, challenges, and theoretical models related to CrT and CR in medical education. Most retrieved sources represent, but are not exclusively, SSCI- and SCI-indexed journals; books and reports were also selected if they were considered relevant for the narrative review. Exclusion criteria omitted studies that focused solely on technical skills, non-peer-reviewed sources, editorials, and non-English articles.

The selection process involved the screening of titles and abstracts for relevance, followed by full-text reviews to ensure alignment with the research objectives. The articles were categorized into pedagogical strategies, assessment methods, and faculty development. Data extraction identified key findings, methods, and outcomes, and thematic analysis revealed patterns, challenges, and gaps in teaching CrT and CR. Narrative synthesis provided a comprehensive overview, integrating diverse insights and highlighting opportunities for future research and educational practice.

3. Critical thinking and clinical reasoning: Synergistic competencies in medicine

Critical thinking and clinical reasoning are complex competencies that present significant challenges in both comprehension and development. While these skills share numerous dimensions, the assumption that developing CrT would automatically enhance CR throughout healthcare education requires careful examination. The increasing emphasis on clinical reasoning education in medical training reflects a growing recognition of the need to cultivate critical thinking skills alongside medical knowledge acquisition.

3.1 Critical thinking in medicine

Critical thinking (CrT) encompasses diverse conceptualizations that vary according to different perspectives and movements [19, 20], with limited agreement among scholars [21]. Facione identifies two sets of positive traits essential for CrT expression: skills and dispositions [22]. Skills comprise a series of intellectual abilities that good thinkers employ when facing and solving problems: interpretation, analysis, evaluation, inference, explanation, and self-regulation. When used together, these skills ensure quality reasoning, enable bias identification, help judge information relevance, facilitate exploring different problem angles within specific contexts, challenge personal assumptions, and support optimal solution-finding [23]. These skills are complemented by dispositions, representing an internal drive to engage in deep

thinking and judiciously apply CrT skills. Critical CrT dispositions include inquisitiveness, systematicity, analyticity, truth-seeking, open-mindedness, self-confidence, and cognitive maturity [24]. Although less visible, dispositions are fundamental to critical thinking expression and the self-monitoring of reasoning quality.

Importantly, the context where reflective judgment develops is a key feature of CrT [25–27]. While CrT can be taught as a generalist competence, thinking critically about a problem or situation requires a specific knowledge background rooted in the ability to recall and understand the basic/core information needed for solution-finding [28]. Consequently, CrT may present as many specificities as there are professions or disciplinary fields [25]. In medicine specifically, CrT is crucial for analyzing patient claims, driving clinical questioning to determine the reasons behind clinical conditions, inferring underlying causes, searching for evidence, considering implications, supporting clinical decisions, and seeking solutions to various problems while engaging patient compliance through shared decision-making regarding proposed solutions [11, 23]. The particular understanding of CrT in the medical area is summarized in **Tables 1** and **2** (skills and dispositions respectively).

3.2 Resemblances between critical thinking and clinical reasoning

Critical thinking (CrT) and clinical reasoning (CR) share many similarities in their decision-making processes, and are often considered equivalent in health sciences literature [18]. Both are complementary cognitive processes crucial when dealing with complex, ill-defined situations typical in the medical field.

Despite being recognized as a central educational ability, CrT encompasses a wide array of definitions and conceptualizations, influenced by psychological, philosophical, and educational perspectives. This diversity makes it challenging to find a single, consensual definition that satisfies all stakeholders involved with the topic [19]. CrT is an intellectually disciplined, metacognitive process supported by various skills and dispositions that, through purposeful, self-regulatory reflective judgment, enhances the likelihood of effective decision-making, logical problem-solving, or reaching valid argumentative conclusions [29].

Both CR and CrT are self-disciplined, self-monitored, and self-corrective thinking processes, though their primary applications differ. CR specifically focuses on clinical conditions and aims at patient well-being and health, while CrT applies more broadly across all life-related situations, from professional contexts to political and social issues. Both processes rely on skills (cognitive or reasoning abilities) that represent a particular “way of thinking,” combined with dispositions (inclination for reasoning performance) that reflect an internal willingness to engage in that thinking pattern. Together, these elements lead to an outcome, a high level of thinking supporting informed decision-making, which represents the ultimate purpose of both processes. The similarities between CrT and CR are further emphasized by Paul and Elder’s work, who adapted their eight Elements of Thought framework into comparable Elements of Clinical Reasoning (**Figure 1**), the fundamental connections between these cognitive processes [30].

3.3 Synergy between critical thinking and clinical reasoning

CrT and CR are deeply intertwined in healthcare, particularly clinical settings. CrT provides the foundation for CR by encompassing information analysis, evidence evaluation, judgment formation, and self-reflection [11, 17]. Without strong critical thinking skills, clinicians may struggle to effectively apply their knowledge in medical practice.

Skills	Overall interpretation	Medical sciences
<i>Interpretation</i>	Understanding and clarifying meaning, such as comprehending and expressing the significance of various experiences, data, situations, judgments, conventions, beliefs, rules, procedures, or criteria	Understanding and making sense of clinical data, patient histories, lab results, imaging studies, and other relevant information. For instance, interpreting symptoms and signs to form an initial diagnosis or understanding the implications of lab values in the context of a patient's overall health
<i>Analysis</i>	Identifying the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions	Break down complex clinical situations into manageable components, examining the relationships between symptoms, risk factors, and potential diagnoses For example, a physician might analyze the relationship between a patient's lifestyle, symptoms, and potential underlying diseases to determine the most likely diagnosis.
<i>Inference</i>	Drawing conclusions, as well as forming hypotheses or conjectures that follow from the evidence or reasoning provided	Drawing conclusions based on clinical evidence and reasoning, to deduce a diagnosis from a set of symptoms or to predict the likely outcome of a treatment For example, a physician might infer that a patient with a given combination of symptoms is likely to have a particular medical condition
<i>Evaluation</i>	Assessing the credibility of statements or other representations, as well as assessing the logical strength of the actual or intended inferential relationships among them	Assessing the reliability and validity of diagnostic tests, treatments, and other clinical data. It includes critically appraising the quality of evidence from clinical studies or evaluating the risk-benefit ratio of a treatment option. Prioritize actions in order to better manage situations of uncertainty and emergency. For instance, a physician may evaluate the credibility of a clinical trial's results before applying the findings to patient care
<i>Explanation</i>	Stating and justifying reasoning in terms of the evidential, conceptual, methodological, criteriological, and contextual considerations that support an interpretation or conclusion	Communicating clearly the clinical reasoning and decisions to patients, colleagues, or other healthcare professionals. It also involves justifying a diagnosis or treatment plan based on evidence and clinical guidelines. For example, a physician might explain to a patient why a particular treatment is recommended based on the patient's test results and clinical guidelines
<i>Self-regulation</i>	Monitoring and correcting one's own cognitive activities, judgments, and evaluations. This involves self-examination and self-correction	This involves continuously monitoring and reflecting on one's own clinical decision-making process; it also includes recognizing when a diagnosis or treatment plan needs reassessment or when personal biases may affect clinical judgment. Moreover, it involves staying updated with the latest medical research and guidelines to ensure that one's practice is evidence-based

Table 1.
Interpretation of CrT skills according to Facione's conceptualization and their understanding in the medical field (Adapted from Ref. [25]).

CR represents a specialized form of problem-solving within clinical contexts, where critical thinking enables clinicians to decompose complex problems, evaluate alternative solutions, and make sound decisions. This process requires professionals to

Dispositions	Overall interpretation	Medical sciences
<i>Truth-Seeking</i>	The desire to seek the best possible understanding of situations or issues, even if it challenges personal beliefs or the <i>status quo</i> . A truth-seeker is committed to following evidence and reason wherever they lead	It involves a relentless commitment to finding the most accurate diagnosis and effective treatment for a patient, even if it challenges conventional wisdom, established practices, or personal biases. Medical professionals must prioritize evidence and objective data over assumptions or incomplete information, continually asking questions and seeking clarity to ensure the best possible patient outcomes
<i>Open-Mindedness</i>	Being receptive to different points of view, willing to consider alternative perspectives, and being tolerant of divergent opinions. Open-minded individuals avoid jumping to conclusions and are ready to adjust their thinking when confronted with new evidence or compelling arguments	It is the willingness to consider alternative diagnoses, treatment options, and patient perspectives. Healthcare providers must remain receptive to new research, alternative therapies, and interdisciplinary insights, recognizing that medical knowledge is constantly evolving. Open-minded clinicians listen to patients' concerns and value the input of colleagues from different specialties, adjusting their approach when presented with new, credible information
<i>Analyticity</i>	The tendency to engage in thoughtful analysis and to anticipate potential consequences or complications. Analytical thinkers are attentive to detail, focus on the complexity of issues, and carefully examine the arguments and evidence before reaching conclusions	It involves a deep, thorough approach to patient care. Medical professionals must carefully analyze symptoms, test results, and medical histories, considering all possible explanations before arriving at a diagnosis. This disposition is critical in identifying subtle signs of illness, anticipating potential complications, and weighing the risks and benefits of different treatment options. Analytical clinicians meticulously assess every piece of data to ensure accurate and well-founded clinical decisions
<i>Systematicity</i>	Use a methodical and organized approach to problem-solving. Individuals who are systematic are thorough in their thinking, ensuring that they consider all relevant factors and explore different options systematically rather than haphazardly	It is about being organized and methodical in clinical reasoning and patient care. This involves following a structured approach to diagnosis and treatment, such as using clinical guidelines and evidence-based practices, ensuring that all relevant factors are considered. Systematic healthcare providers create comprehensive care plans, document their processes thoroughly, and follow up consistently to monitor patient progress
<i>Inquisitiveness</i>	It is a strong curiosity and eagerness to acquire knowledge and understanding. Inquisitive individuals ask questions, seek out information, and are motivated by a desire to learn and understand more deeply	It is a strong desire to continually learn, understand, and explore new medical knowledge. Inquisitive healthcare professionals stay updated with the latest research, actively seek out continuing education opportunities, and are curious about the underlying causes of diseases and conditions. This disposition drives them to ask probing questions, explore innovative treatments, and push the boundaries of what is known in the field.
<i>Self-Confidence</i>	To have confidence in one's own reasoning processes and the ability to think critically. This includes trust in one's ability to reason well and to arrive at logical and sound conclusions, even in complex or uncertain situations	It refers to a healthcare provider's trust in their ability to reason through complex clinical situations and make sound decisions. Confident clinicians are not easily swayed by uncertainty or pressure; they rely on their training, experience, and the best available evidence to guide their decisions. This confidence is crucial when making difficult or time-sensitive decisions, such as during emergencies or when determining a course of treatment for a challenging case

Dispositions	Overall interpretation	Medical sciences
Cognitive maturity	The ability to make reflective, informed, and prudent decisions. This disposition involves recognizing that some issues are complex and that there may not be simple answers. Mature thinkers are aware of the need to consider various factors and the implications of their decisions	It involves making well-considered decisions that reflect a deep understanding of the complexities and uncertainties inherent in healthcare. Mature healthcare providers recognize that not all medical issues have straightforward solutions and that decisions often involve weighing multiple factors, including patient preferences, ethical considerations, and long-term outcomes. They are prudent, reflective, and capable of making difficult decisions in the best interests of their patients, even when faced with ambiguous or incomplete information

Table 2.
Interpretation of CrT dispositions according to Facione’s conceptualization and their understanding in the medical field (Adapted from Ref. [25]).

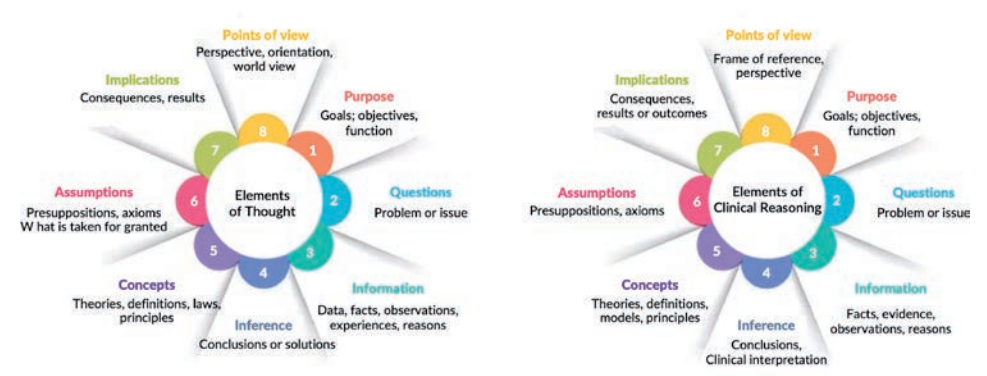


Figure 1.
Schematic comparison of the Elements of Thought in Critical Thinking (standards of reasoning) and the Elements of Clinical Reasoning, which represent basic blocks or steps in the reasoning structure, according to the Paul and Elder model [30].

assess information credibility, question assumptions, and recognize potential biases [1]. Both processes are fundamentally reflective, encouraging clinicians to examine their thought processes and monitor their decisions [14] while balancing clinical guidelines with ethical implications and patient preferences [31].

CrT and CR play vital roles in error minimization by promoting vigilance and helping clinicians identify potential pitfalls in their reasoning process, which is essential to prevent diagnostic errors and adverse outcomes [7, 12]. Research shows that most diagnostic errors and poor medical decision-making stem from flaws in clinical reasoning [32]. Additionally, the intersection of CrT and CR supports clinician adaptability in complex situations, enabling quick decision-making based on incomplete or evolving data while helping clinicians navigate evolving healthcare technologies rapidly [33].

4. Role of medical education in nurturing critical thinking and clinical reasoning

Critical thinking (CrT) and clinical reasoning (CR) have become fundamental components of medical education, explicitly featured in physicians’ competency

frameworks worldwide [13]. While higher education institutions and medical educators recognize the need to integrate these skills into medical curricula, significant implementation challenges persist.

The transition from traditional didactic methods to dynamic, skills-based approaches remains problematic. Students often struggle to develop the necessary cognitive tools for effective decision-making in complex clinical environments [34]. The authors highlight two key issues: the variability in teaching methods and the absence of standardized approaches across universities. Although innovative practices like case-based learning and simulation exist, their effectiveness varies based on faculty expertise and student engagement, creating disparities in skill development across institutions.

Furthermore, limited opportunities for early clinical exposure impede the development of practical reasoning skills. Students face difficulties translating theoretical knowledge into practice, potentially affecting their confidence and competence during the transition to professional roles [35]. Addressing these challenges requires comprehensive reforms, including curriculum revision, enhanced faculty training, and effective implementation of appropriate assessment tools to measure CrT and CR development.

4.1 Effective educational strategies

The effective teaching of CrT and CR in medical education faces several significant challenges [18, 34]. These challenges stem from multiple key aspects that affect both teaching and learning processes.

The inherent complexity of CrT and CR represents a primary challenge, as these skills extend beyond mere knowledge acquisition to practical application in uncertain situations [1, 3]. Individual educators conceptualize clinical reasoning, focusing on various sub-skills and specific medical areas, which influence their educational strategies and research outcomes [36]. Students must simultaneously master core medical knowledge while developing reasoning abilities through clinical problems, integrating multiple knowledge sets, abilities, and behaviors [37]. Additionally, student resistance to engaging in critical thinking and alternative learning methods can impede progress [38].

Educational methods for developing clinical competencies show variable effectiveness across different institutions. While various student-centered approaches are employed, including problem-based learning, case-based learning, simulations, and team-based collaborative learning, there is no consensus on the most effective method. The success of these approaches depends heavily on implementation factors, skill dimension identification, and student engagement [18, 34].

The assessment presents another significant challenge. Traditional evaluation methods may inadequately measure students' reasoning ability through complex clinical scenarios [18, 39]. Moreover, translating classroom-learned skills to clinical settings remains problematic [40, 41]. Limited exposure to real clinical experiences can reduce student confidence and increase the gap between day-one skills and market expectations [42–44], hindering the skills' development and increasing the length of the “acclimatization period” when entering their professional activities.

The already packed medical curriculum presents additional challenges [45, 46]. However, it is possible to integrate CrT development activities within core medical curricula [47], ensuring these skills are regularly practiced for mastery. Clinical skills are typically learned in controlled environments with varying clinical exposure levels [48]. However, the effectiveness of this approach depends on the availability and quality of clinical experiences.

Faculty development and support represent the final crucial challenges, encompassing educator expertise and teaching quality variations within and between institutions. These factors significantly impact the effectiveness of CR training and require careful consideration in medical education planning.

5. Innovative approaches to enhancing critical thinking and clinical reasoning

CrT and CR have gained prominence in medical education, with schools emphasizing their development to enhance clinical practice and professional identity, demonstrate adequate performance in clinical practice, and develop a professional identity [49]. Competency-based curricula, requiring the integration of knowledge, skills, and attitudes, have facilitated this shift. Students engaging in real-world tasks improve their clinical skills and successfully translate these into practical contexts [50]. Embedding CrT in curricula has been shown to reduce diagnostic errors and cognitive biases and improve healthcare quality [51].

CrT and CR strategies differ in their application across medical training stages, with CrT often introduced in early years and CR emphasized in clinical settings, as mentioned in a recent review [34]. Case-based and problem-based learning are widely used to present students with complex medical scenarios, encouraging them to apply theoretical knowledge, enhance decision-making, and understand clinical practices [18, 34]. Research has demonstrated measurable improvements in diagnostic accuracy and decision-making skills through simulation-based learning and case-based methodologies [18, 52]. Abdul Rahman et al. [52] found that medical students engaged in problem-based learning reported a 30% increase in confidence when diagnosing complex cases. Simulation-based learning, employing mannequins, virtual reality, or standardized patients, allows safe clinical skills and decision-making practice, complemented by debriefing sessions to provide feedback and refine performance [53, 54]. Also, Schmidt and Mamede [54] showed that reflective journaling enhanced clinical reasoning by improving students' ability to identify cognitive biases and integrate theoretical knowledge into patient care. Other reflective practices, such as group discussions or debriefing, also encourage the students to analyze their experiences and improve future actions [14].

Innovative strategies like flipped classrooms and concept mapping further enhance CrT and CR by linking core knowledge and visualizing information connections [55]. These methods, often supported by technology, introduce flexibility, facilitate essential knowledge acquisition, and refine technical skills [56]. Collaborative learning through interprofessional education fosters teamwork, communication, and a deeper understanding of healthcare team roles, improving care quality and reducing medical errors [57, 58].

Despite their potential, translating these skills to clinical settings remains challenging. Variability in teaching quality and engagement limits their impact, while non-standardized assessments hinder effectiveness evaluations. Strategies are often assessed *via* self-reports or generalist CrT tests, which may not align with specific interventions [18]. Additional obstacles include insufficient descriptions of interventions, inconsistent durations, and mismatches between cultivated skills and assessment methods. Addressing these challenges requires robust faculty training, integration of interprofessional education, and continuous curriculum refinement.

6. Institutional culture and investments as a factor of change

Critical thinking (CrT) and clinical reasoning (CR) are core competencies that universities and medical programs worldwide strive to nurture. Despite total institutional commitment, various challenges and limitations can hinder the comprehensive return on academic investment. Successful development of medical competencies requires regular mapping of gaps between graduates' skills and labor market demands [59, 60]. This integration becomes increasingly critical given the rapid pace of technological and pharmacological advancements, alongside evolving healthcare settings.

The medical field has been relatively successful in addressing these challenges compared to other health professions, largely due to regular revisions of day-one competency frameworks [13, 61]. Such updates increase the likelihood of new graduates achieving better education-to-job alignment [62]. However, while medical students often demonstrate high levels of cognitive knowledge, their skills and professional dispositions must be cultivated throughout the academic curriculum. Many institutions globally strive to equip their graduates with the competencies needed for workplace success, with particular emphasis on CrT and CR skills. These leading institutions consistently produce high-quality graduates and significantly contribute to the field. However, this level of excellence is not universal among institutions offering clinical sciences education, contributing to significant heterogeneity in medical education quality. This disparity, and other factors, contribute to uneven healthcare service delivery worldwide.

What distinguishes these leading universities in the medical education landscape?

6.1 Institutional culture in nurturing CrT and CR

Institutional culture is fundamental in embedding CrT and CR within medical education. Leading institutions move beyond mission statements, emphasizing analytical skills, evidence-based practice, and lifelong learning. Instead, they invest in carefully designed curricula where these values are interwoven, with core knowledge and integrated into extracurricular activities, creating an environment where CrT and CR flourish naturally. In these settings, educators and clinical tutors are tasked with developing targeted educational interventions that foster both CrT and CR, challenging students to bridge the gap between theoretical knowledge and real-world practice while promoting critical analysis and decision-making. Furthermore, these institutions often embrace an interdisciplinary approach, encouraging students to synthesize knowledge from multiple fields, thereby strengthening their analytical capabilities.

The effective teaching of clinical reasoning demands instructors who possess both deep subject matter expertise and proficiency in teaching these complex cognitive processes. However, research indicates that not all faculty members receive adequate training in educational techniques specific to clinical reasoning development [29, 42, 61]. This often results in significant variations in instructional quality, even within the same institution. Given that most medical educators are selected primarily for their technical and professional expertise rather than their pedagogical background, investing in their professional development becomes crucial, as they represent essential human assets in the educational system [63].

Medical educators serve dual roles as both instructors and role models for critical thinking. They demonstrate their commitment and inspire students through their teaching methods, fostering open dialog, encouraging questioning, and facilitating

debate while simultaneously cultivating professional attitudes [64, 65]. To ensure medical educators achieve these desired qualities, institutions provide comprehensive development programs that enhance teaching methods, thereby strengthening their capabilities in fostering CrT and CR [66].

6.2 Professional educators' development

Most faculty initiatives to enhance teaching in clinical educators include workshops of different durations, short courses, seminars or conferences, fellowships, mentorship programs, and other longitudinal programs [63, 67]. Even though, as in the literature, the appraisal of the success of these strategies is scarce, the success of development programs and activities remains elusive [63]. A regular offer nurtures a culture that values evidence-based practice, reflection, and continuous learning and reflects the institutional commitment to the quality of their human capital and their students.

Despite the programs offered by faculties, professional development can also be reinforced through peer collaboration, shared educational practices, and other mentorship among educators in the medical field by the organization of communities of practice among educators, with a cross-disciplinary perspective, which could bring similar gains compared with formal qualification in nonspecific graduation training programs in diverse educational areas [68]. The communities of practice are powerful informal tools in educators' development [69], whether or not the higher education institutions endorse them.

To achieve excellence, the institution must go beyond preparing its educators. It also needs to recognize their efforts and the impact of their teaching roles. Although more easily talked about than done (or pondered), some higher education institutions and scientific communities have created annual awards to recognize the quality of educators' teaching activities or mentorship. Also, by creating portfolios, educators can showcase their activities and make critical reflections on the outcomes of the implemented activities that can be used for career progression, promotion, and tenure contracts [70–72].

In some institutions, resistance to changing traditional teaching and assessment methods may exist, which can stifle the promotion of CrT and CR. Overcoming this requires a paradigm shift that values innovation and critical analysis. In addition, institutions must be willing to invest in the necessary resources, including the reduction of student/educator ratio, promoting faculty training opportunities, and curricular development.

7. Recommendations

To cultivate clinical excellence, medical education must implement evidence-based strategies that bridge the gap between theoretical knowledge and clinical practice. Below, a few actionable recommendations tailored to advancing CrT and CR in medical education are proposed.

Medical education requires systematic integration of critical thinking and clinical reasoning throughout the educational continuum, from preclinical foundations to residency transitions. This curriculum evolution should incorporate structured reasoning modules and standardized multimodal learning approaches, including case-based discussions and reflective practice documentation, to ensure students

develop robust application of knowledge. Faculty development is equally crucial, as educators require comprehensive preparation as facilitators of reasoning skills. Implementing workshops focused on metacognitive instruction techniques, strategic pairing of clinical experts with educational specialists, and establishment of professional learning communities can significantly advance pedagogical innovation while fostering competence and intellectual inquiry among students.

Current assessment methodologies require substantial refinement to evaluate clinical reasoning properly. Educational institutions should develop Objective Structured Clinical Examinations that evaluate diagnostic reasoning processes, implement script concordance testing to assess performance under conditions of uncertainty, and utilize longitudinal portfolios to document cognitive development. These assessment instruments must reflect the complexity inherent in clinical decision-making. Supporting these educational advances requires appropriate systemic infrastructure, with accreditation frameworks incorporating reasoning competencies as essential requirements. Institutional investment in simulation technologies, optimization of instructor-to-student ratios for individualized guidance, and recognition of programs demonstrating successful critical thinking and clinical reasoning integration are necessary components of this infrastructure, as advancement requires coordinated policy implementation and resource allocation.

Technological integration represents another crucial pathway, with appropriate application of artificial intelligence for diagnostic reasoning feedback, virtual reality environments for decision-making simulation, and natural language processing for documentation analysis enhancing educational outcomes. These technological tools should augment rather than substitute clinical judgment. Finally, establishing a reflective practice culture where error analysis and uncertainty are addressed constructively is essential. Medical education should promote intellectual humility as a professional value and develop interprofessional training programs emphasizing collaborative reasoning, recognizing that exemplary clinicians demonstrate a capacity for deep analysis, adaptive thinking, and continuous professional development.

These coordinated approaches can transform medical education into an effective developmental context for clinical reasoning—producing graduates who demonstrate both technical proficiency and analytical capability.

8. Conclusion

This study underscores the synergy between critical thinking and clinical reasoning as essential competencies for clinical excellence. While prior studies have explored critical thinking (CrT) or clinical reasoning (CR) in isolation, this review uniquely synthesizes their synergistic roles in medical education, contextualizing CrT skills and dispositions within medical practice and establishing a bridge between the two using Paul and Elder's competencies frameworks. Unlike earlier work, this review analyzes institutional and curricular barriers and advocates for culture-driven reforms. While medical education increasingly emphasizes the development of these skills, the complexity of these competencies and the need to cultivate them within clinical contexts present significant challenges for medical schools.

The narrative review design, while comprehensive in scope, faces several methodological constraints including potential selection bias when compared to more structured PRISMA-guided systematic reviews. Our reliance on English-language publications from 2000 to 2024 may have inadvertently excluded valuable non-English studies or earlier foundational work in the field. Implementation presents

significant challenges as well, particularly given the variability in faculty expertise and institutional resources which may limit the generalizability of our proposed strategies, especially considering that approaches like simulation-based learning require substantial infrastructure investment. We must also acknowledge assessment shortcomings, as most studies in our review utilized self-reports or generic critical thinking tests that may not adequately capture the nuances of clinical reasoning.

Several theoretical gaps persist in our understanding, particularly regarding the interplay between critical thinking dispositions and cultural contexts in medical practice. There also remains limited empirical evidence quantifying how critical thinking and clinical reasoning training directly translates to improved patient outcomes such as reduced diagnostic error rates. Curriculum integration faces substantial barriers as packed medical education schedules may hinder the implementation of longitudinal critical thinking training, especially in early medical education phases. Although universities of excellence embed these competencies within their institutional culture and curricula, in other institutions the responsibility often falls primarily on individual educators – an issue that is poorly explored in existing literature.

To operationalize these insights and advance medical education, institutions should prioritize robust faculty development programs to include specialized training in teaching critical thinking skills, interprofessional education frameworks, and ongoing curriculum refinement. Looking toward future directions, we must develop standardized tools and metrics specifically designed for clinical settings, pursue interdisciplinary research collaborations with cognitive scientists, conduct longitudinal studies tracking skill progression from preclinical to residency stages, and embrace technological innovations like virtual reality and generative AI to create adaptive clinical reasoning scenarios that provide real-time feedback to learners. Moving forward, medical educators and policymakers must prioritize the integration of CrT and CR across all stages of training, fostering a culture of inquiry, reflection, and evidence-based practice that recognizes effective education requires not just knowledge acquisition but its application in uncertain real-world situations.

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References

- [1] Benner P, Hughes RG, Sutphen M. Clinical reasoning, Decisionmaking, and action: Thinking critically and clinically. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008
- [2] Staal J, Waechter J, Allen J, Lee CH, Zwaan L. Deliberate practice of diagnostic clinical reasoning reveals low performance and improvement of diagnostic justification in pre-clerkship students. BMC Medical Education. 2023;**23**:684
- [3] Diamond-Fox S, Bone H. Advanced practice: Critical thinking and clinical reasoning. The British Journal of Nursing. 2021;**30**:526-532
- [4] Huang GC, Newman LR, Schwartzstein RM. Critical thinking in health professions education: Summary and consensus statements of the millennium conference 2011. Teaching and Learning in Medicine. 2014;**26**:95-102
- [5] Norman GR, Monteiro SD, Sherbino J, Ilgen JS, Schmidt HG, Mamede S. The causes of errors in clinical reasoning: Cognitive biases, knowledge deficits, and dual process thinking. Academic Medicine. 2017;**92**:23-30
- [6] Croskerry P. From mindless to mindful practice--cognitive bias and clinical decision making. The New England Journal of Medicine. 2013;**368**:2445-2448
- [7] Connor DM, Durning SJ, Rencic JJ. Clinical reasoning as a Core competency. Academic Medicine. 2020;**95**(8):1166-1171. DOI: 10.1097/ACM.00000000000003027
- [8] Higgs J, Jensen GM. Clinical reasoning: Challenges of interpretation and practice in the 21st century. In: Higgs J, Jensen GM, Loftus S, Christensen N, editors. Clinical Reasoning in the Health Professions. 4th ed. Edinburg: Elsevier; 2019
- [9] Young M, Thomas A, Gordon D, Gruppen L, Lubarsky S, Rencic J, et al. The terminology of clinical reasoning in health professions education: Implications and considerations. Medical Teacher. 2019;**41**:1277-1284
- [10] Young ME, Thomas A, Lubarsky S, Gordon D, Gruppen LD, Rencic J, et al. Mapping clinical reasoning literature across the health professions: A scoping review. BMC Medical Education. 2020;**20**:107
- [11] Jenicek M. How to Think in Medicine: Reasoning, Decision Making, and Communication in Health Sciences and Professions. Boca Raton: FL, Productivity Press; 2018
- [12] Shimizu T, Graber ML. An equation for excellence in clinical reasoning. Diagnosis. 2023;**10**:61-63
- [13] Young M, Szulewski A, Anderson R, Gomez-Garibello C, Thoma B, Monteiro S. Clinical reasoning in CanMEDS 2025. Canadian Medical Education Journal. 2023;**14**:58-62
- [14] Mamede S, Schmidt HG. Deliberate reflection and clinical reasoning: Founding ideas and empirical findings. Medical Education. 2023;**57**:76-85
- [15] Dissen A. A critical issue: Assessing the critical thinking skills and

dispositions of undergraduate health science students. *Discover Education*. 2023;2:21

[16] Payan-Carreira R, Reis J. Shaping clinical reasoning. In: Rezaei N, editor. *Brain, Decision Making and Mental Health*. Cham: Springer International Publishing; 2023

[17] Richards JB, Hayes MM, Schwartzstein RM. Teaching clinical reasoning and critical thinking: From cognitive theory to practical application. *Chest*. 2020;158:1617-1628

[18] Payan-Carreira R, Cruz G, Papathanasiou IV, Fradelos E, Jiang L. The effectiveness of critical thinking instructional strategies in health professions education: A systematic review. *Studies in Higher Education*. 2019;44:829-843

[19] Andreucci-Annunziata P, Riedemann A, Cortés S, Mellado A, Del Río MT, Vega-Muñoz A. Conceptualizations and instructional strategies on critical thinking in higher education: A systematic review of systematic reviews. *Frontiers in Education*. 2023;8:1141686. DOI: 10.3389/feduc.2023.1141686

[20] Facione PA. Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction (the Delphi report). In: Association, A. P, editor. *Educational Resources Information Center (ERIC)*. Newark, DE, USA: Millbrae, CA: California Academic Press; 1990

[21] Dwyer CP, Hogan MJ, Stewart I. An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity*. 2014;12:43-52

[22] Facione PA. *Critical Thinking: What It Is and Why It Counts* (2023 update).

Insight Assessment; 2023. Available from: <https://insightassessment.com/wp-content/uploads/2023/12/Critical-Thinking-What-It-Is-and-Why-It-Counts.pdf>

[23] Dwyer CP. What is critical thinking? Definitions and conceptualizations. In: Dwyer CP, editor. *Critical Thinking: Conceptual Perspectives and Practical Guidelines*. Cambridge: Cambridge University Press; 2017

[24] Facione PA. The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skill. *Informal Logic*. 2000;20:61-84

[25] Dumitru D, Bigu D, Elen J, Jiang L, Railienè A, Penkauskienė D, et al. *A European Collection of the Critical Thinking Skills and Dispositions Needed in Different Professional Fields for the 21st Century*. UTAD: Vila Real; 2018

[26] Kahlke R, Eva K. Constructing critical thinking in health professional education. *Perspectives on Medical Education*. 2018;7:156-165

[27] Mcpeck JE. Critical thinking and subject specificity: A reply to Ennis. *Educational Researcher*. 1990;19:10-12

[28] Krathwohl DR. A revision of Bloom's taxonomy: An overview. *Theory Into Practice*. 2002;41:212-218

[29] Dwyer CP. An evaluative review of barriers to critical thinking in educational and real-world settings. *Journal of Intelligence*. 2023;11(6):105. DOI: 10.3390/jintelligence11060105

[30] Hawkins, D, Elder, L, Paul, R. *The Thinker's Guide to Clinical Reasoning: Based on Critical Thinking Concepts and Tools.*, The Foundation for Critical Thinking; 2010

- [31] Jöbges S, Kumpf O, Hartog CS, Spies C, Haase U, Balzer F, et al. Presentation of ethical criteria during medical decision-making for critically ill patients: A mixed methods study. *BJA Open*. 2022;**2**:100015
- [32] Scott IA. Errors in clinical reasoning: Causes and remedial strategies. *BMJ*. 2009;**338**:b1860
- [33] Zayapragassarazan Z, Menon V, Kar SS, Batmanabane G. Understanding critical thinking to create better doctors. *Journal of Advances in Medical Education and Research*. 2016;**1**:9-13
- [34] Araújo B, Gomes SF, Ribeiro L. Critical thinking pedagogical practices in medical education: A systematic review. *Frontiers in Medicine*. 2024;**11**:1358444. DOI: 10.3389/fmed.2024.1358444
- [35] Wagner FL, Sudacka M, Kononowicz AA, Elvén M, Durning SJ, Hege I, et al. Current status and ongoing needs for the teaching and assessment of clinical reasoning - an international mixed-methods study from the students' and teachers' perspective. *BMC Medical Education*. 2024;**24**:622
- [36] Young M, Thomas A, Lubarsky S, Ballard T, Gordon D, Gruppen LD, et al. Drawing boundaries: The difficulty in defining clinical reasoning. *Academic Medicine*. 2018;**93**(7):990-995. DOI: 10.1097/ACM.00000000000002142
- [37] Young JQ, Van Merriënboer J, Durning S, Ten Cate O. Cognitive load theory: Implications for medical education: AMEE guide No. 86. *Medical Teacher*. 2014;**36**:371-384
- [38] Keeley SM, Shemberg KM, Cowell BS, Zinnbauer BJ. Coping with student resistance to critical thinking. *College Teaching*. 1995;**43**:140-145
- [39] Durning SJ, Ratcliffe T, Artino AR Jr, Vleuten Van Der C, Beckman TJ, Holmboe E, et al. How is clinical reasoning developed, maintained, and objectively assessed? Views from expert internists and internal medicine interns. *Journal of Continuing Education in the Health Professions*. 2013;**33**:215-223
- [40] Maggio LA, Cate OT, Irby DM, O'Brien BC. Designing evidence-based medicine training to optimize the transfer of skills from the classroom to clinical practice: Applying the four component instructional design model. *Academic Medicine*. 2015;**90**(11):1457-1461. DOI: 10.1097/ACM.0000000000000769
- [41] Woolley NN, Jarvis Y. Situated cognition and cognitive apprenticeship: A model for teaching and learning clinical skills in a technologically rich and authentic learning environment. *Nurse Education Today*. 2007;**27**:73-79
- [42] Duca N, Adams N, Glod S, Haidet P. Barriers to learning clinical reasoning: A qualitative study of medicine clerkship students. *Medical Science Educator*. 2020;**30**:1495-1502
- [43] Gold JG, Knight CL, Christner JG, Mooney CE, Manthey DE, Lang VJ. Clinical reasoning education in the clerkship years: A cross-disciplinary national needs assessment. *PLoS One*. 2022;**17**:e0273250
- [44] Ovitsh RK, Gupta S, Kusnoor A, Jackson JM, Roussel D, Mooney CJ, et al. Minding the gap: Towards a shared clinical reasoning lexicon across the pre-clerkship/clerkship transition. *Medical Education Online*. 2024;**29**:2307715
- [45] Ginzburg SB, Hayes MM, Ranchoff BL, Aagaard E, Atkins KM, Barnes M, et al. Optimizing allocation

of curricular content across the undergraduate and graduate medical education continuum. *BMC Medical Education*. 2022;**22**:425

[46] Slavin S, D'eon MF. Overcrowded curriculum is an impediment to change (part a). *Canadian Medical Education Journal*. 2021;**12**:1-6

[47] Singh M, Collins L, Farrington R, Jones M, Thampy H, Watson P, et al. From principles to practice: Embedding clinical reasoning as a longitudinal curriculum theme in a medical school programme. *Diagnosis*. 2022;**9**:184-194

[48] Masava B, Nyoni CN, Botma Y. Scaffolding in health sciences education programmes: An integrative review. *Medical Science Educator*. 2023;**33**:255-273

[49] Karami M, Hashemi N, Van Merriënboer J. From obese to lean curriculum: Exploring students' experiences about developing competencies in medical education. *Frontiers in Medicine*. 2024;**11**:1309548. DOI: 10.3389/fmed.2024.1309548

[50] Vandewaetere M, Manhaeve D, Aertgeerts B, Clarebout G, Van Merriënboer JJG, Roex A. 4C/ID in medical education: How to design an educational program based on whole-task learning: AMEE guide No. 93. *Medical Teacher*. 2015;**37**:4-20

[51] Chacon JA, Janssen H. Teaching critical thinking and problem-solving skills to healthcare professionals. *Medical Science Educator*. 2021;**31**:235-239

[52] Abdul Rahman NF, Davies N, Suhaimi J, Idris F, Syed Mohamad SN, Park S. Transformative learning in clinical reasoning: A meta-synthesis in undergraduate primary care medical

education. *Education for Primary Care*. 2023;**34**:211-219

[53] Pelaccia T, Jaffrelot M. Chapter 26- simulation for learning clinical reasoning. In: Chiniara G, editor. *Clinical Simulation*. Second ed. New York: Academic Press; 2019

[54] Schmidt HG, Mamede S. How to improve the teaching of clinical reasoning: A narrative review and a proposal. *Medical Education*. 2015;**49**:961-973

[55] Fonseca M, Marvão P, Oliveira B, Heleno B, Carreiro-Martins P, Neuparth N, et al. The effectiveness of concept mapping as a tool for developing critical thinking in undergraduate medical education – A BEME systematic review: BEME guide No. 81. *Medical Teacher*. 2023;**46**(9):1120-1133

[56] Guze PA. Using technology to meet the challenges of medical education. *Transactions of the American Clinical and Climatological Association*. 2015;**126**:260-270

[57] Thistlethwaite JE. Interprofessional education: Implications and development for medical education. *Educación Médica*. 2015;**16**:68-73

[58] Zechariah S, Ansa BE, Johnson SW, Gates AM, Leo GD. Interprofessional education and collaboration in healthcare: An exploratory study of the perspectives of medical students in the United States. *Healthcare*. 2019;**7**(4):art.117. DOI: 10.3390/healthcare7040117

[59] Laing G, Duffy E, Anderson N, Antoine-Moussiaux N, Aragrande M, Beber CL, et al. Advancing one health: Updated core competencies. *CABI One Health*. 2023;**2023**:303-348. DOI: 10.1079/cabionehealth.2023.0002

- [60] OECD. Skills Use and Skills Mismatch in the Health Sector: What Do we Know and What Can be Done? Health Workforce Policies in OECD Countries: Right Jobs, Right Skills, Right Places. Paris: OECD Publishing; 2016
- [61] Cotta RMM, De Souza Ferreira E, De Aguiar Franco F, Da Costa Souza Barros G, Januário JPT, Moreira TR, et al. The effectiveness of faculty development programs for training university professors in the health area: A systematic review and meta-analysis. BMC Medical Education. 2024;24:768
- [62] Salas-Velasco M. Mapping the (mis)match of university degrees in the graduate labor market. Journal for Labour Market Research. 2021;55:14
- [63] Kohan M, Changiz T, Yamani N. A systematic review of faculty development programs based on the harden teacher's role framework model. BMC Medical Education. 2023;23:910
- [64] Ahmady S, Kohan N, Namazi H, Zarei A, Mirmoghtadaei ZS, Hamidi H. Outstanding qualities of a successful role model in medical education: Students and professors' points of view. Annals of Medicine and Surgery. 2022;82:104652. DOI: 10.1016/j.amsu.2022.104652
- [65] Benbassat J. Role Modeling in medical education: The importance of a reflective imitation. Academic Medicine. 2014;89(4):550-554. DOI: 10.1097/ACM.0000000000000189
- [66] Mohd Tambéh SN, Yaman MN. Clinical reasoning training sessions for health educators—A scoping review. Journal of Taibah University Medical Sciences. 2023;18:1480-1492
- [67] Steinert Y, Mann K, Anderson B, Barnett BM, Centeno A, Naismith L, et al. A systematic review of faculty development initiatives designed to enhance teaching effectiveness: A 10-year update: BEME guide No. 40. Medical Teacher. 2016;38:769-786
- [68] Steinert Y. Faculty development: From workshops to communities of practice. Medical Teacher. 2010;32:425-428
- [69] King SM, Richards J, Murray A-M, Ryan VJ, Seymour-Walsh A, Campbell N, et al. Informal faculty development in health professions education: Identifying opportunities in everyday practice. Medical Teacher. 2021;43:874-878
- [70] Deshpande S, Chari S, Radke U, Karemore T. Evaluation of the Educator's portfolio as a tool for self-reflection: Faculty perceptions. Education and Health. 2019;32(2):75-78. DOI: 10.4103/efh.EfH_277_17
- [71] Kuhn GJ. Faculty development: The Educator's portfolio: Its preparation, uses, and value in academic medicine. Academic Emergency Medicine. 2004;11:307-311
- [72] Mayersak RJ, Yarris LM, Tuttle RC, Jones DC, Nelson AM, Bengtzen RR, et al. Demonstrating your work: A guide to educators' portfolios for graduate medical educators. Journal of Graduate Medical Education. 2021;13:635-639