



FACULDADE DE MEDICINA
UNIVERSIDADE DE
COIMBRA

MESTRADO INTEGRADO EM MEDICINA – TRABALHO FINAL

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**Clinical Reasoning in Undergraduate Medical Education – A Review of the curriculum of the
Faculty of Medicine of University of Coimbra**

ARTIGO CIENTÍFICO ORIGINAL

ÁREA CIENTÍFICA DE OUTRAS ÁREAS DA MEDICINA

Trabalho realizado sob a orientação de:

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MAIO/2020

CLINICAL REASONING IN UNDERGRADUATE MEDICAL EDUCATION - A REVIEW OF THE CURRICULUM OF THE FACULTY OF MEDICINE OF UNIVERSITY OF COIMBRA

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Abstract

Curriculum development is an ongoing, refining process towards the achievement of proposed outcomes. Since students are propelled to direct their efforts into what and how they are being assessed, this study reviewed the curriculum in the Faculty of Medicine of the University of Coimbra, through the lens of assessment. It aimed to understand how to improve the development of clinical reasoning in undergraduate medical curriculum, distinguishing levels of aptitude in knowledge, competence, performance, and action.

An interpretivist research paradigm was employed to gather information on different aspects of the curriculum. The methods of data collection were the analysis of course units' documents, a questionnaire answered by students, and a focus group in which students and faculty members participated. The results showed that learning objectives and assessment methods are focused on the acquisition of knowledge and competence in clinical reasoning, whilst higher levels of aptitude are linked to individual experiences, in an opportunity-based manner. The high ratio of students per tutor, the lack of an institutional approach to developing clinical reasoning, and students' struggle for critical thinking and self-reflection were identified as the major constraints. Strategies for improvement were proposed based on the literature reviewed with an overall emphasis on a systematic, transdisciplinary approach that builds on the acknowledged apprenticeship merits of the curriculum.

All in all, this study's value was not on the validity or generalizability of the results, rather on the approach to the research design and the intent to acknowledge both medical education theory and everyday practice in medical schools. The juxtaposition of perspectives of faculty members and students and of medical education theory provided practical cues for curriculum development which can be of use to this particular medical school or any other interested in improving clinical reasoning.

Key words

MEDICAL EDUCATION, CURRICULUM DEVELOPMENT, CLINICAL REASONING, ASSESSMENT, STUDENT ENGAGEMENT, BEST EVIDENCE MEDICAL EDUCATION, INTERPRETIVIST RESEARCH PARADIGM

Introduction

Clinical reasoning is a core competence to develop in undergraduate medical education. It is a complex cognitive process explained, at least in part, by dual process theory, which describes the interplay of two dichotomic systems that process information - the intuitive and recognition primed system 1 and the analytical and deliberate system 2.^{1,2} From that understanding, educational strategies such as illness scripts and experiential learning are proposed in order to build and refine mental representation and guide decision making in different contexts.^{3,4} Beyond that, literature is notably fragmented on the nature⁵ and approach⁶ to clinical reasoning, providing little guidance on how to structure the curriculum towards its development and acquisition.

As an inarguable outcome for the medical graduate, consistently identified in reference documents such as the CanMEDS framework⁷ and the Tuning Project,⁸ **the development of clinical reasoning should weight on the curriculum** - determining the content, how it is organized and how it will be delivered.^{9,10} Furthermore, it should be taken into consideration that, as shown in Harden's curriculum diagram (Figure 1), the declared curriculum doesn't necessarily translate into the one that will be delivered by faculty and through syllabus or correspond to the one learned by students.¹¹ Therefore, the process of curriculum development should be ongoing, cyclical, where the implementation leads to feedback and evaluation, in order to identify and address further problems and adjust the learning outcomes in accordance.¹²

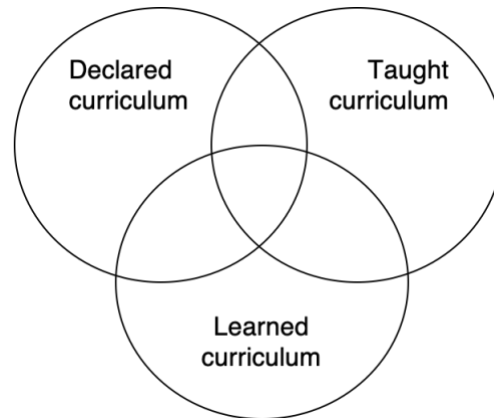


Figure 1. Curriculum diagram to illustrate how the curriculum differs, proposed by RM Harden ¹¹

Subsequently, the question is **how to properly collect feedback and evaluate the different aspects of the curriculum** in order to understand how to improve the development of clinical reasoning competence amongst students. The approach adopted in this paper is to collate perspectives and to review the curriculum through the lens of assessment, since students are propelled to direct their efforts into what and how they are being assessed. Two dimensions are contemplated: the curriculum alignment with learning objectives and standard setting,¹³ and how it gauges the student's level of ability, distinguished in Miller's pyramid between knowledge, competence, performance and action¹⁴ (Figure 2).

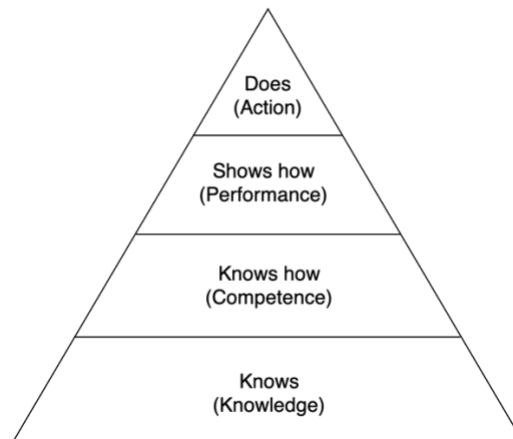


Figure 2. Framework for clinical assessment, proposed by GE Miller ¹⁴

On the whole, the purpose of this study is **to understand how to improve the development of clinical reasoning competence in undergraduate medical curriculum** by enabling a discussion about the curriculum in the Faculty of Medicine of the University of Coimbra (FMUC). The specific objectives are: **(1) Characterize the formal curriculum from the point of view of how learning objectives and proposed assessment methods contemplate the development of clinical reasoning; (2) Collect data on good practices for the development of clinical reasoning competence; (3) Provide a framework for discussing curriculum development among faculty members and students.**

The present paper intends to contribute to the medical school in which it is developed, considering improving the development of clinical competence was a major concern in the curricular reform underwent in 2015, as well as the need to prepare students for the newly adopted exam structure for access to specialty training which intends to evaluate the “ability for clinical reasoning”.¹⁵ Moreover, this work proposes a framework for discussion and development of curriculum that engages the expertise of both faculty members and students, and that focuses on evidence-based medical education, while taking into consideration constraints of context and resources, which is of interest for the international medical education community.

Methods

Medical education is a complex and context-dependent field. In order to address the research question and understand how the undergraduate medical curriculum is promoting the development of a clinical reasoning competence, **an interpretivist research paradigm was employed**. In contrast with an assumption about an objective reality and hypothesis testing that characterizes the positivist paradigm commonly employed in medical studies, this approach acknowledges that the reality in question is subjective and ever-changing, and focuses on understanding and gathering diverse interpretations.^{16,17}

The underlying medical education theories on which meaning is constructed are described in the introduction section. The main premises guiding the work were the outcome-based approach to education⁹ and the well-established premise that assessment drives learning.^{13,14} As for clinical reasoning, given there is not an unanimous definition,⁵ the one being considered here is from a recent scoping review outlining **clinical reasoning as “a skill, process or outcome wherein clinicians observe, collect, and interpret data to diagnose and treat patients”**, and identifying “information gathering, hypothesis generation, forming a problem representation, generating a differential diagnosis, selecting a leading or working diagnosis, providing a diagnostic justification, and developing a management or treatment plan” as its components.¹⁸

The methods employed for data collection were the analysis of course units’ documents, a questionnaire answered by students, and a focus group in which students and faculty members participated. Translated versions of the questionnaire and focus group guide can be found in annex I and II, respectively.

Content analysis of the formal curriculum

To enable comparison, only information that was available for all mandatory course units was included. Specific resources of a course unit, as well as information pertaining elective courses were excluded. Thus, **57 course units information documents (“Fichas de Unidade Curricular Anual”) pertaining to the 2019/2020 academic year were reviewed**, namely the “objectives and competences to develop” and “assessment methods” sections. “Teaching methods” and “bibliography” sections were excluded, considering the lack of uniformity and relevance in the information conveyed. The “objectives and competences to develop” information was classified by the researcher for each course unit according to one of the following categories: absence, implicit presence and explicit presence of each of the clinical reasoning components identified in the introduction of the present work. The “assessment methods” information was analyzed according to the number of assessment moments and type of methods employed per course unit. Data was arranged considering course units individually, curricular year and scientific area of which the course unit is part of.

Questionnaire

To understand students' perception of how the curriculum promotes the development of clinical reasoning competence, **a questionnaire was shared with final year medical students, for two weeks at the beginning of the last semester.** The final year students were chosen in order to get a perspective of the end stage of development of clinical reasoning in undergraduate medical education. Students were asked about their perception of clinical reasoning in regard to each of the fields of Medicine approached by the access to specialty exam¹⁵ – Internal Medicine, Gynecology and Obstetrics, Pediatrics, Surgery and Psychiatry. For each, they had to rate their perception of competence, according to Miller's Pyramid¹⁴ - "knows", "knows how", "shows" and "does". There was also a question, using a Likert scale from 1 to 5, to rate the assessment methods identified in the formal curriculum, according to their usefulness in developing clinical reasoning. Open ended questions were included, as an option to elaborate on the answer after each rating. **94 students (31,65%) out of the 297 enrolled** filled out the Google Forms® survey. Quantitative data was illustrated with graphs. Qualitative data was scarce, therefore categorized and summarized with no considerations regarding the frequency of the comments.

Focus group

This method was employed in order to **explore perceptions about "good practices" in the curriculum and draw ideas upon the interaction of faculty and students.**^{19,20} An **interview guide** was developed, following an appreciative inquiry structure proposed for curriculum development.²¹ This approach is characterized by posing questions that focus on eliciting good experiences, envisioning desired scenarios, and designing possible solutions. It allows to create a collaborative and constructive mindset towards solutions, avoiding the common fixation on problems.²² The focus group included **two faculty members** that held positions with pedagogic responsibilities in the medical school, both in present and past time, and **three final year students** that were involved in student representative structures. The discussion took place through a video conference platform, Zoom®, and was guided in Portuguese language by the researcher with the support of the co-supervisor of the thesis. All participants agreed to participating, as well as having the conference audio and video recorded. In regard to the data analysis, the protocol followed the interest on the topic itself and was supported by Schilling's process for content analysis.²³ Transcription was done by the researcher with all questions and interaction between participants being included, except for observations on behavior which were not included. Afterwards, data was organized in meaningful units, cross-interview and the components ranged from half sentence to full sentence. All meaningful units were paraphrased and standardized, as interest laid on the content of the discussion and not in the analysis of subjects' language. Coding and categorization were done solely by the researcher, two times with a week interval. **To present conclusions, information was organized in three major themes and a summary of the ideas shared was written for each.**

Results

The analysis of the formal curriculum showed there are 57 course units, as part of the standard program (excluding electives), belonging to 5 scientific areas, spread out through 6 years of training (Figure 3). Despite the school's predefined structure for course unit documents, the form in which the information is written differs much. Nevertheless, two general impressions should be noted: one being a **recurrent reference to the importance of preparing students for clinical practice** without concretely mentioning how, and the other being the common use of the verbs such as “understand”, “know” and “demonstrate” to define learning objectives.

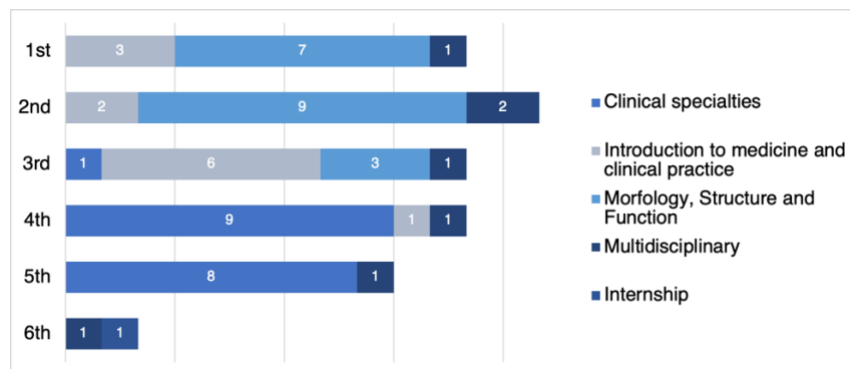


Figure 3. Overview of the curriculum according to the organization of course units' year of training and scientific area

As for the **clinical reasoning components**, all of those identified in the operating definition presented in the study are mentioned in the course units' curricular objectives, most often **implicitly** (Figure 4). The mode of the classification per year showed that information gathering is the only component present throughout every year and the single focus on the 2nd year. Over the last three curricular years, the focus of clinical reasoning is on diagnosis's components, as well as management and treatment (Figure 5).

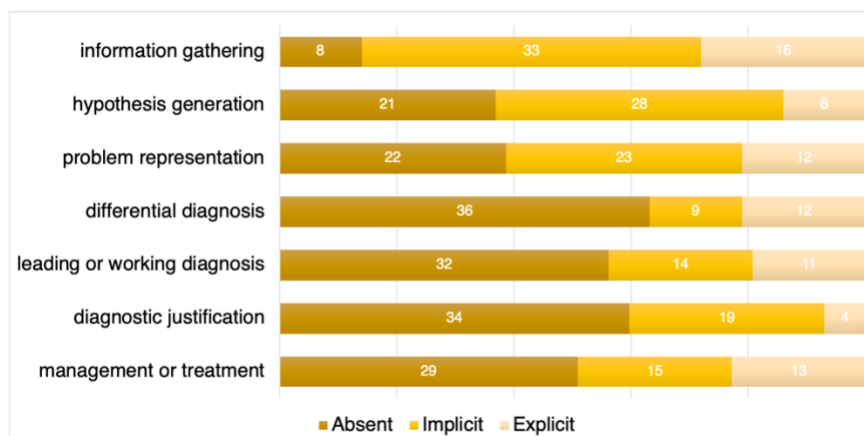


Figure 4. Overview of course units' according to the presence of clinical reasoning components in the curricular objectives

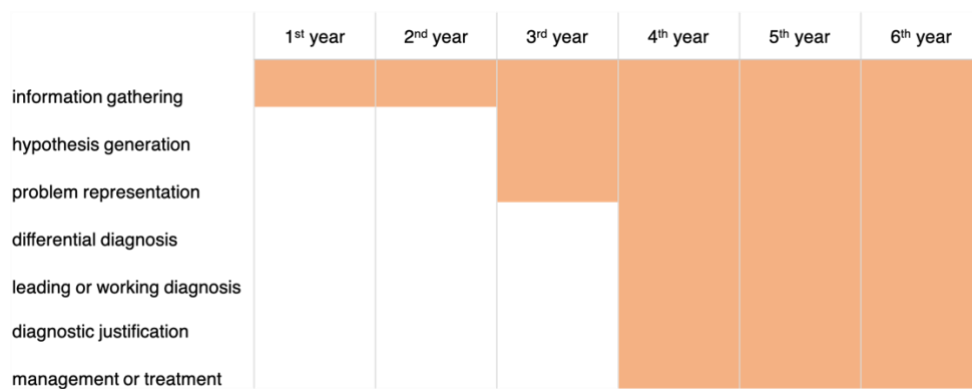


Figure 5. Clinical reasoning components addressed in courses' curricular objectives per curricular year

The perception of final year students over their clinical reasoning competence gathered through the questionnaire shows that the **level of perceived competence stands on the intermediate stages of Miller's pyramids - "knows how" and "shows how"**. The competence "does", described as functioning independently in clinical context is perceived, on average, by 24% of students, highest for "information gathering" (47%) and lowest for "management and treatment" (5%) (Figure 6). Perception of competence between fields of medicine is similar, except for Psychiatry. The "knows" competence level was chosen by more than a 25% of students in all components concerning Psychiatry, whereas for other fields the average of "knows" competence is 8% in all components, except for "management or treatment" which is 22% (Annex I).

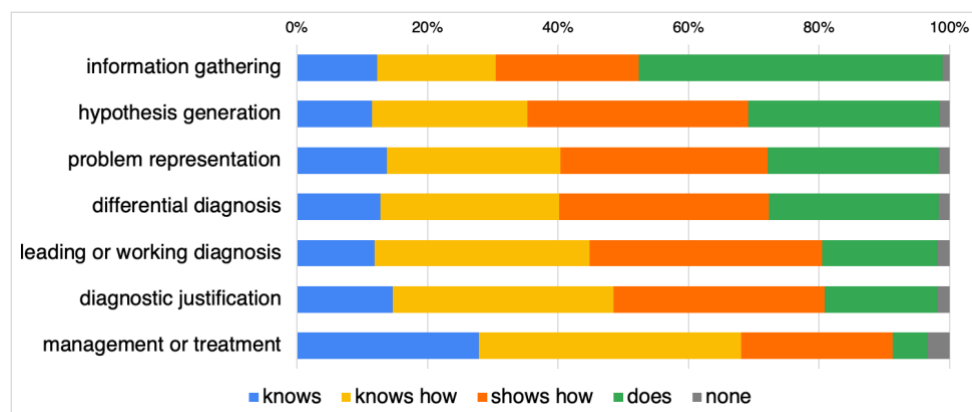


Figure 6. Average perception of clinical reasoning competence for each component

In reviewing the “evaluation methods” section of the course units’ documents, there were also differences between the way information was displayed and the categorization of assessment methods. There was **no mention of formative assessment, besides mentioning “global assessment”**, linked in most cases to either the weight of an oral or written note examination or to the presence of students in the lectures. Table 1 shows all the assessment methods identified in the document analysis and frequency in which they are used in unit courses. Most course units have 2 (35%) or 3 (30%) different assessment methods, as well as different moments of assessment. In the third column, there is the average perception of usefulness collected from the questionnaire where students were asked to rate each assessment method, using a Likert scale, where 1 was not useful and 5 very useful in the development of clinical reasoning. When comparing the frequency in course units and perception of usefulness, **three methods stand out – Key Feature Examinations, Simulation and Direct Observation - as they are perceived more useful and are among the least used.**

Assessment Method	Frequency in course units	Usefulness Rating
Multiple Choice Questions	74%	3,02
True/False	4%	2,59
Extended Matching Questions	9%	2,43
Key Feature Examinations	9%	4,41
Short Answer Questions	19%	2,93
Long Answer Questions	14%	2,54
Oral Examination	11%	3,59
Written Notes	16%	3,78
Simulation	7%	4,33
Direct Observation	7%	4,45
Working Groups	51%	2,38
Global Assessment	11%	3,66

Table 1. Assessment methods identified in the curriculum analysis and students perception on their usefulness in developing clinical reasoning

In the questionnaire’s open-ended questions, students valued experiences such as taking the clinical history of patients in medical and surgical propaedeutics practical classes, shadowing doctors in the 6th year internship and extracurricular internships with immersion in practice and higher autonomy. **In addition to experiences centered in clinical contact, students valued clinical case discussions and receiving feedback on their approach to patients.** Mentions of the 4th or 5th year course units were rare, besides appraisal for specific pediatrics tutors and simulation classes in gynecology. A suggestion was made to distribute 4th and 5th year course units in modules, enabling “students doing, besides seeing”, an immersion in clinical practice as it happens in the 6th year. As for issues highlighted, there were **remarks about the theoretical nature of the curriculum in the approach to basic sciences, on the structure of lectures and what is required from final examinations.**

From the **focus group discussion, three major themes unveiled: clinical reasoning, its definition and development; educational strategies; issues in implementing these ideas.** A summary of the main takeaways from each theme is presented in Table 2.

Theme	Summary	Example of statements
Clinical Reasoning (definition, development)	<ul style="list-style-type: none"> • Participants expressed no concerns over the operative definition for clinical reasoning (see methods sections), having referred to many of its components upon their interventions. • “Problem representation”, was highlighted as one of the most important components considering the need to summarize information, distinguishing what is relevant from what is not, and to choose keywords to guide decision making. • Faculty members elaborated on the construction of cognitive processes, naming the importance of tutor’s introducing and building on a mental scheme and attributing the perception of experience and "clinical sense" to the ability to recognize patterns. • Emphasis was also made on the need for critical thinking and reflection, in order to review the cognitive processes when arriving to a wrong diagnosis. 	<p><i>“If we are capable of structuring the information and summarize it, it’s a key step to good clinical reasoning (...) by selecting keys work properly we avoid clutter in the decision-making tree”</i></p> <p><i>“The perception of great clinical scene is when the person has a mental scheme closer to reality. We should understand the characteristics and try to reproduce them in our students”</i></p> <p><i>“Every time I follow my map and reach a wrong diagnosis, I should review the map”</i></p>
Educational Strategies	<ul style="list-style-type: none"> • Acknowledging clinical reasoning as a core competency of undergraduate medical curriculum, participants called for an alignment between course units with the definition of clear objectives and, for each, the expected level of competence. • All agreed that training should be consistently focused on developing reasoning and preparing for clinical practice from teaching to evaluation methods. • Course units should build on the development of a mental scheme, according to faculty members. One of them having suggested the use of the ABC approach of advanced life support training throughout the curriculum, adding differential diagnosis, treatment and management in subsequent years, to this approach already introduced in the 2nd year. • A contrast was clear when discussing assessment, with faculty members focused more on summative evaluation, and students on formative evaluation, emphasizing on the tutors’ ability to guide and to motivate learning. 	<p><i>“Classes should be a discussion of clinical scenarios and ideas that afterwards translates into the evaluation”</i></p> <p><i>“It is not enough to adapt the curriculum to have a practical evaluation with discussion of a clinical history and clinical cases, if there is not proper guidance throughout the semester”</i></p> <p><i>“A lot of our training is based on clinical vignettes and when we are confronted with whom, we are able to develop clinical reasoning, however when we are with a patient we fail to reason, because the information is not given to us, we have to look for it”</i></p>

Educational Strategies	<ul style="list-style-type: none"> • Clinical vignettes and bedside teaching were deemed essential. Participants found the two strategies complementary, as clinical vignettes challenge students and are effective practice; however they preclude the possibility to gather, structure and summarize information necessary when approaching a patient, which is only given by bedside teaching. • The importance of simulation and peer teaching was highlighted by students, in order to enable more practice, considering the high ratio of students per tutor which, as everyone agreed, limits the opportunities for bedside teaching. 	
Issues	<ul style="list-style-type: none"> • At different points in the discussion, all participants recognized student's difficulty in establishing clinical reasoning, namely in gathering information from the patient and organizing it. Students participating attributed difficulties to the lack of practice and to a subsequent fear of failure when students are challenged. • Faculty members claimed that teaching and evaluating clinical reasoning is difficult and involves planning beforehand which is not being done regularly. • Participants also agreed on the need for an institutional level approach, where there is a leadership with a clear plan and seeking to establish a uniform approach to teaching and evaluating clinical reasoning. It was said that medical schools and heads of course units need to reject individualistic approaches, but rather communicate and share best practices. • Both faculty and students noted the importance of involving students and promoting broad discussions to understand the school's limitations and how to overcome them. • Coming from different perspectives, participants argue the need to change the mentality of students when it comes to accepting subjectivity inherent to medicine, and thus evaluation, as well as welcoming criticism and self-reflection. • One prevalent issue raised was the high ratio of student per tutor with everyone agreeing that it limits the ability for students to reach the highest levels of clinical competence. 	<p><i>"Unit courses should be developed on a perspective of clinical scenarios and its evaluation (...) however it would implicate previous work to the class which is often not done"</i></p> <p><i>"a leadership with a clear plan to what it wants to achieve with the development of clinical reasoning and of critical thinking"</i></p> <p><i>"We need to accept that medicine is inherently subjective, thus evaluation will have a degree of subjectivity"</i></p> <p><i>"It is hardly possible with the number of students per practical class that we reach a level of independent action in clinical context"</i></p>

Table 2. Summary of the focus group data.

Discussion

The three different sources of data allowed for a broad perspective over the curriculum, identifying its formal structure, as well as the perceptions from both faculty members and students on how clinical reasoning is being transmitted and apprehended. Each of the paragraphs elaborates on educational features ascertained, that are substantiated by literature and over which recommendations pertaining to the purpose of the study “to understand how to improve the development of clinical reasoning competence in undergraduate medical curriculum” were drawn upon.

Formal curriculum of the Faculty of Medicine of the University of Coimbra foresees an introduction to clinical practice at early stages, later unravelling into course units on clinical specialties. However, as suggested through the positive experiences shared in the questionnaire, linked to specific moments such as a particular tutor’s pedagogical approach or simulation training, and pointed out in the focus group, there is no **systematic strategy to develop clinical reasoning throughout undergraduate training**. In answer to this, one of the faculty members participating in the focus group suggested to teach clinical reasoning, through an ABCDE approach, commonly used in advanced life support training. Though the specific methodology applied to undergraduate medical curriculum lacks evidence, its premise is supported by **an integrated understanding of the curriculum where there is a progressive development of concepts in a common framework**.²⁴ This perspective also validates the concern raised by the focus group participants about the individualistic manner in which course units are organized, in terms of preventing a cohesive approach to clinical reasoning, since this fragmentation is the lowest stage of the integration ladder that leads to transdisciplinary learning.²⁵

Accordingly, the efforts towards continuity in clinical education may be on **reviewing and reaching an agreement on the learning objectives and delivery methods**.²⁶ This comprehensive appraisal would allow for the curriculum to target higher levels of clinical competence, going further than the intermediate stages of perceived competence found amongst final year students. Objectives should contemplate different categories of cognitive process, beyond “remember” and “understand” to levels of analysis, synthesis and evaluation.²⁷ **Assessment should aim towards an increase in work-based methods**, as the majority identified in the document analysis, namely multiple-choice questions, focus on knowledge and competence, not so much on performance and action.^{14,18,28} These are challenges acknowledged in medical education literature which proposes the implementation of methods such as portfolio, think aloud, direct observation, global assessment or written notes.^{18,28} The latter three being already in place in the curriculum and having had a positive rating in terms of perceived usefulness by students in the questionnaire.

Additionally, in matters of assessment, a dissonance between the experienced and planned curriculum unraveled. While the faculty members emphasized on its summative component, students who participated in the focus group and in the questionnaire, brought up formative assessment. The “good practices” elicited suggested feedback on performance, such as bedside teaching and simulation, and highlighted experiences of clinical immersion, consistency and being challenged. In fact, both perspectives are relevant considering that **standard setting of minimum competence and feedback to the learner** are core principles of assessment.¹³ The opportunity presented may be on the

understanding of the preponderance of summative methodologies in the curriculum, as depicted in the document analysis, and the need for a programmatic assessment approach where there is a **routine assessment of competence and progress**, through a variety of methods, to provide meaningful feedback for the student.²⁹ This structured feedback would also address the concerns raised by the focus group about the need to promote reflection and critical thinking amongst students.³⁰

At a class level, there is not enough evidence to set a strategy to develop clinical reasoning aside from others.⁶ As the focus group participants argued, in a curriculum sturdily based on multiple choice questions and teaching with clinical vignettes, **how clinical cases are presented matters**. Students should be introduced to the “whole case” in order to develop the process of information gathering and problem representation, avoiding this regularly identified struggle. Once that is established, and the student is capable of selecting the key words for its decision making, a “serial cue” approach where only relevant information is presented constitutes a good exercise for practice.⁶ The role of the tutor, as described in the focus group, guiding the cognitive process at the earlier stages enables the students to build their mental schemes, before they are able to recognize patterns.

As for students’ perception of competence, the distribution of perceived clinical competence in the questionnaire from “knows” to “does” for all fields of medicine and all components is unsettling. Positive experiences evoked by students in the focus group and through the questionnaire emphasized on consistency and immersion in clinical practice provided by extracurricular internships, during the 6th year internship, or on an opportunistic basis linked to a tutor’s specific approach to bedside teaching in medical or surgical propaedeutics. This suggests **the crucial role of clinical contact and the value of building a mental database**. Literatures validates the importance of these experiences, calling it “mixed practice”, where cases are presented from multiple categories instead of being sorted by diagnostic category in a “blocked practice”.³

Likewise, these training opportunities allow to tackle errors in clinical reasoning which are mostly attributed to the **vulnerability of the thinking in real-world context - the “lack of practice”** often referred by the students in the data collected. Besides the high ratio of students per tutor the school faces, such perception could come from the focus on clinical specialties found in the curriculum analysis. This hospital-based education, contrasts with a community-based education, which is argued to present a broader view of medical needs and health problems, allowing for a more active learning, while avoiding “student-wise” patients who may lead the interviewing process.³¹

Above all, the findings of this study suggest the need for a more systematic approach to the school’s educational program, a “leadership with a plan that engages the whole academic community” as agreed by the focus group participants. At a class level, it is important to acknowledge that educational skills are needed as much as those of a clinician. Outcome-based education calls for **continuous faculty development programs**, rather than isolated workshops.^{32,33} This would allow to share practices and to reflect on the strategies to develop and address difficulties in clinical reasoning. Plus, it would **improve the delivery of feedback to students**, which, when not done properly, is met with resistance and perceived as not helpful, as observed by the focus group participants when expressing concerns about student welcoming criticism and self-reflection.³⁴ These programs could also expand to the

school's peer teaching initiative - highly regarded by the students - and presented as a solution for the high ratio of students per tutor and to increase clinical practice.

Limitations

Even though clinical reasoning is an undeniable competence to develop by the medical curriculum, there is no consensus on its definition and research is lacking on evidence-based practices.⁶ Similarly, there are no validated resources to conduct a curriculum review on how it is developing clinical reasoning amongst students. Therefore, this study is not supported by validated frameworks to approach the curriculum, instead it is based on well-established medical education theories regarding curriculum development⁹⁻¹² and assessment of clinical competence.^{13,14}

In terms of the chosen methods, there are concerns on the reliability of the sources. Course unit documents are updated and reviewed on a yearly basis, however information conveyed was not verified with heads of course units. Both the questionnaire and focus groups provided relevant perspectives, nonetheless having a bigger sampling would be beneficial, namely consulting students at earlier curricular stages, as well as non-teaching staff. Given the individual nature of the work, as part of a master's thesis, all qualitative analysis was done solely by the researcher, with a supervisor analyzing and providing feedback on the findings. In order to overcome these constraints, method triangulation was employed, collecting information from three different bases. Additionally, all the results reviewed in the "discussion" are supported by relevant medical education references.

Conclusion

Presenting a compromise to the longstanding paradox in medical education “(...) when educational issues were discussed. Critical appraisal and scientific scrutiny were suddenly replaced by personal experiences and beliefs, and sometimes by traditional values and dogmas”,^{35,36} the analysis conducted **found merit on the curriculum’s apprenticeship nature, largely based on specific experiences, while also showing an opportunity for improvement through a systematic approach.** Therefore, this study’s value is not on the generalizability of the results, rather on the approach to the research design and the intent to acknowledge both medical education theory and everyday practice in medical schools.

Evidence based medical education is usually understood as unattainable, not contemplating the specific context and constraints and requiring substantial change and resources. In this study, the methods employed allowed to show the curriculum and draw conclusions from its strengths, threats and perspectives (planned, delivered and learned) with the points argued in the discussion being of use to this particular medical school or any other interested in improving clinical reasoning. It is a first step towards providing a model, as the framework for document analysis, the appreciative inquiry approach for the focus group, and the questionnaire need to be further validated. Regardless, **the juxtaposition of perspectives of faculty members and students and of medical education theory provided practical cues for curriculum development.** Hopefully, contributing to bridging the gap between theory and practice.

Acknowledgments

Thanks are due to all those who encouraged the student activism and medical education journey that led me here. Out of all who have inspired me, I should thank those without whom I would not have been able to complete this work.

To Professor Roger Strasser who took the time to help me transform a fiery idea into a research matter.

To Professor Filipe Caseiro Alves and Dr. Hugo Camilo who, since the first day, trusted me to handle the challenge I was setting myself up to.

To Professor Maria Filomena Ribeiro da Fonseca Gaspar who expressed a genuine interest and with that allowed me to organize my thoughts.

To Francisco Pais Rodrigues who contributed beyond fraternal obligation with expertise and words of guidance.

To FMUC where I always found an open door and someone to talk over ideas on how to improve what is established.

References

1. Croskerry P. A universal model of diagnostic reasoning. *Academic Medicine*. 2009; 84 (8), 1022–1028.
2. Marcum JA. An integrated model of clinical reasoning: dual-process theory of cognition and metacognition. *Journal of Evaluation in Clinical Practice*. 2012; 18(5), 954–961.
3. Eva KW. What every teacher needs to know about clinical reasoning. *Medical Education*. 2005; 39(1), 98–106.
4. Charlin B, Boshuizen HPA, Custers EJ, Feltovich, PJ. Scripts and clinical reasoning. *Medical Education*. 2007; 41(12), 1178–1184.
5. 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.
6. Schmidt HG, Mamede S. How to improve the teaching of clinical reasoning: a narrative review and a proposal. *Medical Education*. 2015; 49(10), 961–973.
7. Frank JR, Snell L, Sherbino J, editors. *CanMEDS 2015 Physician Competency Framework*. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.
8. Cumming A, Ross M. The Tuning Project for Medicine – learning outcomes for undergraduate medical education in Europe. *Medical Teacher*. 2007; 29:7, 636-641.
9. Harden, RM. AMEE Guide No. 14: Outcome-based education: Part 1-An introduction to outcome-based education. *Medical Teacher*. 1999; 21(1), 7–14.
10. Harden, RM. Ten questions to ask when planning a course or curriculum. *Medical Education*. 1986; 20(4), 356–365.
11. Harden, RM. AMEE Guide No. 21: Curriculum mapping: a tool for transparent and authentic teaching and learning. *Medical Teacher*. 2001; 23(2), 123–137.
12. Thomas P, Kern DE, Hughes MT, Chen BY. *Curriculum development for medical education: a six-step approach*. Johns Hopkins University Press; 2016
13. Wass V, Van der Vleuten C, Shatzer J, Jones R. Assessment of clinical competence. *The Lancet*. 2001; 357(9260), 945–949.
14. Miller GE. The assessment of clinical skills/competence/performance. *Academic Medicine*. 1990; 65(9), S63–7.
15. Despacho n.º 4412/2018 do Ministério da Saúde (2018). *Diário da República: II série, nº 86*.
16. Bunniss S, Kelly DR. Research paradigms in medical education research, *Medical Education*. 2010; 44: 358-366
17. McMillan W. Theory in healthcare education research: the importance of worldview. In: Cleland J, Durning SJ, editors. *Researching medical education*. John Wiley & Sons, Ltd.; 2015. P. 15-24
18. Daniel M, Rencic J, Durning SJ, Holmboe E, Santen SA, Lang, V, et al. Clinical Reasoning Assessment Methods: A scoping review and practical guidance. *Acad Med*. 2019; Jun;94(6):902-912
19. Hanson JL, Balmer DF, Giardino AP. Qualitative Research Methods for Medical Educators. *Academic Pediatrics*. 2011; 11(5), 375–386.

20. Barbour RS. Making sense of focus groups. *Medical Education*. 2005; 39(7), 742–750.
21. Sandars J, Murdoch-Eaton D. Appreciative inquiry in medical education. *Medical Teacher*. 2016; 39(2), 123–127.
22. Michael S. The promise of appreciative inquiry as an interview tool for field research. *Development in Practice*. 2005; 15:2, 222-230.
23. Schilling J. On the Pragmatics of Qualitative Assessment. *European Journal of Psychological Assessment*. 2006; 22(1), 28–37.
24. Brauer DG, Ferguson KJ. The integrated curriculum in medical education: AMEE Guide No. 96. *Medical Teacher*. 2014; 37(4), 312–322.
25. The integration ladder: a tool for curriculum planning and evaluation. *Medical Education*. 2000; 34(7), 551–557.
26. Hirsh, DA, Ogur B, Thibault GE, Cox M. “Continuity” as an Organizing Principle for Clinical Education Reform. *New England Journal of Medicine*. 2007; 356(8), 858–866.
27. Anderson, LW, Krathwohl, DR, Bloom BS. A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives (Complete ed.). New York: Longman; 2001.
28. Thampy H, Willert E, Ramani S. Assessing Clinical Reasoning: Targeting the Higher Levels of the Pyramid. *J Gen Intern Med*. 2019; 34(8):1631-1636.
29. Schuwirth LWT, Van der Vleuten C. Programmatic assessment: From assessment of learning to assessment for learning. *Medical Teacher*. 2011; 33(6), 478–485.
30. Qureshi NS. Giving effective feedback in medical education. *The Obstetrician & Gynaecologist*. 2017; 19(3), 243–248.
31. Harden RM, Sowden S, Dunn WR. Educational strategies in curriculum development: the SPICES model. *Medical Education*. 1984; 18(4), 284–297.
32. Leslie K, Baker L, Egan-Lee E, Esdaile M, Reeves S. Advancing Faculty Development in Medical Education. *Academic Medicine*. 2013; 88(7), 1038–1045.
33. Audétat MC, Dory V, Nendaz M, Vanpee D, Pestiaux D, Junod Perron N, Charlin B. What is so difficult about managing clinical reasoning difficulties? *Medical Education*. 2012; 46(2), 216–227.
34. Hewson MG, Little ML. Giving feedback in medical education. *Journal of General Internal Medicine*. 1998; 13(2), 111–116.
35. Van der Vleuten C. Evidence-based education? *Advances in Physiology Education*. 1995; 269(6), S3.
36. RM Harden, Grant J, Buckley G, Hart IR. BEME Guide No. 1: Best Evidence Medical Education. *Medical Teacher*. 1999; 21(6), 553–562.

Annex I

The questionnaire included an introduction which included a brief description of each of the clinical components and of the levels of competence.

Question 1 to 6 – Multiple Choice Grid - Considering [Internal Medicine/ Gynecology and Obstetrics/ Pediatrics/ Surgery/ Psychiatry] what level of clinical competence do you understand having for each component?

	Knowledge “knows”	Competence “knows how”	Performance “shows how”	Action “does”
information gathering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
hypothesis generation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
forming a problem representation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
generating a differential diagnosis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
selecting a leading or working diagnosis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
providing a diagnostic justification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
developing a management or treatment plan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 1.1 to 6.1 – Open-ended question - Would you highlight any educational experience throughout your course studies particularly useful for the development of clinical reasoning in such field of medicine?

Question 7 – Multiple Choice Grid – Rate from 1 (not useful) to 5 (very useful) each of the assessment methods used throughout the course of studies, in terms of usefulness in developing clinical reasoning.

	1	2	3	4	5	N/A
Multiple Choice Questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
True/False	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extended Matching Questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Key Feature Examinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Short Answer Questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Long Answer Questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral Examination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Written Notes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Direct Observation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working Groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Assessment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Annex II

Phase	Question
Introduction	<ul style="list-style-type: none"> - Share with the group your name, role in the school, and background/experience in medical education. - Briefing where clinical reasoning definition and components are introduced.
Discovery	<ul style="list-style-type: none"> - Recall a moment you regard as a good educational experience, towards developing clinical reasoning. - What is good about what we are currently doing towards developing clinical reasoning, in terms of assessment, whether formative or summative?
Dream	<ul style="list-style-type: none"> - Introduce Miller's Pyramid of clinical competence - How do you think we can target the higher levels of the pyramid towards developing clinical reasoning with assessment methods?
Design	<ul style="list-style-type: none"> - What needs to be done differently to move closer to the previously hypothesized situations? What are the required resources?
Destiny (or Deliver)	<ul style="list-style-type: none"> - What do you think it is actually achievable? How can we improve the development of clinical reasoning in the curricula?
Closing	<ul style="list-style-type: none"> - Anything else you would like to add?

Table 3. Focus group interview guide. N/A

Annex III

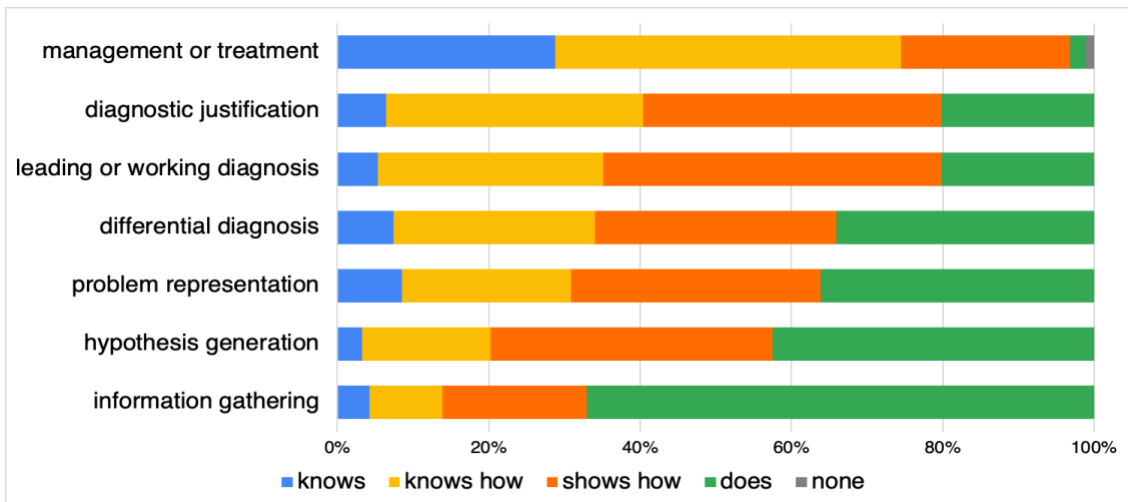


Figure 7. Perception of clinical reasoning competence for each component in the field of Internal Medicine

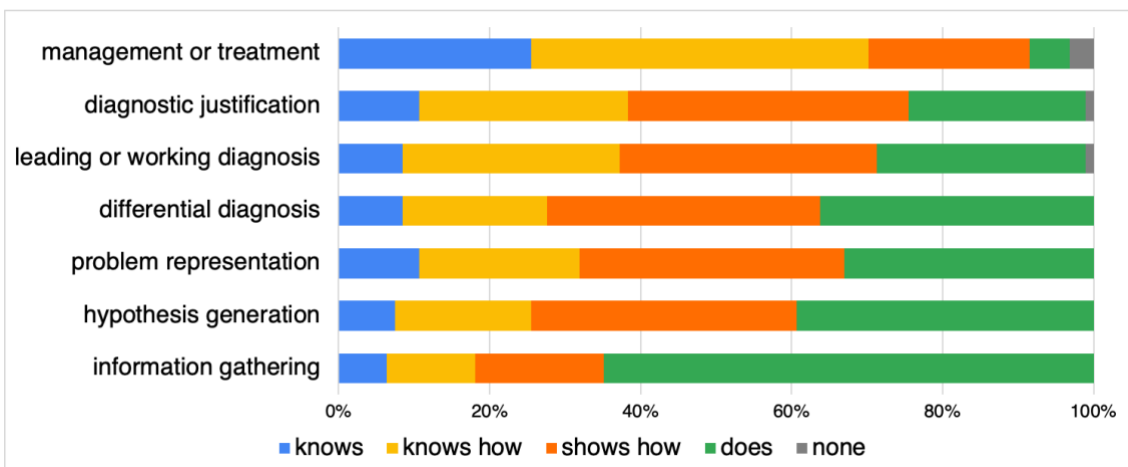


Figure 8. Perception of clinical reasoning competence for each component in the field of Surgery

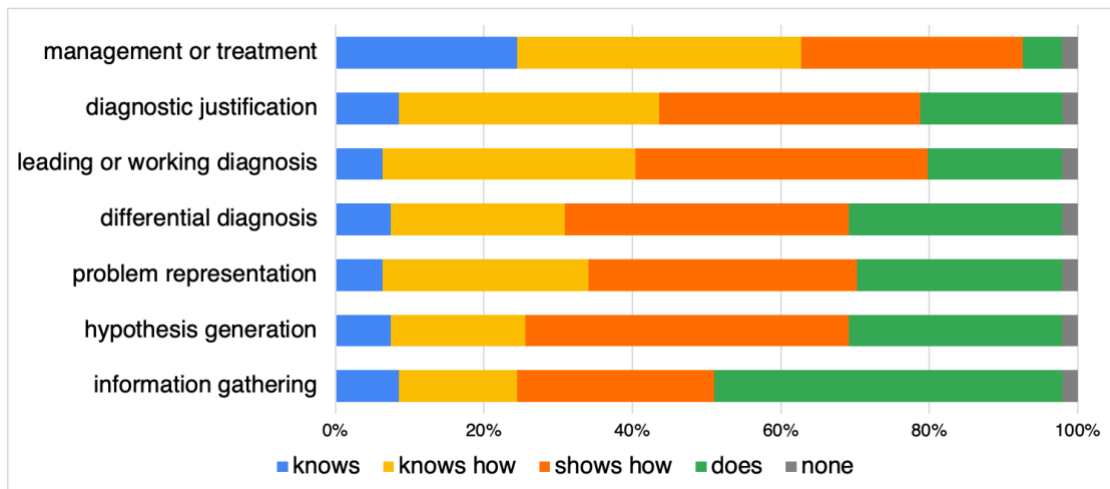


Figure 8. Perception of clinical reasoning competence for each component in the field of Pediatrics

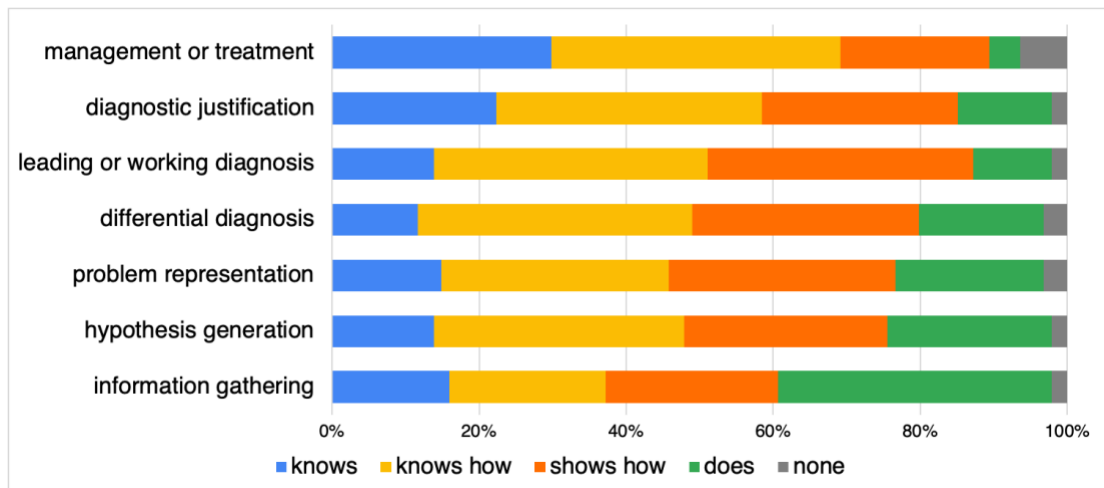


Figure 9. Perception of clinical reasoning competence for each component in the field of Gynecology and Obstetrics

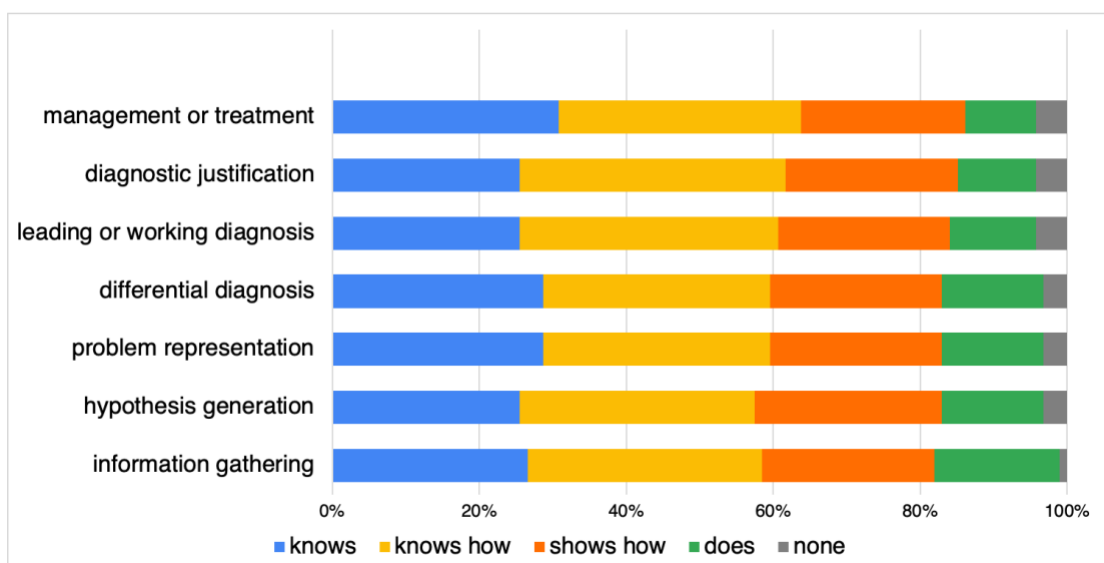


Figure 10. Perception of clinical reasoning competence for each component in the field of Psychiatry