

Article

Implementing Clinical Case Discussions to Enhance Clinical Reasoning Skills: A Pilot Study in an Italian Medical School

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Abstract: Background: Clinical reasoning (CR) is fundamental in medical education. However, the Italian curriculum has not incorporated a structured CR format yet. Therefore, we introduced the Clinical Case Discussions (CCD), to medical students attending the University of Bologna as a tool for developing CR abilities. CCDs are a case-based peer-teaching format, simulating the diagnostic process using published patient cases. Methods: Students of all clinical years of the University of Bologna Medical School were invited to voluntarily participate in a two-day CCD training program. They completed pre- and post-training questionnaires assessing their expectations before and impressions after the training and comparing learning outcomes to their usual classes. Results: Twenty-one students participated in this pilot program. Before the training, more than half of the participants expressed either interest or a strong interest in all proposed learning objectives. Afterward, 84.6% of the students stated that the training much exceeded (63.5%) or exceeded (23.1%) their expectations considering its utility for their future medical activities. A total of 92.3% strongly agreed (84.6%) or agreed (7.7%) to have improved their CR. Conclusions: Although this pilot program had some intrinsic limitations, the students' positive feedback on this CCD format (combining the benefits of case-based learning and peer teaching) encourages further research on its potential role in the Italian curriculum.

Keywords: clinical reasoning; clinical case discussions; case-based learning; medical education; peer teaching; curriculum development



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1. Introduction

The increasing accessibility of online resources for medical education has empowered students' learning. Thus, the focus in medical education is shifting from memorizing facts to applying knowledge [1]. Consequently, teaching clinical reasoning (CR), which can help students with the assessment and application of information, has been recognized as highly beneficial in medical education [2]. While there are many different definitions of clinical reasoning (CR) in the field of medical education, in this study, we used the term CR to

describe “observing, collecting, analyzing, and interpreting patient information to arrive at a diagnosis and management plan” [3].

In Germany, the increased attention given to CR is reflected by the fact that the new Competence-Based Learning Objective Catalog of Medicine (NKLM [<http://www.nklm.de>]) includes several learning objectives related to clinical or scientific reasoning. Competency catalogs from other European countries, such as the General Medical Council of the UK’s “Outcomes for Graduates,” also emphasize the importance of CR by including competency goals that require doctors to be able to explain their CR process, formulate differential diagnoses, and develop appropriate management plans [4]. More significantly, CR is already recognized as a Key Concept in the CanMEDS 2015 framework by the Royal College of Physicians and Surgeons of Canada, which is used worldwide [5]. With the upcoming CanMEDS 2025 update, the Royal College has identified CR as an emerging and crucial concept in medical education [6]. Promoting CR education in Italy is particularly relevant, as “competency-based” assessments, including CR exercises, are becoming integral to the evaluation process [7]. Additionally, introducing CCD training, which is well established in other European countries, aligns with the University of Bologna’s goal of fostering medical education internationalization and cross-border healthcare collaboration within the Global Alliance of Medical Excellence (GAME) network [8].

However, teaching CR poses significant challenges. Current learning formats and curricula often do not emphasize CR, which may lead to educators being less well-versed in teaching this concept. In addition, experienced practitioners might already have developed illness scripts they can apply intuitively instead of explicitly reasoning through a case as a student might need to. Thus, teaching the reasoning steps a student needs requires dedicated thought on the practitioner’s part [9]. As CR is increasingly recognized as a skill to acquire rather than a concept to know, it becomes necessary to establish a structured approach to teaching and mastering this skill [10].

Case-based learning, a methodology that has been utilized since the early twentieth century, is one of the oldest methodologies in medical education and has proven particularly effective in teaching CR [11]. Moreover, incorporating peer or near-peer teaching into medical education can significantly improve learning outcomes. Peer teaching benefits both the peer teachers and learners, as teachers are forced to test their understanding of an issue through teaching it, while students can learn from an educator with a small cognitive distance from them. In addition, this approach can also produce exam results comparable to those achieved through traditional faculty-led lectures [12,13]. Interestingly, one study showed that students who received instruction from their peers achieved significantly higher scores on standardized tests than those taught by faculty members [14].

The CCD format differs from traditional peer-taught problem-based learning (PBL) formats by presenting the data contained in a real, complex clinical case sequentially using a serial-cueing approach. While a peer-teacher facilitates the discussion, a medical expert is present to provide support and ensure factual accuracy when needed. Consequently, CCD sessions shift the focus away from mere knowledge acquisition towards developing essential skills needed for clinical reasoning in the workplace [15]. This might explain why integrating the CCDs into the medical curriculum at the Ludwig-Maximilians-University in Munich during the COVID-19 pandemic has proven a successful tool for CR education [16–18].

So far, no CR-focused, structured teaching format has been implemented in the Italian curriculum. Hence, we conducted this pilot program to introduce the CCD format as a method for students at the University of Bologna to learn CR and teach it to their peers.

As we regard CCDs as an optimal clinical reasoning format to introduce to students early in their rotations in clinical departments, we believe the course should be introduced at the end of the preclinical years, after students have completed foundational courses in basic science, semiology, psychology, and physical examination, and have started their clinical training. Introducing the Clinical Reasoning course at this stage would allow students to apply their acquired basic knowledge in CCD teams. This led us to invite third-

to sixth-year medical students from our six-year medical degree program to participate in the pilot initiative.

To make sure that this initiative meets Italian medical students' learning needs, we assessed to what extent the educational objectives of the pilot CCD training align with medical students' self-assessed learning needs. We also evaluated student satisfaction with this innovative teaching approach.

2. Materials and Methods

2.1. Structure of a CCD Session

To maintain a reality-based approach, each CCD session is based on a case report, which has been published in the peer-reviewed literature. As part of the structured approach to history-taking in CCDs, a patient's history is always presented in accordance with a standardized pattern (Table 1).

Table 1. CCD patient presentation.

Structure of a CCD Patient Presentation		
Abbr.	Category	Description of Category
CC	Chief complaint	Reason the patient sought medical attention
HPI	History of present illness	Patient's symptoms related to the current presentation
PMH	Prior medical history	Known comorbidities
ME	Medication	-
ALL	Allergies	-
ROS	Review of symptoms	Other patient reported signs or symptoms that are not part of the current HPI
VS	Vital signs	Blood pressure, heart rate, respiratory rate, oxygen saturation, temperature
PE	Physical examination	Physical and neurological examination of the patient
CMP	Complete metabolic panel	Electrolytes ¹ , carbon dioxide, glucose, blood urea nitrogen (BUN), GFR, creatinine, albumin, total protein, aminotransferases (AST, ALT), gamma-glutamyl transferase (gGT), bilirubin, alkaline phosphatase
CBC	Complete Blood Count	Hematocrit, hemoglobin, erythrocytes, MCV, MCH, MCHC, platelet count, white cell count, neutrophils, band forms, lymphocytes, monocytes, eosinophiles, basophiles
COA	Coagulation studies	PT, PTT, INR
URIN	Urine analysis	Dip stick, urine sediment
EKG	Electrocardiogram	-
CXR	Chest radiograph	-

¹ Calcium, chloride, sodium, potassium.

After presentation of these data, attending students are asked to write a comprehensive patient assessment including all diagnostically relevant information. Together, they draft a problem list consisting of the patient's problems, potential differential diagnoses, and tests to confirm or reject those diagnoses. In a reality-based order, discussants can obtain test results until they arrive at a final diagnosis. At the end of a session, the patient's management and pathology results are reviewed, and arguments for and against relevant potential diagnoses are examined. Lastly, an in-depth explanation of selected teaching points is presented.

In every CCD session, there are four different roles. First, there is the moderator, a student, who is guiding the discussion throughout the case. The role of the moderator is typically assumed by an experienced student who has gained proficiency in facilitating CCDs through prior moderator training sessions under the guidance of faculty educators. These students have also participated in CCD sessions previously, allowing them to develop a comprehensive understanding of the format's requirements. Faculty ensure their proficiency in leading these discussions. Second, there is the presenter, who is responsible for picking a case and presenting the relevant information. Third, an experienced clinician is present during the case, providing assistance if needed, but letting the student group

solve the case as independently as possible. Lastly, there are the discussants, i.e., all other attending students. They are actively discussing the case, working together to develop the problem list, differentials, and tests to determine the final diagnosis.

2.2. Content of the CCD Moderator Training

The training was led by a team from LMU Munich consisting of an experienced CCD educator recruited from LUM junior faculty who was aided by students who had undergone CCD training as described above. In accordance with the inverted classroom method, learning materials were distributed to students beforehand and subsequently presented to the group by participating students [19]. During the training, the course of a CCD session and its educational objectives were introduced to the students [16]. Key aspects of a productive learning environment were discussed and reinforced throughout the training [20]. Additionally, participants engaged in public speaking exercises to practice and refine their critical thinking and communication skills [21].

Then, the role of the CCD moderator as a peer teacher was introduced to the student group [22]. The tasks and required skills of CCD moderators were discussed in comparison to other teaching roles (e.g., tutors or lecturers). The benefits of peer teaching for both students and faculty were explored [12]. Structured and constructive feedback was emphasized as necessary for enhancing skills, and different methods for giving feedback were discussed [23]. To teach probabilistic diagnostics, we introduced a “Serial Queuing” exercise based on Kassirer’s “Learning Clinical Reasoning” [24].

As being a CCD moderator requires not only knowledge but especially practical skills, we simulated parts of a typical CCD session. During these simulations, students were provided with the opportunity to lead CCDs and gain practical experience. Students received feedback from their peers regarding their performance and interaction with the group. Additionally, we constructed potentially challenging scenarios that could arise during a CCD to help students develop effective coping strategies.

2.3. Study Design

After ethical approval of the Institutional Review Board of the University of Bologna (Protocol N. 335646 issued 14 November 2023), this pilot study was performed according to the Declaration of Helsinki. Students of all clinical years of the University of Bologna medical faculty were invited to participate in a two-day CCD training program. Participation in the CCD training was voluntary. Selection criteria for the course included proficiency in English at a C1 level or higher, completion of basic science courses, current engagement in a clinical internship, and no prior experience with CCD training. Due to practical constraints, the data were derived solely from the convenience sample of attendees in the pilot CCD training.

Two days before the training, students anonymously responded to an open-ended question about their learning motivation, a series of closed-ended questions regarding their motivation and interest in the proposed educational objectives, as well as their expectations regarding teacher preparation, collaboration with course colleagues, and the course’s utility for future medical activities. Since the questions were specifically related to the learning goals of the training, we developed ad hoc questions tailored to these objectives. Owing to the uniformity in educational background and demographic information among students, and to ensure anonymity, questions specifically addressing gender and education were excluded.

Afterward, the participants were invited to anonymously complete a survey including open-ended questions following Gibbs’ reflective cycle [25] for qualitative analysis of students’ satisfaction and action plan, a self-evaluation of learning based on proposed educational objectives, and individual questions regarding the congruence of initiative content with prior preparation. The responses to the open-ended question were analyzed using quantitative thematic analysis [26]. This process involved repeatedly reading students’ responses to gain a comprehensive understanding of the content, identifying initial codes

and themes, reviewing these themes, and then defining and naming them. The texts were read and coded by two independent psychologists who were not familiar with the specific structure and learning materials of the CCD training. Any discrepancies were resolved through discussion until a consensus was achieved.

Finally, the participants completed the Student Evaluation of Educational Quality (SEEQ) questionnaire, which is a validated questionnaire to measure students' experience in the training across the following domains: perceived learning, teacher enthusiasm, organization, group interactions, teacher-student individual rapport, breadth of coverage, assignments/readings, and difficulty. Of note, there is a debate about whether to use the global rating or the specific factors of SEEQ [27,28]. Marsh and Roche, however, argued in favor of using a profile of scores that encompasses the different SEEQ factors. They suggested that while the scores on various dimensions of the SEEQ are interrelated, they cannot be accurately represented by a single overarching factor. The SEEQ has been proposed as a multidimensional and reliable tool to be used by faculty as feedback about teaching [29]. Additionally, the SEEQ measures students' overall satisfaction with the training compared to the standard courses. Quantitative answers were collected on a 5-point Likert scale ranging from 1, denoting "strongly disagree," to 5, indicating "strongly agree". Finally, the SEEQ measures whether the training meets students' expectations (1 = not at all, 5 = much exceeded) [30]. SPSS software version 22 was used for data analysis. Descriptive statistics are reported. No further analysis was conducted due to the small sample size and the inconsistency in participants who responded before and after the CCD training. This inconsistency limits the possibility of conducting a within-subject analysis of responses before and after the training.

3. Results

3.1. Student Cohort

Twenty-one third- to sixth-year medical students from the University of Bologna were enrolled in a two-day intensive CCD moderator training program in November 2023. Twelve students were enrolled in the single-cycle degree program taught in English in Bologna; nine students were enrolled in the single-cycle degree programs taught in Italian in Bologna (eight students) and Ravenna (one student).

3.2. Students' Expectations Prior to the Initiative

Sixteen out of twenty-one students responded to the questionnaire before the CCD training, with thirteen students providing responses post-training. Before the training, more than half of the participants expressed either interest or a strong interest (scores 4–5 on the 5-point Likert scale) in all proposed learning objectives (Table A1). In total, 94.1% of the students were strongly (82.3%) or generally (11.8%) interested in getting to know a new teaching format, whereas only 5.9% had no expectations in this regard. Moreover, 88.2% of the participants strongly agreed (58.8%) or agreed (29.4%) to look forward to learning basic concepts of learning science, and nearly all students (94.1%) strongly agreed to expect an improvement in their clinical reasoning skills. Their expectation to practice their medical English was 64.7% rather low, as only 41.2% strongly and 23.5% generally expressed interest in this regard. A total of 93.8% of students stated that they considered the training either very highly (56.3%) or highly (37.5%) useful for their future medical activities. Regarding the preparedness of the faculty for the training, 81.3% of students had very high (68.8%) or high (12.5%) expectations, and 87.5% of them disclosed very high (31.3%) or high (56.3%) interest in collaborating with their course colleagues during the training.

3.3. Students' Evaluation after Their Participation

A total of 92.3% of students strongly agreed to the fact that they learned about an innovative teaching format (CCD) and either strongly (76.9%) or generally (15.4%) agreed to have had the opportunity to learn about the basic concept of learning science (Table A2).

A total of 92.3% of the participants reported strongly agreeing (84.6%) or agreeing (7.7%) to have had the chance to improve their clinical reasoning as well as practice their medical English (53.8% of participants strongly agreed and 30.8% of them agreed).

In the end, 84.6% of the students stated that the training much exceeded (63.5%) or exceeded (23.1%) their expectations considering its utility for their future medical activities. More than half of participants (61.5%) reported that faculty preparedness for the training much exceeded (53.8%) or exceeded (7.7%) their expectations and 76.9% of the students declared high satisfaction regarding the collaboration with their colleagues during the training (53.8% of them reported much exceeded expectations and 23.1% of them exceeded expectations).

A content analysis of the responses to the open-ended questions revealed that students positively assessed the opportunity to learn new methods for approaching clinical cases. One student stated: "I was only used to learning theory and learning about a disease and then its characteristics. This session helped me understand to go from the other way, i.e., start from different clinical presentations and then come to a diagnosis". Another student remarked: "From the course, I learnt how to dissect a clinical problem in a more systematic, schematic and scientific way rather than intuitive". Furthermore, they expressed interest in further promoting the initiative. For instance, one student expressed: "I'm willing to volunteer at CCD sessions, do clinical case presentations, and support the development of the University of Bologna student team as a whole if the university permits it". Another student mentioned: "I would like to introduce the CCD format in Bologna. I am looking forward to transmitting all that I learned to my colleagues so that we can work better in the future".

3.4. CCD Moderator Training Compared to Curricular Courses

Lastly, participating students were asked to compare the CCD training to their usual courses. Although most students agreed (50%) or strongly agreed (16.7%) with the statement that the course content aligned well with their prior knowledge, 66% of them evaluated the training as either more difficult (58%) or a lot more difficult (8%) than their usual courses.

Nevertheless, over 90% of students provided highly positive evaluations across all SEEQ domains. As shown in Table 2, students rated all SEEQ domains above average based on their scores on the five-point Likert scale. Furthermore, they perceived the training to be overall superior compared to their standard classes.

Table 2. The mean and standard deviation (SD) scores of the 13 students' evaluations of their experience in the CCD moderator training across SEEQ domains and their overall evaluation of the CCD moderator training compared to standard curricular courses. Likert scale from 1 = strongly disagree to 5 = strongly agree.

Student Evaluation Regarding . . .	Mean (SD)
Learning	4.98 (0.08)
Enthusiasm	4.85 (0.27)
Organization	4.84 (0.38)
Group interaction	4.89 (0.26)
Individual rapport	4.62 (0.51)
Breadth	4.5 (0.52)
Assignment	4.5 (0.5)
Overall	4.6 (0.38)

4. Discussion

The students in our cohort considered CCDs an excellent tool for improving their CR skills. Their impressions align with the existing consensus that CCDs are a valuable and proven tool for fostering CR in medical students in the German setting [18].

Alongside improvements in CR, participating students reported an increase in their general learning motivation. This matches previous observations indicating that case-based learning formats contribute to enhanced educational outcomes, such as increased course participation, confidence, discussion, and higher exam scores [31]. CCDs seem to meet students' needs in this regard as well, resulting in a self-assessed general improvement in their performance beyond clinical reasoning.

Although participants had high expectations of the CCD moderator training, the format managed to even exceed them. Moreover, students evaluated the CCD moderator training as superior to their standard classes. As peer-teaching or near-peer teaching formats have proven to be generally well accepted among students, their exceptional feedback aligns with prior observations [12,13,31]. Since CCDs unite case-based learning and peer teaching or near-peer teaching, CCDs are well suited to meeting the needs of the surveyed students.

After the training, students expressed their desire to continue conducting CCDs on a regular basis. Given that the implementation of a CR course has been shown to improve students' differential diagnostic and patient presentation skills in the context of a German medical curriculum, CCDs could also be a beneficial addition to the standard curriculum in Italian medical education [32].

There have been discussions about the best stage within a medical curriculum to implement CR education [18,32,33]. During a CCD session, students are encouraged to explain their answers to peers of different grade levels. This supports the learning process for both the receiver and giver of the information, benefiting the overall learning experience for students across different grade levels. Thus, students are forced to make themselves clear to less experienced students and can be fact-checked by more experienced students [31]. Our results are in line with this, as students found the CCD moderator training more challenging than their usual courses yet agreed that it aligned well with their prior knowledge.

Our observations have certain limitations. First, the concept of CCD as a CR tool was introduced only to voluntarily attending highly motivated students, which introduces self-selection bias. Second, learning improvements were solely based on subjective reports from the students themselves; there was no objective measure of their academic progress. Third, there was no control group exposed to a different format. Nevertheless, the great interest in the CCD format as a CR approach highlighted the self-perceived need for such teaching formats among medical students at the University of Bologna.

In the next step, it is important to continuously evaluate ongoing CCD training initiatives to assess the effectiveness of the training model itself. Steps should be taken to minimize self-selection bias among participants. Therefore, learning improvements should be analyzed between two groups: students who voluntarily participate in CCD sessions and those who participate as an obligatory part of their medical curriculum. Additionally, incorporating objective evaluations of student learning, including pre- and post-training assessments, is essential. Furthermore, consideration should be given to including control groups exposed to a CR format different from CCDs.

In summary, this study highlights the potential medical students attending degree programs at the University of Bologna see in the CCD format, which may become a valuable tool for CR education and represent a meaningful addition to the medical curriculum. As students reported significant benefits in their learning progress and high perceived importance of the acquired skills for their future medical careers, we believe the impact of CCDs on objectively measured learning outcomes in a controlled setting is a promising avenue of research ahead of the forthcoming revision of the Italian curriculum. We hope our pilot study facilitates and inspires such research studies.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors upon request.

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Appendix A

Table A1. Questionnaire used to evaluate expectations before the CCD moderator training.

Before the CCD Moderator Training (n = 16)					
Please indicate how much you agree or disagree with these statements.					
I am looking forward to....					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(a) Getting to know an innovative teaching form	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Improving my clinical reasoning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) Learning basic concepts of learning science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(d) Practicing my medical English	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please rate your expectations regarding....					
	Very low	Low	Neutral	High	Very high
(a) Collaboration with your course colleagues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Preparedness of the faculty for the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) How useful you anticipate the training will be for your future medical activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Table A2. Evaluation form used after CCD moderator training.

Evaluation after the CCD Moderator Training (n = 13)					
Please indicate how much you agree or disagree with these statements.					
THIS TRAINING GAVE ME THE OPPORTUNITY TO.....					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(a) Learn about an innovative teaching form	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Improve my clinical reasoning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) Learn about basic concepts of learning science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(d) Practice my medical English	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Table A2. Cont.

Evaluation after the CCD Moderator Training (n = 13)					
Please indicate how much you agree or disagree with these statements.					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(a) The course content aligns well with my prior knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) I would find it interesting to attend a second edition of this initiative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please rate how well the following aspects matched your expectations...					
	Much Less Than Expected	Less Than Expected	Met Expectations	Exceeded expectations	Much Exceeded Expectations
(a) Collaboration with your course colleagues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(b) Preparedness of the faculty for the training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(c) How useful the training will be for your future medical activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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