Clinical Reasoningand Self-confidence Assessment Tool(CRESCAT): a preliminary validation study.

Abstract

Background: Case-based learning, a clinical reasoning inductive methodology,can be a pedagogical strategy for preclinical medical students. Self-confidence is also an essential issue in this phase of the medical course. Specific tools, such as questionnaires specially designed for this purpose, can better assess the development of these skills.
Objective: To validate a questionnaire that assesses preclinical medical students' clinical reasoning accuracy and self-confidence.
Methods: We designed the Clinical Reasoning and Self-confidence Assessment Tool (CRESCAT), which was developed and validated to measure accuracy and self-confidence. The target population is the first- and second-year medical students. The questionnaire is compounded by 7 clinical cases of commonly known diseases, with 5 to 6 questions for each case. An expert panel developed the answers' template. A Likert scale was used to measure self-confidence. CRESCATwas applied in November 2022 to a more advanced samplethan the preclinical students: fourth-year students (4YMS, n=7) and internal medicine medical residents (IMMR, n=7). Statisticalanalysis included Cronbach's alpha to determine the reliability of Likert scale answers. The Kruskal-Wallis test compared CRESCAT measures. Spearman's correlation was applied for the primary objectives. Statistical significance was set at $P < .050$.
Results: We observed an increase in average accuracy from 4YMS to IMMR (65.2±2.9% and 77.7±2.3%, respectively; $P = .006$). Although there was no difference in self-confidence averages, a moderate correlation was found between self-confidence and accuracy (Rs = .663, $P = .001$). The validation population considered the CRESCAT friendly and easy to answer.
Conclusions: We tested a clinical reasoning and self-confidence assessment tool (CRESCAT) developed for preclinical medical students. It was applied to fourth-year students and medical residents, showing its potential to discriminateaccuracy and correlate withself-confidence.

Keywords:medical education, clinical reasoning, medical student assessment, assessment tool.

Introduction

Medical education presents numerous pedagogical challenges, encompassing psychosocial [1-4] methodological and assessment concerns. [5-7] Clinical reasoning (CR) is a pivotal process for accurate diagnosis,[8] thereby mitigating errors. [9] Case-based learning is a methodology for CR development based on illness scripts and analytic habits. [10-14] It employs a framework for each case study to organize information, summarize the case, generate a hypothesis, justify the choices, and plan management.

[15] Testing this framework is essential for CR assessment, as observed in several studies investigating this issue. [15-21]. Once there were few initiatives to systematically evaluate CR in the preclinical medical student population [20], this studyaimed to validate a dedicated CR and self-confidence assessment tool.

Methods

Tool development

We developed the Clinical Reasoning and Self-confidence Assessment Tool (CRESCAT) based on Daniel et al. [15] and Cate [21] for clinical reasoning (CR) accuracy measures. We associated a Likert scale for self-confidence measurement [22]. The different types of questions suggested to assess each component of Clinical Reasoning (CR) were selected from a large constructive systematic review study, which selected the most discriminative questions among 377 articles on CR assessment, establishing weights for each type of assessment on each component. [15]. Questions based on the Utrecht Case-based clinical reasoning test(UCT) were also included [21]. Differentquestions can identify diverse cognitive pathways the student uses to execute CR. The assessed components of CR accuracy included compilation, summarization, differential diagnosis, central hypothesis, justification, pathophysiological explanation, and clinical management. CRESCAT has seven cases with five or six questions per case. As most studies on CR assessment included 12 to 40 questions, we used 40 questions in the CRESCAT (Table 1). The cases are about commonly known diseases, as the target population is preclinical. The distribution of the questions was as follows: extended multiple-choice (EMC) questions: 3; written case brief (WCB) questions: 5; Utrecht Case-based Clinical Reasoning Test (UCT) questions: 12; Modified essay questions (MEQ) in series questions: 6; Short open questions (SOQ): 12; Conventional multiple choice (CMC) questions: 2. Self-confidence questions: 7.A time of 120 minutes was established for the total resolution of the instrument.A Likert scale [22]was used to measure self-confidence because of its role in the student's CR results [6]. The original research tool was written in Portuguese, and we have provided an English version as an appendix to this article for transparence and possible study reproduction.

Ethical approvement

This research is registered in the Brazilian Ethical Committee for Human Beings Research under 66975122.9.0000.8967. Informed consent was obtained at the time of the test application, and the data were confidentially treated only by research staff members.

Participants selection

After a pilot application to 3 internal medicine specialists, we observed that the questionnaire was easy to understand and likely to test CR. Then, we selected a sample with more advanced students than the preclinical students, fourth-year students (4YMS, n=7), and internal medicine medical residents (IMMR, n=7) recruited by convenience.The sample size was calculated for a target population of 60 preclinical studentsat our medical school, considering a confidence level of 95% and a 15% error level. The desired size was 20, and we obtained 14 answers. At the time of the study, we had 7 medical residents and obtained 7 respondents in the fourth-year class.

Application and scoring

CRESCAT was applied in November 2022in a classroom frequently used by medical residents.The standard answers from the template of the CR components were prepared by a panel of 3 *CR* experts who did not communicate with the validation responders [23]. They suggested writing or formulating questions to improve the instrument's clarity anddeveloping the keywords expected to come up with the correct answer. The following scale of answers was established for the CR questions: answers would be regarded asentirelyaccurate when they met the criteria of the answer and received a score of 1 (one); partially correct when elements provided for in the template were predominant to other components and, in this case, the score would be 0.5 (half); and considered wrong when they are entirely different from the template or with elements not predominant over the non-foreseen ones, receiving a score of 0 (zero). Thus, the minimum overall score was 0 (zero, 0%), and the maximum possible score was 40 (forty, 100%) in the questions on CR. The presentation of accuracyaverages was standardized in percentages.The 7 answers about self-confidence are not part of the template and were elaborated through visual means where the respondent should mark from 1 to 5 the self-confidence in selectedanswers, with 1 being the least confident and 5 the most confident, and can generate a total of 0 (zero) to 35 (thirty-five), with an average between 1 and 5. This result was presented as averages with the possibility of using percentages for graphical comparison.

Statistical analysis

Based on the sample size, the Kolmogorov-Smirnov test was unreliablein determining the data normality, so we assumed that the sample and groups did not have a normal distribution. Cronbach's alpha assessed the reliability of Likert scale answers. The Kruskal-Wallis test was used to compare CRESCAT measures for samples that were not normally distributed. We used Pearson's test to establish a correlation between the primary measures, accuracy, and self-confidence. Statistical significance was set at $P < .050$.

Table 1. Questions' models and references on CRESCAT questions.

Component	Method	Command	Reference
Data Compilation	Extended multiple choice (with more than one correct) (EMC)	In the case presented above, you classify the following information as relevant: (You can mark more than one correct).	Case, Swanson, Ripkey, 1994 [16]
	Written Case Briefs (WCB)	Write a case summary in 3 lines.	Dory et al., 2016 [18]
Hypothesis generation	Modified essay questions (in series, one linkedto the next) (MEQ)	You classify the following findings as relevant... Given the answer above you will summarize the case as... and then his central hypothesis is: ... Name 3 more differential diagnoses...	Rademakers, Cate, Bär2005 [24]
	Utrecht CBCR Test (UCT)	Choose one alternative for each question in the answer box.	Cate, 2017 [21]
Summary and Case headline	Short open questions (SOQ)	Summarize in 3 lines and/or in one sentence the clinical problem.	Rademakers, Cate, Bär, 2005 [24]
Differential diagnosis	Short open questions (SOQ)	Answers in 1 or 2 lines.	Rademakers, Cate, Bär, 2005 [24]
	Utrecht CBCR Test(UCT)	Choose one alternative for each question in the answer box.	Cate, 2017 [21]
Central Hypothesis	Conventional multiple choice (only one correct option) (CMC)	Conventional 5-option test	Daniel et al., 2019 [15]
	Utrecht CBCR Test (UCT)	Choose one alternative for each question in the answer box.	Cate, 2017 [21]
Diagnostic justification	Short open questions (SOQ)	Answers in 2 or 3 lines.	Rademakers, Cate, Bär, 2005 [24]
Workout	Conventional multiple choice (CMC)	Conventional 5-option test	Daniel et al., 2019 [15]
	Short open questions (SOQ)	Answers in 2 or 3 lines.	Rademakers, Cate, Bär, 2005 [24]
	Modified essay questions (in series, one linked to the next) (MEQ)	By raising such a hypothesis, you would request... and if this examination gives the result..., What would be your next step? ... In the event of a failed diagnosis or therapy, you would do...	Rademakers, Cate, Bär, 2005 [24]
	Utrecht CBCR Test (UCT)	Choose one alternative for each question in the answer box.	Cate, 2017 [21]
Self-confidence	Self-assessment	How confident are you with your answer to question number ... ?	Likert, 1932 [22]

CRESCAT: Clinical Reasoning Assessment Tool. EMC: extended multiple-choice questions. WCB: written case brief. MEQ: modified essay questions. CBCR: Case-based clinical reasoning. UCT: Utrecht CBCR Test. SOQ: short open questions. CMC: conventional multiple-choice questions. Source: the authors, based on Daniel et al. [15] and Cate [21].

Results

Cronbach's alpha was calculated to assess the reliability of the answers on the Likert scale, and the results were considered good (alpha= .768).

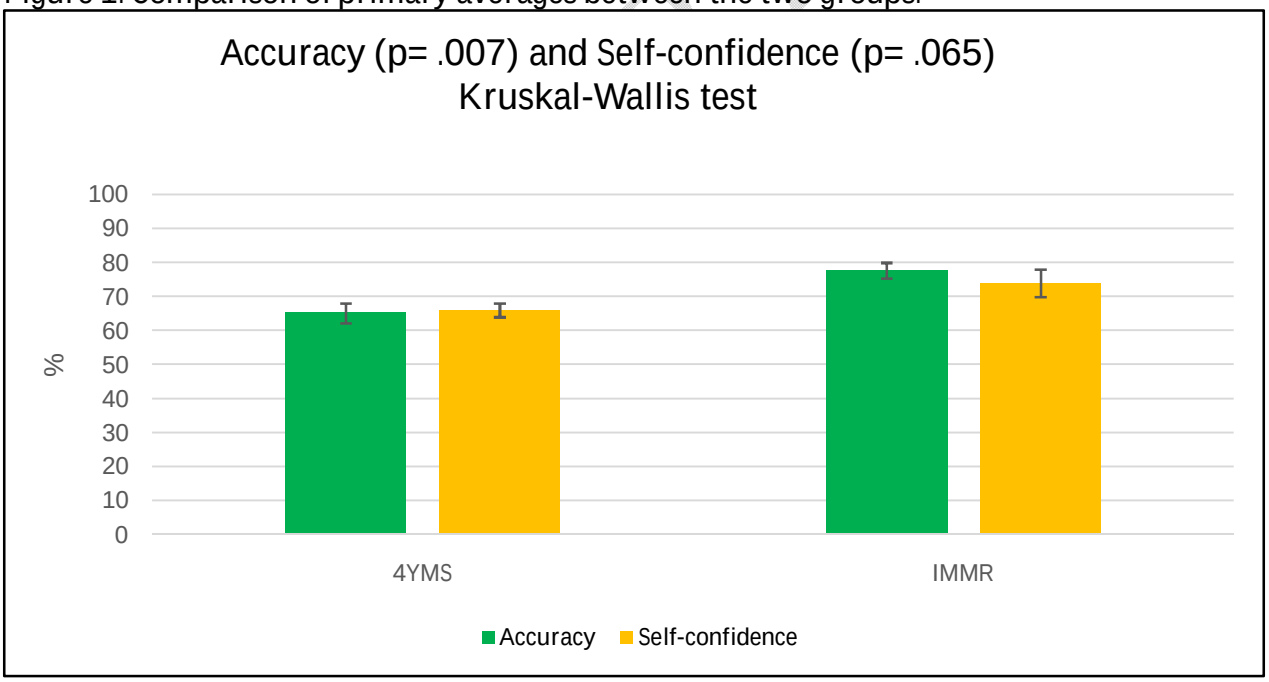
The accuracy averages differed between the two groups, but no difference was observed in the self-confidence averages (Table 2, Figure 1).

Table 2. Demographic data and comparison of accuracy and self-confidence averages in the validation process.

	4YMS (SD)	IMMR (SD)	p	Test
Age (average)	27,3	32,1	.630	K-W
Male (%)	57,1	57,1	1	Chi^2
Accuracy (average)	65.2 (2.9)	77.7 (2.3)	.007	K-W
Self-confidence (average)	3.3 (0.1)	3.7 (0.2)	.055	K-W

4YMS: fourth-year medical students. SD: standard deviation. IMMR: internal medicine medical residents. K-W: Kruskal-Wallis test. Chi^2: chi square. Source: the authors.

Figure 1. Comparison of primary averages between the two groups.

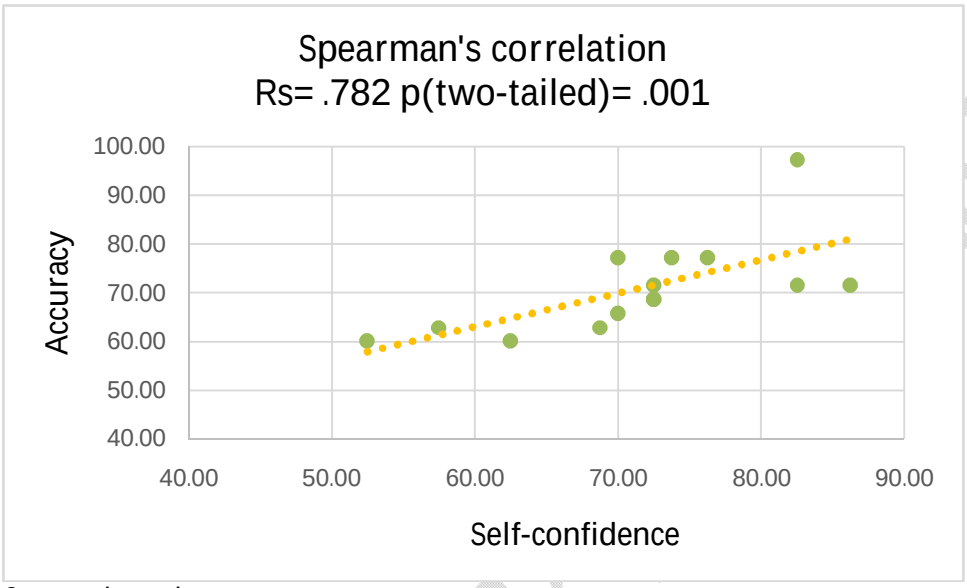


4YMS: fourth-year medical students. SD: standard deviation. IMMR: internal medicine medicalresidents. Source: the authors.

When compared by CR components, there was a difference only in the differential diagnosis skill (4YMS: 71% vs. IMMR: 91%, p= .006; Kruskal-Wallis test). The other components did not differ between the two groups.

We also found a moderate positive correlation between accuracy and self-confidence, with an R-value of .782 and a p-value of .001 (Figure 2).

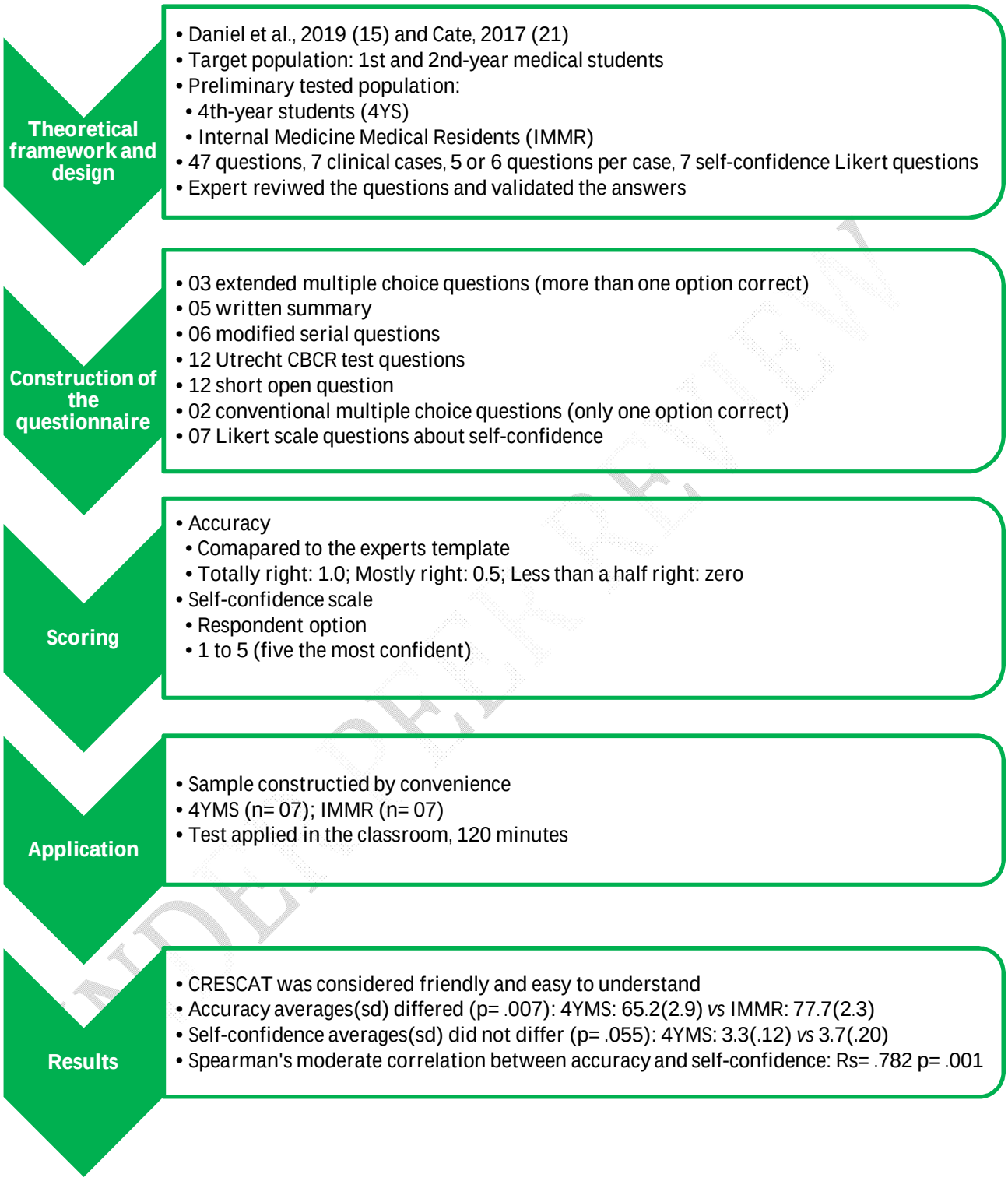
Figure2. Scatter plot between the entire sample accuracy and self-confidence. Spearman's correlation.



Source: the authors.

All validation processes, from creation to results, are summarized in Figure 3.

Figure 3. Validation processes.



CRESCAT: Clinical Reasoning Assessment Tool. 4YS: fourth-year medical students. IMR: internal medicine medical residents. CBCR: case-based clinical reasoning. Rs: Spearman's Rho. Source: the authors.

Discussion

Key Findings

The questions developed derived from a robust, constructive review [15]. The added questions are supported by the literature [21,22]. After building solid articles, the Clinical Reasoning Assessment Tool (CRESCAT) was verified by experts, had an easy understanding of the application, and was evaluated through a template created by experts, with good reliability in self-confidence answers.An increasing accuracy resultwas obtained with the level of practice, and a correlation between accuracy and self-confidence was observed. Self-confidence was not different in the groups. There were differences only in the 'differential diagnosis'component of clinical reasoning (CR).

Implications for medical education

These findings support the teaching and assessment of CR in preclinical medical students once a systematic methodology is applied [21, 25]. The case-based learning (CBL) methodology is now understood to have pedagogical components that can complement students' psychological properties, giving learning a sense [26-28]. The primary objective of CBL is to clear students' medical decision-making [29] and to avoid diagnostic errors [30].Therefore, we recommend reviewing medical education curricula to insert or reinforce CR-inductive methodologies by training professors in case-based or simulation-based learning. [21]

The accuracy growingwhile self-confidence has no difference suggests that medical students, having initial medical knowledge, tend to inflate their self-assessment [31]. This is highly suggestive of the phase I Dunning-Kruger effect, which means that naïve comprehension of medical themes can lead to inflated and falseself-confidence [32]. This can generate diagnostic errors, harming patients. In the artificial intelligence era, the illusion of competence can be especially dangerous [33] and must be fought by metacognitive awareness [34]. Enhancing critical thinking is one strategy to give students true-based self-confidence [26-28].

The correlation between accuracy and self-confidence suggests adouble-handed process in which better knowledge guides to better self-confidence, and true-based self-confidence leads to better skill achievements [21,35]. Critical thinking seems to be a moderator [26-28], and CR teaching [35] and assessment [20] contribute to refiningmedical student's cognition.A systematic assessment tool is desirable to give students appropriate feedback once all student-centered strategies apply the CR-induction methodologies in a mentorship scenario. [21,35]

CRESCAT differs from other CR assessments (15-21). First, it seeks self-confidence, and unexpectedly, we observed that self-confidence grows before CR is acquired. Further studies with the same questionnaire and larger sample sizes are desirable to clarify this finding. Another difference is that we compiled the best evidence on CR assessment (15, 21) in a single questionnaire, which analyzes CR assessment from many angles and nuances.Comparingdifferent strategies to assess CR in preclinical students, recent studies observed that each strategy can determine a component of the CR construct. [36,37]

Limitations
Our study has limitations, such as the limited sample size and groups andthe convenience sampling method, which can affect the error level and impact the generalizability of the findings.

Future directions
The next step is to apply the CRESCAT to a larger sample and compare it between medical schools with diverse pedagogical methodologies.After that, CRESCAT can be a valuable tool for other institutions.

Conclusion

The difference in clinical reasoning accuracy and its correlationwith self-confidence suggest that the CRESCAT is easily applicable and can discriminate between different levels of practice. This assessment tool can help professorsadopt tailored educational interventions. We encourage other researchers to amplify thesestudies for continuous validation and refinement.

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

References

1. Figueiredo DS, Lima KA, Figueiredo FNS, Bellodi P, Porfirio GB, Carraro E et al. The first year of the rest of our lives: Mental health of medical students. Res Soc Dev;2022;11:9. http://dx.doi.org/10.33448/rsd-v11i9.3165.

2. Huang GC, Newman LR, Schwartzstein RM. Critical Thinking in Health Professions Education: summary and consensus statements of the Millennium Conference 2011. Teach Learn Med;2014;26(1):95-102. http://dx.doi.org/10.1080/10401334.2013.857335.

3. Tanaka MM, Furlan LL, Branco LM, Valerio NI. Medical Students' Adaptation in the Early Years of College. Rev Bras Educ Med;2016;40(4):663-668. http://dx.doi.org/10.1590/1981-52712015v40n4e00692015.

4. Torres V, Sampaio CA, Caldeira AP. Incoming medical students and their perception on the transition towards an active learning Interface ComunSaúde Educ;2019;23:1700471. http://dx.doi.org/10.1590/interface.170471.

5. Dunlosky J, Rawson KA, Marsh EJ, Nathan MJ, Willingham DT. Improving students' learning with effective learning techniques: promising Directions from Cognitive and Educational Psychology. Psychol Sci Public Interest;2013;14(1):4-58. http://dx.doi.org/10.1177/1529100612453266.

6. Hayat AA, Shateri K, Amini M, Shokrpour N. Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: a structural equation model. BMC Med Educ;2020;20(1):[76]. http://dx.doi.org/10.1186/s12909-020-01995-9.

7. Mcconnell MM, Eva KW. The role of emotion in the learning and transfer of clinical skills and knowledge. Acad Med;2012;87(10):1316-1322. http://dx.doi.org/10.1097/ACM.0b013e3182675af2.

8. Cate OT. Durning SJ. Understanding clinical reasoning from multiple perspectives: A conceptual and theoretical overview. In: CATE Ollie T.; CUSTERS, Eugène J.F.M.; DURNING, Steven J. Principles and Practice of Case-based Clinical Reasoning Education: a method for preclinical students. Innovation and Change in Professional Education series. Springer Open. 2017;15(3):35-46.

9. Graber ML, Franklin N, Gordon R[T1]. Diagnostic error in internal medicine. Arch Intern Med;2005;165(13):1493-1499. http://dx.doi.org/10.1001/archinte.165.13.1493.

10. Bowen J, Cate O.T. Prerequisites for learning clinical reasoning. In: CATE Ollie T.; CUSTERS, Eugène J.F.M.; DURNING, Steven J. Principles and Practice of Case-based Clinical Reasoning Education: a method for preclinical students. Innovation and Change in Professional Education series. Springer Open. 2017;15(4): 47-64.

11. Rencic J. Twelve tips for teaching expertise in clinical reasoning. Med Teach;2011;33(11):887-892. http://dx.doi.org/10.3109/0142159X.2011.558142.

12. Cate OT. How to teach clinical reasoning to junior students? In: CATE Ollie T.; CUSTERS, Eugène J.F.M.; DURNING, Steven J. Principles and Practice of Case-based Clinical Reasoning Education: a method for preclinical students. Innovation and Change in Professional Education series. Springer Open. 2017;15(1):3-19.

13. Si J. Strategies for developing pre-clinical medical students' clinical reasoning based on illness script formation: a systematic review. Korean J Med Educ;2022;34(1):49-61. http://dx.doi.org/10.3946/kjme.2022.219.

14. Tureck F, Souza S, Faria RMD. Teaching strategies for clinical reasoning in Brazilian medical schools - an integrative review. Rev Bras Educ Med;2023;47(1):20220023. http://dx.doi.org/10.1590/1981-5271v47.1-20220032.

15. Daniel M, Rencic J, Durning SJ, Holmboe E, Santen SA, Lange V. et al. Clinical Reasoning Assessment Methods: a scoping review and practical guidance. Acad Med;2019;94(6):902-912. http://dx.doi.org/10.1097/acm.0000000000002618.

16. Case SM, Swanson DB, Ripkey DR. Comparison of items in five-option and extended-matching formats for assessment of diagnostic skills. Acad Med;1994;69(10) (suppl):S1-S3. http://dx.doi.org/10.1097/00001888-199410000-00023.

17. Cleary TJ, Konopasky A, La Rochelle JS, Neubauer BE, Durning SJ, Artino AR. First-year medical students' calibration bias and Accuracy across clinical reasoning activities. Adv Health Sci Educ Theory Pract;2019;24(4):767-781. http://dx.doi.org/10.1007/s10459-019-09897-2.

18. Dory V, Gagnon R, Charlin B, et al. In Brief: validity of case summaries in written examinations of clinical reasoning. Teach Learn Med;2016;28(4):375-384. http://dx.doi.org/10.1080/10401334.2016.1190730.

19. Kunina-Habenicht O, Hautz WE, Knigge M, Spies C, Ahlers O. Assessing clinical reasoning (ASCLIRE): instrument development and validation. Adv Health Sci Educ Theory Pract;2015;20(5):1205-1224. http://dx.doi.org/10.1007/s10459-015-9596-y.

20. Simpkins AA, Koch B, Spear-Ellinwood K, St John P. A developmental assessment of clinical reasoning in preclinical medical education. Med Educ Online;2019;24(1):1591257. http://dx.doi.org/10.1080/10872981.2019.1591257.

21. Cate OT. Assessment of Clinical Reasoning Using the CBCR Test. Innovation and Change in Professional Education Series. In: CATE Ollie T.; CUSTERS, Eugène J.F.M.; DURNING, Steven J. Principles and Practice of Case-based Clinical Reasoning Education: a method for preclinical students. Innovation

and Change in Professional Education series. Springer Open. 2017;15(7):85-94.

22. Likert R. A technique for the measurement of attitudes. Arch Psychol;1932;22(140):1-55.

23. Gunawan J, Marzilli C, Aungsuroch Y. Establishing appropriate sample size for developing and validating a questionnaire in nursing research. Belitung Nurs J. 2021 Oct 28;7(5):356-360. http://dx.doi.org/10.33546/bnj.1927.

24. Rademakers J, Cate OT, Bär PR. Progress testing with short answer questions. Medical Teacher;2005;27(7):578-82. http://dx.doi.org/10.1080/01421590500062749.

25. Hawks MK, Maciuba JM, Merkebu J, Durning SJ, Arnold R, Steven J.; Mallory R, Arnold MJ, et al. Clinical Reasoning Curricula in Preclinical Undergraduate Medical Education: a scoping review. Academic Medicine;2023;98(8):958-965. http://dx.doi.org/10.1097/acm.0000000000005197.

26. Richards JB, Hayes MM, Schwartzstein RM. Teaching clinical reasoning and critical thinking: from Cognitive Theory to Practical Application. Chest;2020;158(4):1617-1628. http://dx.doi.org/10.1016/j.chest.2020.05.525.

27. Mamede S, Van Gog T, Sampaio AM. How can students' diagnostic competence benefit most from practice with clinical cases? The effects of structured reflection on future diagnosis of the same and novel diseases. Acad Med;2014;89(1):121-127. http://dx.doi.org/10.1097/ACM.0000000000000076.

28. Mamede S, Schmidt HG. Deliberate reflection and clinical reasoning: founding ideas and empirical findings. Med Educ;2023;57(1):76-85. http://dx.doi.org/10.1111/medu.14863.

29. Mcgregor CA, Paton C, Thomson C, Chandratilake M, Scott H. Preparing medical students for clinical decision making: a pilot study exploring how students make decisions and the perceived impact of a clinical decision-making teaching intervention. Med Teach;2012;34(7):508-517. http://dx.doi.org/10.3109/0142159x.2012.670323.

30. Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. Acad Med;2003;78(8):775-780. http://dx.doi.org/10.1097/00001888-200308000-00003.

31. Kruger J, Dunning D. Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. J Pers Soc Psychol;1999;77(6):1121-1134. http://dx.doi.org/10.1037/0022-3514.77.6.1121.

32. Rahmani M. Medical Trainees and the Dunning–Kruger Effect: when they don't know what they don't know. J Grad Med Educ;2020;12(5):532-534. http://dx.doi.org/10.4300/JGME-D-20-00134.1.

33. He G, Kuiper L, Gadiraju U. Knowing about Knowing: an illusion of human competence can hinder appropriate reliance on AI systems. Arxiv;2023;11333. http://dx.doi.org/10.48550/ARXIV.2301.11333.

34. Siqueira MA. Relationshipbetween metacognitive awareness and motivation to learn in medical students. BMC Med Educ;2020;20(10):393. http://dx.doi.org/10.1186/s12909-020-02318-8.

35. Mclean SF. Case-Based Learning and its Application in Medical and Health-Care Fields: a review of worldwide literature. J Med Educ Curric Dev;2016; 3:20377. http://dx.doi.org/10.4137/JMECD.S20377.

36. Fürstenberg S, Helm T, Prediger S, Kadmon M, BerberatPO, HarendzaS. Assessing clinical reasoning in undergraduate medical students during history taking with an empirically derived scalefor clinical reasoning indicators. BMC Medical Education, 2020;20(1):368.https://doi.org/10.1186/s12909-020-02260-9.

37. Covin Y, LongoP, WickN, Gavinski K, Wagner, J. Empirical comparison of three assessment instruments of clinical reasoning capability in 230 medical students. BMC Medical Education, 2020;20(1):264.https://doi.org/10.1186/s12909-020-02185-3

APPENDIX:CRESCAT QUESTIONNAIRE AND EXPERTS' TEMPLATE

Dear student, we thank you for volunteering to participate in this survey. It was designed specifically for students in the first two years of the course, and we ask you to give the best answer you can despite your initial experience in the medical field. You have 120 minutes to answer it.
This test has no relation to your grades in undergraduate courses.
It is forbidden for the applicator to provide any information about the interpretation or resolution of the test.
If you feel uncomfortable or embarrassed, ask the applicator for help.
The data from this test, including the identification and results of each test, will be kept confidential. The research group will analyze the results anonymously.
We undertake to inform you as soon as possible about the progress of the research.
STUDENT INITIALS:
YEAR/GRADE:
INSTITUTION:
DATE:

CASE 1: Carefully read the case below and, with the available information, answer questions 1 to 7.

A 25-year-old man had a fever (38.3°C) for 4 days. At first, he had a clear, runny nose and slight cough, but in the last 2 days, he started to have a more frequent cough with yellowish sputum and pain in the left hemithorax. He had tonsillitis in childhood and underwent appendectomy at the age of 14. A hypertensive mother, she had a myocardial infarction at the age of 55. Father had skin cancer resection at the age of 45. One brother has a heart murmur. Physical examination showed tachycardia (108 bpm), confirmed fever (38.2°C) and increased respiratory rate (24 mpm), normal BP (118/74 mmHg), and lung rales in the left base, with a marked reduction in breath sounds in this and local base. A cardiovascular physical examination showed no abnormality. Chest X-rays and Blood Counts were requested at the unit where he was treated.

After each number, there is a question. After the letters, there are options. The expert's correct answer is written in red.

1. Circle the alternatives considered as relevant data to the case (it is possible that there be more than one correct option):
a. 4-day turnaround. b. mother with heart disease. c. brother with a heart murmur. d. fever. e. yellowish sputum. f. tonsillitis in childhood. g. history of appendectomy. h. increased heart rate. i. increased respiratory rate. j. lung rales

2. Describe how confident you are about question 1:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

3. Write a summary of this case (without exceeding the established 5 lines):
A young man with acutefever, chest pain on the left, productive cough with yellowish discharge, tachycardia, tachypnea, crackles and reduced breath sounds at the left base. (Keywords underlined)

4. Provide 3 differential or alternative diagnoses:
Community-acquired pneumonia
Broncopneumonia
Pulmonary embolism
Heart failure
Atypical pneumonia
Derrama pleural
(Keywords underlined)

5. Write your central diagnostic hypothesis and justify: Central hypothesis: Community-acquired pneumonia, probably lobar. Justification: The young man has no declared personal comorbidities, fever, chest pain, productive cough, and a compatible physical examination.(Keywords underlined)

6. If the requested blood count yields a result of 14500 leukocytes/mm³ with 12% band cells and chest X-rays observe condensation in the left lower lobe with an air bronchogram, do these findings reinforce or weaken your central hypothesis? Justify.
They are reinforced because the blood count suggests acute bacterial infection, and the condensed X-raysand bronchogram suggest pneumonia.(Keywords underlined)

7. Do you continue with your central hypothesis if the requested blood count results in 11000 leukocytes/mm³ and 7% rods and chest X-rays reveal a complete opacification of the left base? Or would you exchange or add for any of the differences or alternatives? Which?
Would add or change the diagnosis of pleural effusion due to X-raycomplete opacification. (Keywords underlined)

CASE 2: Carefully read the case below and, with the available information, answer questions 8 to 14.

A 35-year-old woman, a domestic worker, arrives at the health unit complaining of pain when urinating. The condition started 3 days ago, and she is worried because she cannot exercise her activity, as she wants to urinate several times during the day; when she arrives at the bathroom, she urinates in small amounts, burning,

and notices a foul odor coming from the urine. She has a history of being diabetic, diagnosed a few months ago. She was pregnant 4 times, having had an abortion, and 3 children by standard delivery, the youngest son at 7 years old. His father died of cirrhosis last year. She had nofever, and her physical examination showed only pain in the region above the pubis. The doctor ordered a urine test.

8. Circulate the alternatives considered relevant data to the case (there may be more than one correct one).
a. Pain when urinating. b. father with cirrhosis. c. urine in small amounts. d. no fever. e. 4 pregnancies, last 7 years ago. f. diabetes. g. history of abortion. h. domestic worker. I. Pain in the region above the pubis. J. Foul odor in the urine

9. Describe how confident you are about question 8:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

10. Write a summary of this case (without exceeding the established 5 lines):
Woman of childbearing age, diabetic, with acute pain when urinating (dysuria), increased frequency and reduction in the amount of urine (frequency), foul odor in the urine, suprapubic pain. (Keywords underlined)

11. Write your central diagnostic hypothesis and justify: Central hypothesis: Low UTI or cystitis. Justification: diabetic woman with acutedysuria, frequency, and foul odor in the urine, without fever, and with suprapubic pain. (Keywords underlined)

12. Provide 3 differential or alternative diagnostic hypotheses:
Low urinary tract infection (UTI) or acute cystitis
Glomerulopathy
Genital infection
Cystocele
Genital dystopia
Bladder neoplasm (Underlined keywords)

13. If the urine test requested results in increased leukocytes, positive nitrite, and many gram-negative bacilli, do these findings reinforce or weaken your central hypothesis? Justify.
They reinforce becausethey indicate infection in the urine.

14. Do you continue with your central hypothesis if the urine test requested results in normal leukocytes and many red blood cells? Or would you add or exchange any of the differentials or alternatives? Which?
I would add or replace it withglomerulopathy, neoplasia, or lithiasis. (Keywords underlined)

CASE 3: Carefully read the case below and, with the available information, answer questions 15 to 21

A 63-year-old businessman arrives at the emergency room complaining of shortness of breath that made him wake up and seek help. He has been short of breath in the last 15 days, and soon after, he had a fever, runny nose, and intense muscle and pharyngeal pain. He also had an altered sense of smell and taste. As he improved in 48 hours, he did not seek care or take tests. A few days later, he started to have intense fatigue, with shortness of breath to walk fast and uphill, but currently, he has shortness of breath even to climb 2 flights of stairs indoors. He had no chest pain. He has a history of hypertension and dyslipidemia and has been using Losartan and Simvastatin. He underwent gallbladder surgery. He used prostate medication until a year ago. He smokes 10 cigarettes a day and drinks 3 shots of whiskey every night. His father died of a heart attack. He says he has hemorrhoids. Blood pressure: 168/100mmHg, Heart rate: 128 bpm, Temperature: 37.1°C, and Respiratory rate: 24mpm. Cardiac auscultation with a third heart sound and pulmonary auscultation with crackles in both lungs. The doctor on duty requested an electrocardiogram, chest x-rays, troponins, and c-reactive protein.

15. Circulate the alternatives considered as relevant data to the case (there may be more than one correct one)?
a. shortness of breath. b. smoking. c. alcoholism. d. gallbladder surgery. e. 4 family history of infarction. f. prostate disease. g. Elevation of heart rate. H. Third sound. I. Crackling rales. j. hemorrhoids.

16. Describe how confident you are about question 15:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

17. Write a summary of this case (without exceeding the established 5 lines):
An elderly man, alcoholic, smoker, with cardiovascular risk factors, presents with dyspnea on medium exertion (functional class II) of recent onset with progressive worsening in the last few days, history of brief airway infection before the condition, on examination, he was hypertensive, tachycardic, febrile, tachypnea, with alterations in cardiac auscultation (B3) and pulmonary (bilateral crackles). (Keywords underlined)

18. Write your central diagnostic hypothesis and justify the central hypothesis: Viral myocarditis. Justification: heart failure after mild airway infection, remains febrile. (Keywords underlined)

19. Provide 3 differential or alternative diagnostic hypotheses:
Viral or infectious myocarditis
Heart failure (HF)
Acute myocardial infarction (AMI)
Exacerbation of chronic obstructive pulmonary disease (COPD)
Pulmonary embolism
Derrame pleural
Pericarditeaguda
Long Covid
Aortic dissection (Underlined keywords)

20. If the requested electrocardiogram (ECG) results in ST-segment elevation with frequent ventricular arrhythmia, troponin, and CRP are also elevated, and chest x-rays show signs of pulmonary congestion, do these findings reinforce or weaken your central hypothesis? Justify.
They reinforce. Because x-rays confirm heart failureand ECG has a myocardial injury and ventricular arrhythmia, CRP indicates active inflammation,and troponin confirms myocardial injury. (Keywords underlined)

21. If, upon seeing the electrocardiogram (ECG) described above, you had referred the patient to an emergency cardiac catheterization (coronary angiography) that came with no coronary obstruction, do you continue with your central hypothesis? Or would you add or exchange it for any differentials or alternatives? Justify the conduct of performing a catheterization in this case.
I would maintain or reinforce the central hypothesis. The conduct is justified because there are symptoms, risk factors, and ECG alterations compatible with AMI, and in the emergency room, we seek to rule out a more serious situation. (Keywords underlined)

CASE 4: To answer the case below, choose from the options provided in the box after questions 22 to 27.

A 55-year-old woman presents with intense joint pain in her wrists and elbows, occasionally in her knees. The condition began about 5 years ago, evolved in crises that were previously sporadic, and subsided with the use of an anti-inflammatory that she used on her own. Last winter, however, the pain became more substantial and frequent; sometimes, she feels these joints are swollen, and she has difficulty mobilizing her wrists and elbows in the morning. She believes she has been depressed in recent months. He has a history of biliary colic but has not had gallbladder surgery. She was pregnant 2 times and underwent 2 cesarean sections. She denies being hypertensive or diabetic. He does not smoke and does not drink. On physical examination, arthritis was observed in the wrists and joint deformity with ulnar deviation of the wrists.

22. What is the most likely diagnosis? Choose only one (1) from the "diagnostic options" list
Rheumatoid arthritis

23. Which diagnostic test is the most useful? Choose only one (1) from the "diagnostic testing options" list
Rheumatoid factor

24. What therapeutic options are applicable to this diagnosis? Choice 3 from the list of "therapeutic options" Physical therapy and psychotherapy
Physiotherapy and psychotherapy
Use of Corticosteroids
Use of immunobiological drugs

25. What symptoms would you expect to find if one of your differential diagnoses is Systemic Lupus Erythematosus? Select 5 from the "Symptoms" list.
Changes in emotional state
Asymmetric pain
Redness on the face
Changes in emotional state
Reduction in urine volume
Elevation of blood pressure

26. If one of your options is Rheumatic Fever, what physical examination findings would you expect to find? Select 2 from the "Signals" list
Subcutaneous nodules
Involuntary movements
Cardiac murmur

27. If your primary option is Septic Arthritis, what diagnostic tests would you order? Select 2 from the "diagnostic test options" list
Magnetic resonance imaging
Blood cells count
Joint ultrasound
Joint puncture

Diagnostic options	**Symptoms**
Systemic erythematosus lupus Osteoarthritis Charcot Arthropathy Mixed collagen disease Scleroderma Rheumatoid arthritis Rheumatic fever Septic Arthritis Reactive arthritis	Symmetrical pain Asymmetric pain Redness on the face Large joints affected Small joints affected Morning movement impairment Improvement with anti-inflammatories Changes in emotional state Reduction in urine volume Elevation of blood pressure
Signs	**Diagnostic Testing Options**
Joint deformity Subcutaneous nodules Fever > 39°C Involuntary movements Cardiac murmur Facial erythema Reduced limb length Lips inflammation	Magnetic resonance imaging Antinuclear factor Anti-MS antibody Antiphospholipid antibody Rheumatoid factor Joint puncture Hepatitis B serology Syphilis serology O-anti-streptolysin Blood cell count Joint ultrasound
Therapeutic options	
Joint puncture Physiotherapy and psychotherapy Surgical treatment Use of Corticosteroids Use of immunobiological drugs Chronic use of non-steroidal anti-inflammatory drugs	

28. Describe how confident you are about questions 22 to 27:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

CASE 5: To answer the case below, choose from the options provided in the box after questions 29 to 34.

A 77-year-old man has had severe constipation for 3 days. He says he has not eliminated feces for 3 days and has little gas elimination. He has distension and abdominal pain in the left flank. Hypertension using Losartan. Slow bowel habit: sometimes it goes up to 2 days without having a bowel movement. Hemorrhoid surgery 20 years ago. Weight loss of 5kg in the last 6 months. The abdomen was distended and painful in the left flank on physical examination. Digital rectal examination: clean gloves.

29. What is the most likely diagnosis? Choose only one (1) from the "diagnostic options" list: Colon cancer

30. Which diagnostic test is the most useful? Choose only one (1) from the list of "diagnostic testing options": Colonoscopy

31. What therapeutic options are applicable to this diagnosis? Choose 2 from the "therapeutic options" list:
Surgery
Chemotherapy
Analgesia

32. If one of your options is Mesenteric Ischemia, what symptoms would you expect to encounter? Select 5 from the "Symptoms" list
Mild pain
Severe pain
Fecal elimination stop
Fever
Fecal vomiting
Abdominal murmur

33. If one of your options is Pancreatitis, what physical examination findings would you expect to find? Select 2 from the "Signals" list
Hematoma periumbilical
General wall renitence

34. If your primary option is a diverticular disease of the colon, what diagnostic tests would you order? Select 2 from the "diagnostic test options" list
Abdominal Tomography
Abdominal Ultrasound
Abdominal Magnetic Resonance Imaging

Diagnostic options	**Symptoms**
Diverticular disease of the colon	Mild pain
Appendicitis	Severe pain
Mesenteric ischemia	Fecal elimination stop
Intestinal tuberculosis	Fever
Irritable bowel syndrome	Fecaloid vomiting
Colon cancer	Diarrhea
Oxyurids	Jaundice
Internal hemorrhoids	Anal itching
Pancreatitis	Abdominal murmur
Signs	**Diagnostic Testing Options**
Liver enlargement	Paracentesis
Spleen enlargement	Antigliadin antibodies
Periumbilical hematoma	Lactose Tolerance Test
Blumberg signal	Abdominal Tomography
General wall renitence	Colonoscopy
	Contrasted X-rays of the colon
	Parasitological stool exam
	Blood cell count
	Abdominal ultrasound
	Abdominal Magnetic Resonance Imaging
Therapeutic options	
Clinical observation	
Laxatives	
Pro-kinetics	
Surgery	
Analgesia	
Chemotherapy	

35.Describe how confident you are about questions 29 to 34:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

CASE 6: Carefully read the case below and, with the available information, answer questions 36 to 41.

A 68-year-old man has been experiencing food regurgitation and weight loss. Burning in the upper abdomen and center of the chest. For many years, it has worsened in the last 2 years. For about 6 months, he has reported that after ingesting food, he has abdominal burning and then needs to regurgitate or even vomit the food that returns partially digested amid gastric liquid. He denies blood

loss along with vomiting. On treatment for gastritis from the age of 40, use Omeprazole 40mg 1 or 2 tablets daily. He is hypertensive, controlled on Losartan 50mg/day and Hydrochlorothiazide 25mg/day. He denies diabetes. He has been a smoker of 15 cigarettes a day since he was 20 years old. Weight: 68kg (Usual weight: 80kg) Height: 175cm Blood pressure: 120/80mmHg Heart rate: 76 bpm Pain on the palpation of the epigastrium.

36. Make a summary of the case without exceeding the 5 lines available:
Elderly man, with chronic food regurgitation, unintentional weight loss proven on physical examination, vomiting with gastric juice, burning in the abdomen and the center of the chest, with peptic disease medicated with Omeprazole, hypertensive and smoker.(Keywords underlined)

37. Which organ or system is affected? And what would be the clinical problem?
Upper digestive system: esophagus, stomach, duodenum. Dysphagia and/or consumptive syndrome.(Keywords underlined)

38. Select the central diagnostic hypothesis from among the following (only one option):
a. Atrophic gastritis. b. Chagasic megaesophagus. c. Celiac disease.d. Pyloric stenosis. e. Gastro-esophageal reflux disease.

39. Describe how confident you are about question 38:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

40. Justify your choice:
Partially digested food, presence of gastric juice, and time to vomiting suggest pyloric stenosis.

41. Present 2 differential or alternative diagnoses, different from those mentioned in question 38.
Esophageal cancer/esophagealconstriction
Gastric cancer
Pancreatic cancer

CASE 7: Carefully read the case below and, with the available information, answer questions 42-47.

A 28-year-old woman arrives at the emergency room carried by family members due to intense shortness of breath and loss of consciousness. He was fine until 4 hours ago when he started to have shortness of breath until he passed out. She was using antidepressants and contraceptives. She has never been pregnant, and her

last menstrual period was 7 days ago. On arrival, she was unresponsive to verbal stimuli, with increased respiratory (32 mpm) and heart rate (118 bpm), hypotensive (88/44 mmHg), and oxygen saturation was 84%. The lips were blue-colored. Cardiological and pulmonary examination showed no alteration.

42. Make a summary of the case without exceeding the 5 lines available:
A young woman was treated in an emergency room with acuteloss of consciousness after severe dyspnea, which had started 4 hours earlier. Using contraceptives and antidepressants. Drowsiness, tachypnea, tachycardia, hypotension, cyanosis, and hypoxemia.(Keywords underlined)

43. Which organ or system is affected? And what would be the clinical problem?
Respiratory system. Severe acute respiratory failure.

44. Select the central diagnostic hypothesis from the following (only one option):
a. Bacterial pneumonia. b. Viral pneumonia. c. Pulmonary embolism. d. Pulmonary tuberculosis. e. Anxiety crisis.

45. Describe how confident you are about question 44:
a. No confidence at all
b. Low confidence level
c. Neutral
d. High confidence level
e. Total confidence (No template for this question)

46. Justify your choice:
Acute and severe respiratory condition, rapid evolution, alteration of all vital signs.

47. Present 2 differential or alternative diagnoses different from those in question 44.
Pneumothorax
Pleural effusion
Pericardial effusion
Diabetic ketoacidosis
Exogenous intoxication