

Competency-Based Medical Education in Radiology: A Survey of Medical Student Perceptions

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Abstract

Purpose: Implementing competency-based medical education in diagnostic radiology residencies will change the paradigm of learning and assessment for residents. The objective of this study is to evaluate medical student perceptions of competency-based medical education in diagnostic radiology programs and how this may affect their decision to pursue a career in diagnostic radiology. **Methods:** First-, second-, and third-year medical students at a Canadian university were invited to complete a 14-question survey containing a mix of multiple choice, yes/no, Likert scale, and open-ended questions. This aimed to collect information on students' understanding and perceptions of competency-based medical education and how the transition to competency-based medical education would factor into their decision to enter a career in diagnostic radiology. **Results:** The survey was distributed to 300 medical students and received 63 responses (21%). Thirty-seven percent of students had an interest in pursuing diagnostic radiology that ranged from interested to committed and 46% reported an understanding of competency-based medical education and its learning approach. The implementation of competency-based medical education in diagnostic radiology programs was reported to be a positive factor by 70% of students and almost all reported that breaking down residency into measurable milestones and required case exposure was beneficial. **Conclusions:** This study demonstrates that medical students perceive competency-based medical education to be a beneficial change to diagnostic radiology residency programs. The changes accompanying the transition to competency-based medical education were favored by students and factored into their residency decision-making.

Résumé

Objectif: La mise en place du programme de formation médicale par compétences dans les résidences de radiologie diagnostique va modifier le paradigme relatif à l'apprentissage et à l'évaluation des résidents. L'objectif de cette étude était d'évaluer les perceptions des étudiants en médecine sur le programme de formation médicale par compétences en radiologie diagnostique ainsi que l'impact de ces appréciations sur leur décision de poursuivre une carrière dans cette discipline. **Méthodes :** Des étudiants en première, deuxième et troisième année de médecine dans une université canadienne ont été invités à répondre à un sondage composé de 14 questions constituées d'un mélange de questions à choix multiple, à réponse par oui ou par non, à réponse sur une échelle de type Likert ou à réponse libre. Le but était de recueillir des renseignements sur la compréhension et les perceptions des étudiants concernant le programme de formation médicale par compétences, ainsi que de recueillir des données sur l'impact que pourrait avoir la transition vers ce type de programme sur la décision de s'engager dans une carrière en radiologie diagnostique. **Résultats :** Le sondage a été distribué à 300 étudiants en médecine, parmi lesquels 63 ont répondu (21 %). 37 % des étudiants avaient un intérêt pour la poursuite d'une carrière en radiologie diagnostique (qui variait du simple intérêt à l'engagement envers une telle carrière) et 46 % déclaraient avoir une compréhension du programme de formation médicale par compétences et de son approche pédagogique. Les étudiants ont rapporté à 70 % que le déploiement de ce type de programme en radiologie diagnostique était un facteur positif et presque tous ont déclaré tirer avantage de la partition du programme de résidence en segments

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mesurables et du fait que ce programme exigeait l'exposition à des cas. **Conclusions :** Cette étude démontre que selon l'opinion des étudiants en médecine, le programme de formation médicale par compétences est un changement bénéfique pour le cursus de résidence en radiologie diagnostique. Les changements associés à la transition vers un tel programme ont été appuyés par les étudiants et ont joué un rôle dans leur choix de spécialité de résidence.

Keywords

competency-based medical education, diagnostic radiology, medical student perceptions, radiology residency

Introduction

Competency-based medical education (CBME) is a redesigned framework for postgraduate medical education (PGME) that emphasizes the acquisition of demonstrable competencies throughout residency.^{1,2} The traditional method of evaluating residents involves a cross-sectional and high-stakes assessment at the end of their training. However, recognizing that this offers a narrow gauge of residents' competencies, PGME programs have started to transition away from this model.^{1,3} Introducing CBME has shifted the focus of residency training from being time based to outcomes based and centered on developing the holistic skills of a physician that extend beyond medical expertise.⁴

In Canada, the implementation of CBME is being guided by the Royal College of Physicians and Surgeons of Canada's (RCPSC) competence by design framework.⁵ Competence by design divides residency into 4 stages: transition to discipline, foundations of discipline, core of discipline, and transition to practice. Progression between stages is based on the longitudinal and repeated demonstration of competence in entrustable professional activities (EPAs), such as interpreting radiological examinations and providing a differential diagnosis.⁶ These EPAs are divided into milestones—observable markers of a resident's performance in a given situation, such as making core imaging observations and differentiating normal from abnormal.^{6,7} In this new model, residents are assessed based on their ability to demonstrate the synthesis of knowledge, practical skills, and attitudes that they will need once they graduate.²

According to the RCPSC, all diagnostic radiology programs in Canada are expected to move to CBME by 2021, though only 1 program has already completed the transition.⁸ This will result in several changes to the delivery of postgraduate diagnostic radiology education, including increasing the frequency of assessments; moving certification examinations a year earlier, to allow more clinical time in the final year for the "transition to practice" stage; and introducing flexible teaching options to give residents exposure to chosen areas of interest. These changes, and the widespread implementation of CBME in general, may impact students' decisions to pursue certain residency programs. Understanding how medical students perceive CBME would be beneficial for PGME programs as they make this transition and start to engage incoming residents in this new model of training and assessment. The purpose of this study is to understand how CBME in diagnostic radiology residency programs is perceived by medical students and how these changes factor into their decision to pursue a career in diagnostic radiology.

Methods

An online survey was created using Google Forms. The survey was distributed by e-mail to approximately 300 first-, second-, and third-year undergraduate medical students at Queen's University School of Medicine. The invitation to participate was sent to students up to 3 times over a 4-week period. Students followed the link to a page that described the survey and informed consent was obtained before they could begin. Participation in the survey was voluntary and students' responses were anonymous. Data were collected from March 3, 2019, to April 1, 2019.

The survey contained a total of 14 questions, including a mix of multiple choice, yes/no, 5-point Likert scale, and open-ended questions (Appendix A). Input on the survey design was provided by the survey specialists from Centre for Teaching and Learning, Queen's University. Questions related to the respondents' demographics (gender, year of medical school, and highest degree obtained prior to medical school) were asked at the beginning of the survey to allow for subgroup analysis of the results. The remainder of the survey questions inquired about students' interest in pursuing a career in diagnostic radiology, their understanding of CBME, perceptions of how CBME influences their decision to pursue a diagnostic radiology residency, and concerns about its implementation.

Results

A total of 21% (63/300) of invited medical students responded to the survey and all completed the survey in its entirety. Demographic data of the respondents are presented in Table 1; 50.8% (32/63) of respondents were men and 49.2% (31/63) were women; 38.1% (24/63) of respondents were in their first year of medical school, 30.2% (19/63) were in their second year, and 31.7% (20/63) were in their third year; 11.1% (7/63) of respondents had not completed an undergraduate degree prior to starting medical school, 57.1% (36/63) had a bachelor's degree, 25.4% (16/63) had a master's degree, and 6.3% (4/63) had a PhD.

Interest in Diagnostic Radiology and CBME Among Medical Students

Survey respondents were asked to indicate their interest in pursuing diagnostic radiology as a residency program (Table 2). Of 63 students, 7.9% (5/63) indicated that they were "committed" to pursuing diagnostic radiology, 25.4% (16/63) were "interested," 15.9% (10/63) were "neutral," 30.2% (19/63) were "not very interested," and 20.6% (13/63) had "no interest at all."

Table 1. Demographics of First-, Second-, and Third-Year Medical Students Completing the Survey.

	n (%)
Gender	
Male	32 (50.8)
Female	31 (49.2)
Year of medical school	
First	24 (38.1)
Second	19 (30.2)
Third	20 (31.7)
Education	
No degree	7 (11.1)
Bachelor's	36 (57.1)
Master's	16 (25.4)
MBA	0 (0)
PhD	4 (6.3)

Table 2. Interest in Radiology Residency Programs.

	How Interested Are You in Pursuing Radiology as a Residency Program? n (%)
Committed	5 (7.9)
Interested	16 (25.4)
Neutral	10 (15.9)
Not very interested	19 (30.2)
No interest at all	13 (20.6)

Table 3. Students' Understanding of Competency-Based Medical Education.

	How Do You Feel About the Following Statement: I Understand the Learning Approach That CBME Seeks to Implement. n (%)
Strongly agree	3 (4.8)
Agree	26 (41.3)
Neutral	16 (25.4)
Disagree	17 (27.0)
Strongly disagree	1 (1.6)

In order to gauge students' understanding of CBME, respondents were asked to indicate the extent to which they agreed with the statement: "I understand the learning approach that CBME seeks to implement" (Table 3); 4.8% (3/63) of students strongly agreed with the statement, 41.3% (26/63) agreed, 25.4% (16/63) were neutral, 27% (17/63) disagreed, and 1.6% (1/63) strongly disagreed.

Perceptions of CBME in a Diagnostic Radiology Residency Program

Of all, 34.9% (22/63) of students indicated that the implementation of CBME in a diagnostic radiology residency program will factor into their decision-making and/or rank-order

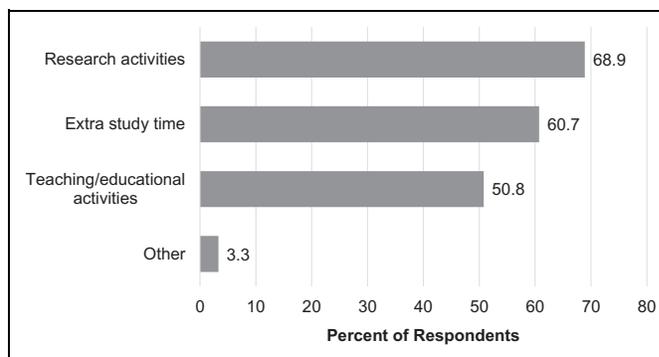


Figure 1. Responses to how students would use additional time for scholarly activities upon early completion of their program's requirements.

list, while the remaining 65.1% (41/63) of students indicated that this was not a factor. Students were then asked to indicate whether the implementation of CBME was a positive change for diagnostic radiology residency programs; 69.8% (44/63) of students surveyed responded "yes" to this question and 30.2% (19/63) responded "no". All but 1 student (98.4%; 62/63) indicated that breaking down residency training into measurable milestones and required case exposure seemed like a positive change.

The introduction of "mini-fellowships," an opportunity to gain more in-depth exposure to specific subspecialties within diagnostic radiology, was deemed to influence the decision to pursue diagnostic radiology by 77.8% (49/63) respondents, but not for the remaining 22.2% (14/63). When asked whether the increased frequency of assessments by preceptors, allied health-care professionals, and patients during residency appealed to students, 61.9% (39/63) responded "yes" and the remaining 38.1% (24/63) responded "no." Students were then asked to indicate whether the intended change to move the RCPSC licensing examination forward by 1 year positively influenced their decision to pursue a diagnostic radiology residency; 68.3% (43/63) of students responded "yes" and 31.7% (20/63) of students responded "no."

Upon meeting their program requirements, it is expected that CBME residency programs will afford residents additional time for scholarly activities. This additional time for research or other academic activities appealed to 95.2% (60/63) of survey respondents. Students who responded "yes" to this question were asked how they would spend the additional time, with options for "research," "extra study time," "teaching/educational activity," and "other." Responses are summarized in Figure 1.

In the final section of the survey, 14.3% (9/63) of respondents identified concerns with the implementation of CBME. In order of decreasing frequency, these concerns were the increased number of assessments, the potential for CBME to extend the length of residency, and new challenges with the administrative organization.

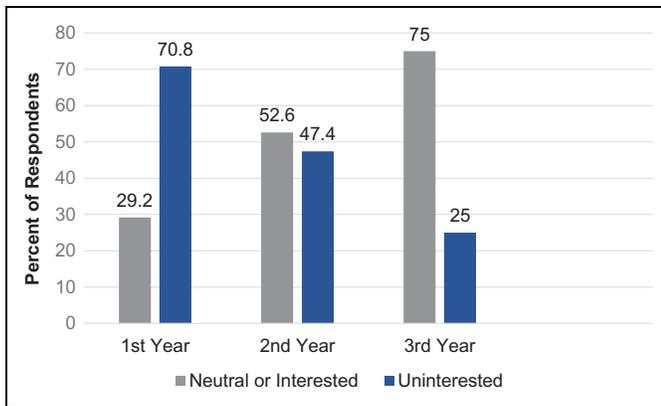


Figure 2. Student interest in pursuing radiology as a residency program. Neutral or interested includes students who responded “neutral,” “interested,” or “committed”; uninterested includes students who responded “not very interested” or “no interest at all.”

Interpreting Subgroup Perceptions of Diagnostic Radiology and CBME

Subgroup analyses revealed variations in the perceptions of diagnostic radiology programs and the implementation of CBME. When asked about their interest in pursuing radiology, 70.8% (17/24) of first-year students responded “no interest at all” or “not very interested,” 12.5% (3/24) responded “neutral,” and 16.7% (4/24) responded “interested” or “committed.” A trend was observed such that the same groups of responses were seen in 47.4% (9/19), 15.8% (3/19), and 36.8% (7/19) of second-year students, and in 25% (5/20), 15% (3/20), and 60% (12/20) of third-year students, respectively (Figure 2). Stratifying the responses to this question by gender revealed that only 25.8% (8/31) of female students responded “interested” or “committed,” while 46.9% (15/32) of male students chose the same responses.

Of the students whose interest in diagnostic radiology ranged from “interested” to “committed,” the implementation of CBME in a diagnostic radiology residency was considered to be a positive factor for 87% (20/23). In the group with little to no interest in diagnostic radiology, 51.6% (16/31) provided the same answer. When respondents were asked whether they understand the learning approach of CBME, 69% (20/29) of those who responded “agree” or “strongly agree” went on to say that the implementation of CBME was a positive change to diagnostic radiology residency programs. In contrast, of those who responded “disagree” or “strongly disagree,” 58.8% (10/17) subsequently agreed that CBME was a positive change.

For students uninterested in pursuing diagnostic radiology (responded “no interest at all” or “not very interested”), 99% (28/31) did not consider CBME in the program as a factor in their decision-making. However, when considering the advantages of CBME, many students in the same group changed their response. The introduction of “mini-fellowships” and the possibility of a shorter residency were reported as positive factors in the decisions of 71.0% (22/31) and 45.2% (14/31) of respondents, respectively.

Discussion

This is the first study to evaluate medical students’ understanding of CBME and how the implementation of CBME within a diagnostic radiology residency program may affect their decision to pursue this specialty. Of the students who responded to the survey, we found that 37% had an interest in diagnostic radiology that ranged from interested to committed. Stratifying the responses by cohort revealed that interest in diagnostic radiology increased as students progressed through their medical education. The proportion of students who responded “interested” or “committed” grew from 16.7% of first-year students to 60% of third-year students. This suggests that the increased exposure to diagnostic radiology that accompanies the progression through preclerkship and clerkship encourages interest in diagnostic radiology. Indeed, previous work has shown that early exposure to diagnostic radiology teaching and mentorship enhances student interest and consideration of diagnostic radiology as a career choice.⁹ However, in many medical schools, students have little opportunity to interact with radiologists and gain diagnostic radiology experience until their clerkship years, by which point they have often shortlisted other specialties. To address this, many schools have started to facilitate greater exposure to diagnostic radiology by introducing core radiology concepts in preclerkship, interest group-led teaching, and mentorship around diagnostic radiology as a career and residency applications.^{10,11}

When stratified by gender, 26% of female students reported an interest that ranged from “interested” to “committed.” This differed markedly from their male peers, 47% of whom chose the same responses. This is in agreement with a previous study by the Association of American Medical Colleges which found that only 26% of female fourth-year medical students selected diagnostic radiology as a specialty, and it was ranked eleventh overall by women, compared to fifth overall by men.¹²

Overall, we found that 33.3% of respondents agreed that they understand the CBME learning approach, which did not vary significantly by year. However, a pattern emerged when survey responses were stratified by interest in pursuing diagnostic radiology; 69% of students whose response to the statement about understanding CBME ranged from “agree” to “strongly agree” subsequently agreed that CBME was a positive change for diagnostic radiology programs. This proportion decreased to 58.8% for those who disagreed or strongly disagreed with the statement. Thus, the lack of a formal introduction to CBME leads students to independently learn about the topic and influences their perception of how CBME may impact their residency experience. Here, the lack of familiarity with CBME may have affected students’ subsequent answers to the survey.

The advent of CBME brings with it a new method of assessment, progression through residency, and opportunities for developing competency. Indeed, 35% of students indicated that CBME in a residency program would factor into their decision-making and/or rank list and 70% indicated it to be a positive change for diagnostic radiology residency programs. The proportion of students indicating it to be a positive change was even greater for those who had initially reported an interest in

pursuing diagnostic radiology. Thus, this emphasizes the importance of teaching medical students about CBME early so that their residency decision is well informed. Almost all students agreed that breaking down residency into measurable milestones and required case exposure was a positive change, suggesting that more students may view CBME as a positive change, given accurate information about the learning approach.

The majority of students surveyed were also in favor of the opportunity to pursue mini-fellowships throughout residency, the increased frequency of assessments, and the possibility of moving the licensing examination forward by up to 1 year. For those students who were interested in pursuing additional scholarly activities throughout residency, the majority favored conducting research, followed closely by extra studying, and then teaching and educational activities.

Although these results speak favorably of the implementation of CBME in diagnostic radiology residency programs, concerns were raised by the survey respondents. These pertained mostly to the increased frequency of assessments that is a hallmark of CBME, the possibility of extending one's residency if milestones are not accomplished in the intended time frame, and the additional administrative burden that accompanies a more assessment-intensive program. Although these concerns were repeated by a number of respondents, it is possible that addressing misconceptions about CBME could clarify many of these concerns.

The perceptions of CBME highlighted by medical students in this study echo the limited research done on this topic in the past.¹³ Using several metrics to gauge perceptions and attitudes, this survey demonstrates that medical students have a positive perception of CBME and its impact on diagnostic radiology residency programs. However, room exists for formal education to be introduced at an early stage in medical school in order to outline the structure of CBME and its components. Introducing this early would have the advantage of shaping students' perceptions of CBME. For example, reframing the changes to assessment as more frequent opportunities for feedback may encourage students to perceive them as opportunities to improve their own skills. For interested students, more specialty-specific guidance should be offered to understand how CBME is integrated into their specialty of choice. As this survey demonstrates, this has the potential to markedly influence students' residency choices and, ultimately, their career path. Indeed, for students who indicated that they had little to no interest in diagnostic radiology, the possibility of pursuing mini-fellowships was still considered to be positive factors in many students' decision-making. This highlights the important role that medical education has in guiding students' understanding of CBME and residency, since this will ultimately be a crucial factor in their perceptions of different programs.

There are multiple limitations to our study. The survey was distributed to medical students at one school. The school's affiliation with a large, tertiary care center and the teaching of diagnostic radiology throughout the preclerkship and clerkship curricula may influence students' perceptions of

diagnostic radiology and their understanding of CBME. The survey response rate was also low (21%), so it does not capture the attitudes of all medical students at this school. It would be interesting to note any changes in perception, if a presurvey CBME tutorial was provided to the medical students. Further work in this area would benefit from surveying a larger number of medical students as well as medical students at a larger number of Canadian medical schools, to further evaluate the perceptions that accompany the transition to CBME.

Conclusions

This study demonstrates that medical students largely have positive perceptions of CBME being incorporated into diagnostic radiology residency programs in Canada. Competency-based medical education may draw increased interest for medical students to pursue diagnostic radiology, which is attributable to its integrated learning approach and clarity in required milestones for each respective postgraduate year. Our findings suggest that medical students would likely benefit from an early introduction of CBME teaching model to understand its application in diagnostic radiology training.

Appendix A

Question 1

What year of medical school are you in?

- First year
- Second year
- Third year

Question 2

What is your gender?

- Female
- Male
- Other

Question 3

What is the highest degree that you've obtained prior to medical school?

- No degree
- Bachelor's
- Master's
- MBA
- PhD

Question 4

How interested are you in pursuing radiology as a residency program?

- No interest at all
- Not very interested
- Neutral
- Interested
- Committed

Question 5

How do you feel about the following statement: I understand the learning approach that CBME seeks to implement.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Question 6

Does CBME in a radiology residency factor into your decision-making/rank list?

- Yes
- No

Question 7

Does the implementation of CBME factor positively for a radiology residency?

- Yes
- No

Question 8

Does the idea of breaking down residency training into measurable milestones and required case exposure seem like a positive change (eg, a PGY-2 resident must be able to identify pneumonia on a chest X-ray)?

- Yes
- No

Question 9

CBME may introduce “mini-fellowships,” an opportunity for you to gain more in-depth exposure to specific subspecialties within radiology. Would this opportunity influence your decision?

- Yes
- No

Question 10

CBME may increase the frequency of assessment by preceptors, allied health-care professionals, and/or patients during the residency training. Does this appeal to you?

- Yes
- No

Question 11

Moving up the Royal College licensing examination by approximately 1 year is a goal of CBME. Is this a factor that positively influences your decision to go into a CBME radiology program?

- Yes
- No

Question 12

Does the idea of extra time for research or other academic activities (upon meeting CBME requirements ahead of time) appeal to you?

- Yes
- No

Question 13

If you answered yes to the above question, how would you like to use this time? Check all that apply.

- Research activities
- Extra study time
- Teaching/educational activity
- Other

Question 14

Do you have any concerns about implementing CBME into radiology residency training? (Free text)

Authors' Note

Joseph Yang and Danny Jomaa contributed equally to the study. This study was reviewed and approved by the Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board.

Declaration of Conflicting Interests

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References

1. Veale P, Busche K, Touchie C, Coderre S, McLaughlin K. Choosing our own pathway to competency-based undergraduate medical education. *Acad Med.* 2019;94(1):25-30. doi:10.1097/ACM.0000000000002410.
2. Frank JR, Snell LS, Cate OT, et al. Competency-based medical education: theory to practice. *Med Teach.* 2010;32(8):638-645. doi:10.3109/0142159X.2010.501190.
3. Hodges B. Assessment in the post-psychometric era: learning to love the subjective and collective. *Med Teach.* 2013;35(7):564-568. doi:10.3109/0142159X.2013.789134.
4. Albanese MA, Mejicano G, Mullan P, Kokotailo P, Gruppen L. Defining characteristics of educational competencies. *Med Educ.* 2008;42(3):248-255. doi:10.1111/j.1365-2923.2007.02996.x.
5. Competence by Design. The Royal College of Physicians and Surgeons of Canada; 2014. www.royalcollege.ca/rcsite/.../royal-college-competency-by-design-ebook-e.pdf. Accessed March 17, 2019.

6. Deitte LA, Gordon LL, Zimmerman RD, et al. Entrustable professional activities: ten things radiologists do. *Acad Radiol.* 2016; 23(3):374-381. doi:10.1016/j.acra.2015.11.010.
7. Ten Cate O, Chen HC, Hoff RG, Peters H, Bok H, van der Schaaf M. Curriculum development for the workplace using Entrustable Professional Activities (EPAs): AMEE Guide No. 99. *Med Teach.* 2015;37(11):983-1002. doi:10.3109/0142159X.2015.1060308.
8. Competence by Design (CBD) Cohort Roll Out Plan. The Royal College of Physicians and Surgeons of Canada; 2018. www.royalcollege.ca/rcsite/documents/icre/2018-07-16-cohort-roll-out-revised-e.pdf. Accessed March 17, 2019.
9. Branstetter BFt, Faix LE, Humphrey AL, Schumann JB. Preclinical medical student training in radiology: the effect of early exposure. *AJR Am J Roentgenol.* 2007;188(1):W9-W14. doi:10.2214/AJR.05.2139.
10. Taylor CS, Weatherly B, Farley EP, Clemons MP, Watts J, Vijayakumar V. Generating medical student interest in the field of radiology. *J Am Coll Radiol.* 2018;15(2):340-342. doi:10.1016/j.jacr.2017.08.018.
11. Kraft M, Sayfie A, Klein K, Gruppen L, Quint L. Introducing first-year medical students to radiology: implementation and impact. *Acad Radiol.* 2018;25(6):780-788. doi:10.1016/j.acra.2018.02.002.
12. Ram R, Jumper H, Lensing SY, Tang J-L, Deloney LA, Kenney PJ. Understanding gender differences among medical students when choosing radiology as a medical specialty. *Acad Radiol.* 2018;25(10):1353-1358. doi:10.1016/j.acra.2018.04.001.
13. Dehmoobad Sharifabadi A, Clarkin C, Doja A. Perceptions of competency-based medical education from medical student discussion forums. *Med Educ.* 2019;53(7):666-676. doi:10.1111/medu.13803.