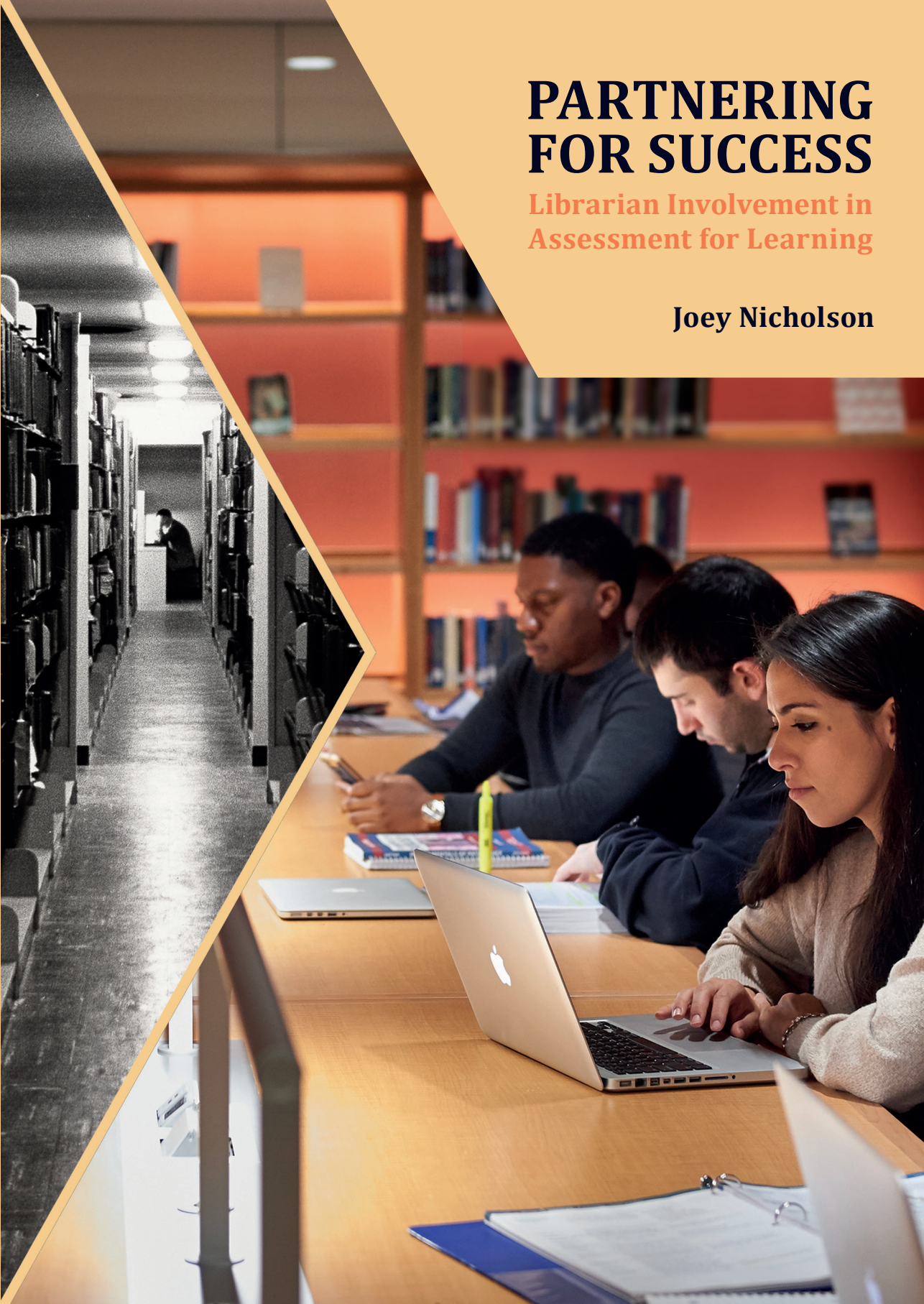
Partnering for success



PARTNERING FOR SUCCESS

Librarian Involvement in Assessment for Learning

Joey Nicholson

Partnering for Success

Librarian Involvement in Assessment for Learning

Joey Nicholson

The research reported here was carried out at Maastricht University | Maastricht UMC+

in the School of Health Professions Education

in the context of the research school (Interuniversity Center for Educational Research)

Partnering for Success: Librarian Involvement in Assessment for Learning

ISBN
978-94-6473-305-1

Cover, design/lay-out and print
Promotie In Zicht | www.promotie-inzicht.nl

Cover images courtesy of The Lillian and Clarence de la Chapelle Medical Archives at NYU Langone Health.

Partnering for Success

Librarian Involvement in Assessment for Learning

Exploring implementation of librarian-led observational assessment of evidence-based medicine skills in medical students

DISSERTATION

to obtain the degree of Doctor at Maastricht University,
on the authority of the Rector Magnificus,
Prof. dr. Pamela Habibović
in accordance with the decision of the Board of Deans,
to be defended in public
on Wednesday 20 December 2023, at 16.00 hours

by

Joey Nicholson

Promotors
Prof. dr. A.B.H. de Bruin
Prof. dr. C. van der Vleuten

Co-Promotor
Prof. dr. A. Kalet (Professor of Medicine, Medical College of Wisconsin, USA)

Assessment Committee
Prof. dr. E.W. Driessen (Chair)
Dr. R.E. Stalmeijer (Maastricht University)
Dr. E.E. Brouwer (Maastricht University)
Prof. dr. L. Maggio (Uniformed Services University, USA)
Prof. dr. S. Jones (Medical University of South Carolina, USA)

Contents

1

Introduction

"Evidence-based medicine de-emphasizes intuition, unsystematic clinical experience and pathophysiologic rationale as sufficient grounds for clinical decision making and stresses the examination of evidence from clinical research. Evidence-based medicine requires new skills of the physician, including efficient literature searching and the application of formal rules of evidence evaluating the clinical literature."- Evidence-Based Medicine Working Group, 1992[1]

1. Evidence-Based Medicine Working Group. Evidence-based medicine. A new approach to teaching the practice of medicine. JAMA. 1992;268:2420-2425.

Evidence-Based Medicine

While evidence-based medicine (EBM) has been increasingly used over the past century, it wasn't formally defined until the early 1990's. Evidence-based medicine was initially coined as a phrase in a 1991 editorial by Guyatt.[1] Shortly thereafter in 1992, Guyatt and the Evidence-Based Medicine Working Group published their landmark paper outlining the rules, requirements, and best practices.[2] These starting principles continue to evolve in 2000 to also incorporate a more explicit focus on patient values and preferences.[3]

EBM is an essential component of practicing medicine effectively.[4,5] Through rigorously finding and evaluating scientific evidence, healthcare professionals are able to make informed decisions. Well-informed clinical decisions, based on reliable scientific evidence, are necessary to ensure safe and effective care for patients.[6] As new scientific publications continue to be produced at exponential rates, the ability to find and appraise the most relevant evidence grows more important.[7,8] For aspiring physicians, a thorough grounding in EBM during medical school will prepare them to be better able to navigate the rapid pace of discovery and adapt to advancements.[9] Ultimately, EBM as an exercise in lifelong learning and continuous improvement should begin in medical school and be reinforced throughout practice. This will help to create and maintain physicians that are able to consistently provide high-quality and safe healthcare. To achieve this end result, interprofessional teams will need to work together to develop and implement best practices in teaching and assessment of EBM. To foreshadow, the aim of this dissertation is to explore how librarians, as primary teachers of EBM for medical students, can lead assessment of EBM competence in partnership with medical educators.

The five steps of EBM are typically listed as: Ask, Acquire, Appraise, Apply, and Assess.[5] Ask refers to asking the most relevant question to help solve the patient problem at hand. Acquire focuses on conducting an efficient search to find the best evidence. Appraise refers to examining the studies and critically appraising them to determine their validity. Apply requires clinicians to incorporate patient values and preferences along with the highest quality evidence available to solve the patient problem. And finally assess refers to assessing one's own ability to perform this set of steps effectively, and incorporating any improvements necessary to get better.

Through these five steps, EBM should help guide clinical decision-making,[3,6,10] increase efficiency in healthcare delivery,[9,11] and improve patient outcomes.[12,13] However, to achieve these goals EBM must be learned and practiced effectively. A crucial element in supporting learning is implementing a comprehensive and multi-faceted approach to assessment. Not only does a programmatic approach

provide targeted feedback and encourage learner self-development, but it also provides a unique opportunity for educators to better tailor instruction and continuously improve their instructional efforts.[14-18]

In the case of EBM, there are seven primary assessment categories: reaction to the EBM educational/assessment experience; attitude; self-efficacy; knowledge; skill; behavior; and patient benefit. These levels of assessment build on each other and it is important to understand, for instance, that without self-efficacy a learner will not be able to demonstrate the skill, and so forth. Most of these categories have multiple possible validated tools that an EBM educator could use. Within this categorization framework, there are some known gaps. There are many surveys about attitude and self-efficacy. There are many multiple-choice tests to assess knowledge.[19-21] There are a handful of written performance assessments to assess skills.[22-24] But there are three under-represented categories: learner reaction to the educational experience, behaviors, and patient benefit.

Learner reaction to the EBM educational experience is most often assessed through quick evaluations at the end of a teaching session. In this format, medical students are reacting to the teaching session as a learning experience. However, assessment and not just teaching can also be used for learning, and learner feedback should be pursued about their assessment experiences as well. Incorporating medical student feedback about how they are being assessed can help inform revisions to better meet the learning needs of students.

For actual behaviors, the ability to implement this combination of skills and knowledge in practice, there have been few successful efforts.[25] A handful of OSCEs or computer-based formats for assessing EBM have been developed, but ultimately these land on assessing skills as evidenced by the outcome, not observing behaviors and providing actionable feedback to learners.[25-33] Finding an effective way to monitor behaviors and provide feedback using a competency-based rubric is the current gap in developing impactful effective assessment of EBM. Patient benefit is the ultimate goal of thorough practice of EBM, as evidenced through better patient outcomes following documented EBM practice. However, we need to first fully understand how to assess and provide feedback on EBM behaviors.

Observational Assessment in Medical Education

Observation is a valuable method to evaluate learner skills, behaviors, and performance in real-time or simulated settings. It involves watching learners, either live or recorded, as they engage in a task. Using this approach allows the educator to see how well the taught knowledge and skills are implemented as a cohesive set of actions and behaviors. This provides an opportunity to offer learners individualized and actionable feedback. Furthermore, it provides educators with directly observed evidence of the impact of their instruction, guiding further initiatives and continuous quality improvement of their own practices.

Objective Structured Clinical Examinations (OSCEs) are a widely utilized format for observing performance and providing feedback on competence. OSCEs were first used in medical education in the late 1970s by Harden and Gleeson.[34] Initially they were seeking to address concerns about validity of traditional exams for clinical competence, which lacked standardized procedures and objective assessment criteria. Pioneering this observational format allowed them to introduce a set of stations where performance of specific clinical skills would be assessed using a predefined checklist or rating scale, allowing for better standardization and enhanced objectivity. This is especially valuable for integrated sets of behaviors that are not simply reliant on knowledge or skill alone, such as clinical reasoning, communication skills, or EBM.[35,36]

Observational assessment, like an OSCE, is an assessment format that enables educators to meet the unique needs of each learner. It is pivotal for learners to have this opportunity to practice and receive feedback on their behaviors in order to improve. Indeed, learners are integral to the assessment process.

In 2016, the New York Simulation Center (NYSIM), in collaboration with NYU Grossman School of Medicine (NYUGSM), began development of Night onCall (NOC), a multi-case, immersive, simulation-based, readiness-for-internship OSCE.[37] This OSCE is designed to provide a medical student with benchmarked scores across the AAMC's 13 Core Entrustable Professional Activities (EPAs), including EBM (EPA 7).[38] In the EBM station, a health sciences librarian remotely observes and rates the medical student's patient-specific clinical question formulation and literature-based evidence search strategy, see Box 1 for more details. As of 2023, NOC has since been rolled out to ten US medical schools as part of a consortium funded in part by the Josiah Macy Jr. Foundation. Students completing NOC receive a comprehensive written report on their performance organized by competency and EPA

Box 1 Description of EBM OSCE Process in NOC

Seeing a Patient: First, the learner is paged to see their third case, a standardized patient presenting with very high blood pressure and complaining of a headache. Upon entering the room, the learner interacts with both a standardized nurse and a standardized patient to get more details about the patient's history, their important vital signs, and their chief complaint.
Station Setup: After learning about the patient, the learner has 10 minutes to formulate a clinical question and answer it by using whatever sources they choose on the Internet. The computer screen on which they perform this activity is recorded.
Asking a Question: Upon first sitting down at a computer outside the patient room, the learner is first presented with a screen asking them to state the most pertinent and answerable clinical question that they will need to address in order to help this patient.
Searching for Evidence: After entering the question they believe is the most pertinent, they are given a question determined by clinicians to be the most important to answer first: "In a patient with hypertensive urgency, what is the safest management strategy?" They are then instructed to open a new browser tab and begin their search for evidence. They are not instructed to use any specific sources and are assessed on how they perform the most important aspects of a search for evidence.
Assessing EBM via Observation: Screen recordings are observed by a trained health sciences librarian via a video, either live while the learner is performing the task or in a recording. Librarians use a theory-informed and behaviorally-anchored rubric to assess and provide feedback on specific behaviors identified as important in the search process.

To conduct observational assessment, one must first be able to break down the behaviors into observable and meaningful parts. For EBM, some of these parts can be observed naturally. Asking a question has a clear outcome, a well-formed and relevant clinical question. Applying evidence found to a clinical scenario manifests in a treatment plan. It is the two steps between asking a question and applying evidence, acquiring evidence and appraising that evidence, that are most often hidden from sight and done as a solo activity. Yet, these are important behaviors within EBM that require practice and feedback in order to improve. Creating a rubric grounded in theory and tailored to the independent performance of these steps would enable critical observation-based feedback. Once a rubric

has been established and tested, ensuring that medical students have a voice in implementation, including frequency and timing, will be essential for long-term success.

Optimal Foraging Theory

Foraging Theory, also referred to as Optimal Foraging Theory or Information Foraging Theory, is one approach to understanding and describing strategies used for information seeking and application.[39,40] This theory originally comes from evolutionary ecology, where it was used to answer the question: among hunter-gatherers or animal foragers, what factors are behind the diversity of individual actions that enable foraging success. For any given population, the answer to this question can then be used to assess behaviors in typical environments and predict which behaviors are more adaptive and lead to greater success.

Foraging theory began to be examined in library and information science in the 90s initially by Sandstrom.[39] As refined by Pirolli and Card,[41] the theory assumes that people will modify their approach within an environment in order to maximize their rate of gaining valuable information. The environment, in this case, is the modern information landscape replete with many different sources of information, ranging from well-researched to anecdotal to ill-informed. As information sources continue to proliferate, navigating this landscape requires a certain set of learned behaviors in order to be consistently successful. This information landscape is analogous to patches of food. Some patches will be robust and have lots of nutritious food, requiring less time to fulfill the biological need. Other patches will be barren and require more time and more difficult foraging in order to supply any nutrition. A goal for foragers, of both food and information, is to maximize their gains while minimizing their effort.

Three defining concepts of information foraging are: information patch models; information scent models; and information diet models. Information patch models relate to time spent and information searching and filtering activities within one patch. Or, how efficiently does someone spend their time searching within a specific database and using features of that database to get closer to their information need. Information scent models refer to how an information seeker uses clues to identify the value of information presented to them. Or, how effectively does a searcher utilize clues like key words in the title, subject headings, or study design type to identify relevant information. And lastly, information diet models involve what information objects are actually selected at the end result of a foraging session. Or, how accurately does a searcher find just the right article or piece of evidence to answer their question at hand.

Information foraging theory as a theoretical framework has been used to describe and understand the information-seeking patterns of practicing clinicians in order to provide adaptive solutions to information overload.[42,43] Proposed solutions to information overload range from implementing a librarian-led literature search service, [44] leveraging artificial intelligence to design better health information technology solutions, [45] or implementing training for EBM.[46,47] An unexplored opportunity thus far is to use information foraging theory to help create behavior-based rubrics that assess and provide feedback to learners on their own information foraging ability within the context of the EBM steps acquire and appraise.

Librarian Roles in Medical Education

Medical librarians have supported education and helped navigate complicated information sources for centuries. There is evidence of organized medical information in libraries as far back as the library of King Assurbanipal of Assyria in Nineveh, with clay tablets dating to 2000 B.C.[48] More recognizable medical libraries came into existence in the 1500s with the development of scientific society libraries and book circulation clubs.[49] But, the modern medical library and librarian in the United States really began to take shape after 1940. In this era, the U.S. National Library of Medicine was formalized and the AMA Council on Medical Education recommended inspections to enforce standards for information use and access in hospitals and medical schools.[49,50] The Medical Library Association began to help define and differentiate the roles and responsibilities of a medical librarian when it began credentialing in 1949.[51,52]

In these contexts, the traditional role of a medical librarian was that of someone who was able to collect, organize, and provide access to valuable information. The role of the medical librarian today has grown and changed, owing in large part the enormous growth of publications and the democratization of information access over the Internet.[53,54] One role of medical librarians in the U.S. is that of teaching faculty, integrated into medical school curriculum development and design for EBM. In this modern role, librarians work alone or collaborate to provide instruction sessions on EBM and assess medical student ability to effectively practice this set of behaviors.

Despite being tasked with teaching EBM, medical librarians are less often the evaluators of this set of behaviors. There is an opportunity here to align both teaching and assessment of EBM as a part of one role, and incorporate this fully into existing curricula.

Dissertation Outline

To better understand the role of the librarian in EBM, this thesis answers the research question *How is evidence-based medicine competency assessment implemented by librarians and experienced by medical students*?
This over-arching research question is informed by four subordinate research questions:
What is the level of engagement of US and Canadian health sciences librarians in teaching and assessing EBM (using the elements of Entrustable Professional Activity (EPA) 7 as a proxy)? (Chapter 2)
What are the observable information-seeking behaviors of senior medical students performing an EBM activity? (Chapter 3)
What are the needs and preferences of librarians when assessing EBM behaviors in medical students via observation using a competency-based rubric? (Chapter 4)
How do graduating medical students feel about being assessed on EBM behaviors via observation? (Chapter 5)

Reflexivity

This research project originated as I began to develop my own professional identity as a medical librarian, embedded in a medical school curriculum, and feeling like a fish out of water. My experience felt like an uphill climb, where many encouraged collaboration and participation, but they did not have the resources, tools, or expertise to support my climb. The experiences I had as a librarian both teaching EBM and attempting to advocate for any kind of formal EBM assessment influenced data collection, analytical process, and evolution of the research trajectory.

It is my hope that through this thesis I will be able to make the case that there is an assessment gap in medical student education for EBM that should be filled by medical librarians. This gap could be bridged by providing medical librarians a theory-based rubric that can be used to observe and assess performed behaviors of EBM. Librarians themselves must delineate the support they need from their institutions in order to provide observational assessment of EBM for medical students. And finally, that this type of observational assessment of EBM performed by librarians is seen as valuable to the medical students in refining and improving their skills as they get ready to begin practice.

Chapter 2 – Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students
Published as "Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students",[55] this study aimed to investigate the involvement of health sciences librarians in teaching and assessing Entrustable Professional Activity 7 (EPA 7), related to clinical question formation and evidence retrieval. We conducted a survey among Association of Academic Health Sciences Libraries (AAHSL) member libraries to assess librarian awareness of and engagement in teaching and assessing EPA 7. This paper establishes gaps in assessment practices and opportunities for enhanced collaboration.

Chapter 3 – Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation
Published as "Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation",[56] this study aimed to examine the evidence-based medicine practices of medical students in seeking answers to clinical scenarios. We used the framework of Optimal Foraging Theory (OFT) to understand their information-seeking patterns and determine the effectiveness and efficiency of different methods. Applying OFT to medical student performance on EBM tasks informed creation of a theory-based rubric to assess observed behaviors.

Chapter 4 – Librarian-led assessment of medical students' evidence-based medicine competency: facilitators and barriers
This study aimed to explore the integration of librarians, who are experts in evidence-based medicine (EBM), into the assessment of medical students' EBM competence. Fifteen librarians were trained as raters for an immersive multi-station OSCE called Night onCall, which assessed medical student readiness for residency. After the experience, focus groups were conducted to gather librarians' perceptions of assessing medical students using this format and how they could implement similar assessments at their institutions. This paper uncovers the many different kinds of barriers to assessing EBM and explores some possible solutions.

Chapter 5 – "That's definitely gonna be important" medical student perspectives on a simulation-based evidence-based medicine competency assessment
This study aims to explore medical students' perceptions of receiving feedback on evidence-based medicine (EBM) competence through participation in Night

onCall. Graduating medical students from one medical school were interviewed to understand their experiences and interactions with the simulation-based assessment of EBM competence. This paper provides insights into the needs and preferences of medical students who are about to enter residency and guides implementation in ways that students feel could be more effective for learning.

Chapter 6 – General discussion

This chapter integrates the findings from the studies that comprise this dissertation and summarizes how they contribute to EBM assessment. The implications of this work including potential barriers to implementation, are described to guide practitioners of and future researchers on EBM assessment.

References

1. Guyatt G. Evidence-based Medicine. ACP J. Club. 1991;March/April.
2. Evidence-Based Medicine Working Group. Evidence-based medicine. A new approach to teaching the practice of medicine. JAMA. 1992;268:2420-2425.
3. Guyatt GH, Haynes R, Jaeschke RZ, et al. Evidence-based medicine: Principles for applying the users' guides to patient care. JAMA. 2000;284(1290):R9.
4. Swanson JA, Schmitz D, Chung KC. How to practice evidence-based medicine. Plast. Reconstr. Surg. 2010;126(1):286-294.
5. Straus SE, Glasziou P, Richardson WS, Haynes RB. Evidence-based medicine E-book: How to practice and teach EBM: Elsevier Health Sciences; 2018.
6. Chow N, Gallo L, Busse JW. Evidence-based medicine and precision medicine: Complementary approaches to clinical decision-making. Precision Clinical Medicine. 2018;1(2):60-64.
7. Steen RG. Retractions in the scientific literature: is the incidence of research fraud increasing? J. Med. Ethics. 2011;37(4):249-253.
8. Larsen P, Von Ins M. The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index. Scientometrics. 2010;84(3):575-603.
9. Djulbegovic B, Guyatt GH. Progress in evidence-based medicine: a quarter century on. Lancet. 2017;390(10092):415-423.
10. Phillips RS, Vaarwerk B, Morgan JE. Using Evidence-Based Medicine to Support Clinical Decision-Making in RMS. Cancers (Basel). 2022;15(1):66.
11. Shortell SM, Rundall TG, Hsu J. Improving patient care by linking evidence-based medicine and evidence-based management. JAMA. 2007;298(6):673-676.
12. Montori VM, Brito JP, Murad MH. The optimal practice of evidence-based medicine: incorporating patient preferences in practice guidelines. JAMA. 2013;310(23):2503-2504.
13. Leape LL, Berwick DM, Bates DW. What practices will most improve safety?: evidence-based medicine meets patient safety. JAMA. 2002;288(4):501-507.
14. Preston R, Gratani M, Owens K, Roche P, Zimanyi M, Malau-Aduli B. Exploring the Impact of Assessment on Medical Students' Learning. Assessment & Evaluation in Higher Education. 2020;45(1):109-124.
15. Norcini J, Anderson MB, Bollela V, et al. 2018 Consensus framework for good assessment. Med. Teach. 2018;40(11):1102-1109.
16. Van Der Vleuten CP, Schuwirth L, Driessen E, Govaerts M, Heeneman S. Twelve tips for programmatic assessment. Med. Teach. 2015;37(7):641-646.
17. Dijkstra J, Galbraith R, Hodges BD, et al. Expert validation of fit-for-purpose guidelines for designing programmes of assessment. BMC Med. Educ. 2012;12(1):1-8.
18. van der Vleuten CP, Schuwirth LW, Driessen EW, et al. A model for programmatic assessment fit for purpose. Med. Teach. 2012;34(3):205-214.
19. Buljan I, Jeroncic A, Malicki M, Marusic M, Marusic A. How to choose an evidence-based medicine knowledge test for medical students? Comparison of three knowledge measures. BMC Med. Educ. 2018;18(1):290.
20. Ilic D. Assessing competency in Evidence Based Practice: strengths and limitations of current tools in practice. BMC Med. Educ. 2009;9:53.
21. Fritsche L, Greenhalgh T, Falck-Ytter Y, Neumayer HH, Kunz R. Do short courses in evidence based medicine improve knowledge and skills? Validation of Berlin questionnaire and before and after study of courses in evidence based medicine. BMJ. 2002;325(7376):1338-1341.
22. Smith AB, Semler L, Rehman EA, et al. A Cross-Sectional Study of Medical Student Knowledge of Evidence-Based Medicine as Measured by the Fresno Test of Evidence-Based Medicine. J. Emerg. Med. 2016;50(5):759-764.
23. Kenney A, Yu C, Sena A, Ghafoor N, Moffett S. Comparison of two validated evidence-based medicine assessments: Do they correlate? AEM Educ Train. 2022;6(6):e10831.

24. Ramos KD, Schafer S, Tracz SM. Validation of the Fresno test of competence in evidence based medicine. BMJ. 2003;326(7384):319-321.

25. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.

26. Kumaravel B, Stewart C, Ilic D. Development and evaluation of a spiral model of assessing EBM competency using OSCEs in undergraduate medical education. BMC Med. Educ. 2021;21(1):204.

27. Tudiver F, Rose D, Banks B, Pfortmiller D. Reliability and validity testing of an evidence-based medicine OSCE station. Fam. Med. 2009;41(2):89-91.

28. Bradley P, Humphris G. Assessing the ability of medical students to apply evidence in practice: the potential of the OSCE. Med. Educ. 1999;33(11):815-817.

29. Amini R, Hernandez NC, Keim SM, Gordon PR. Using standardized patients to evaluate medical students' evidence-based medicine skills. J. Evid. Based Med. 2016;9(1):38-42.

30. Yazbeck Karam V, Park YS, Tekian A, Youssef N. Evaluating the validity evidence of an OSCE: results from a new medical school. BMC Med. Educ. 2018;18(1):313.

31. Davidson RA, Duerson M, Romrell L, Pauly R, Watson RT. Evaluating evidence-based medicine skills during a performance-based examination. Acad. Med. 2004;79(3):272-275.

32. Frohna JG, Gruppen LD, Fliegel JE, Mangrulkar RS. Development of an evaluation of medical student competence in evidence-based medicine using a computer-based OSCE station. Teach. Learn. Med. 2006;18(3):267-272.

33. Fliegel JE, Frohna JG, Mangrulkar RS. A computer-based OSCE station to measure competence in evidence-based medicine skills in medical students. Acad. Med. 2002;77(11):1157-1158.

34. Harden RM, Gleeson F. Assessment of clinical competence using an objective structured clinical examination (OSCE). Med. Educ. 1979;13(1):39-54.

35. Harden RM, Lilley P, Patricio M. The Definitive Guide to the OSCE: The Objective Structured Clinical Examination as a performance assessment: Elsevier Health Sciences; 2015.

36. Khan KZ, Ramachandran S, Gaunt K, Pushkar P. The objective structured clinical examination (OSCE): AMEE guide no. 81. Part I: an historical and theoretical perspective. Med. Teach. 2013;35(9):e1437-e1446.

37. Kalet A, Zabar S, Szyld D, et al. A simulated "Night-onCall" to assess and address the readiness-for-internship of transitioning medical students. Adv Simul (Lond). 2017;2:13.

38. Association of American Medical Colleges. Core Entrustable Professional Activities for Entering Residency: Faculty and Learners' Guide. Washington, D.C.: AAMC; 2014.

39. Sandstrom PE. An Optimal Foraging Approach to Information-Seeking and Use. Library Quarterly. 1994;64(4):414-449.

40. Pirolli P, Card S. Information foraging. Psychol. Rev. 1999;106(4):643-675.

41. Pirolli P. Information foraging theory : adaptive interaction with information. Oxford: Oxford University Press; 2007.

42. Dwairy M, Dowell AC, Stahl J-C. The application of foraging theory to the information searching behaviour of general practitioners. BMC Fam. Pract. 2011;12(1):90.

43. Dwairy M. Foraging Theory Applied to Medical Information Searching2012.

44. Coumou HCH, Meijman FJ. How do primary care physicians seek answers to clinical questions? A literature review. J. Med. Libr. Assoc. 2006;94(1):55-60.

45. Kannampallil TG, Franklin A, Mishra R, Almoosa KF, Cohen T, Patel VL. Understanding the nature of information seeking behavior in critical care: Implications for the design of health information technology. Artif. Intell. Med. 2013;57(1):21-29.

46. Maggio LA. Educating physicians in evidence based medicine: current practices and curricular strategies. Perspect Med Educ. 2016;5(6):358-361.

47. Maggio LA, Cate OT, Irby DM, O'Brien BC. Designing evidence-based medicine training to optimize the transfer of skills from the classroom to clinical practice: applying the four component instructional design model. Acad. Med. 2015;90(11):1457-1461.

48. Birchette KP. The history of medical libraries from 2000 bC to 1900 aD. Bull. Med. Libr. Assoc. 1973;61(3):302.

49. Connor JJ. Medical Library History: A Survey of the Literature in Great Britain and North America. Libraries & Culture. 1989;24(4):459-474.
50. History of Accreditation of Medical Education Programs. JAMA. 1983;250(12):1502-1508.
51. Brodman E. Medical Librarianship. Public Health Reports (1896-1970). 1955;70(5):473-478.
52. Bell J. History of the Medical Library Association's credentialing program. Bull. Med. Libr. Assoc. 1996;84(3):320.
53. Maggio LA, Durieux N, Tannery NH. Librarians in Evidence-Based Medicine Curricula: A Qualitative Study of Librarian Roles, Training, and Desires for Future Development. Med. Ref. Serv. Q. 2015; 34(4):428-440.
54. Cooper ID, Crum JA. New activities and changing roles of health sciences librarians: a systematic review, 1990–2012. Journal of the Medical Library Association: JMLA. 2013;101(4):268.
55. Nicholson J, Spak JM, Kovar-Gough I, Lorbeer ER, Adams NE. Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students. BMC Med. Educ. 2019;19(1):330.
56. Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. J. Med. Libr. Assoc. 2020;108(2): 219-228.

2

Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students

This chapter is published as:
Nicholson J, Spak JM, Kovar-Gough I, Lorbeer ER, Adams NE. Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students. BMC medical education. 2019;19(1):330.

Structured Abstract

Background
This study was conducted to examine gaps and opportunities for involvement of librarians in medical education and patient care as well as improve the teaching and assessment of Entrustable Professional Activity 7 (EPA 7) -- the ability to form clinical questions and retrieve evidence to advance patient care.

Methods
The Association of Academic Health Sciences Libraries (AAHSL) Competency-Based Medical Education Task Force surveyed all AAHSL member libraries in October 2016 on health sciences librarian awareness and involvement in teaching and assessing EPA 7.

Results
The survey response rate was 54% (88/164 member libraries). While 90% (n=76) of respondents were regularly engaged in teaching or assessing aspects of EPA 7 only 34 (39%) were involved explicitly in a Core EPA 7 project, 44% (15/34) of these projects were librarian initiated.

Conclusions
Involvement in teaching and assessment of EPA 7 is an untapped opportunity for librarians to collaborate in medical education and patient care. Although librarians are already deeply involved in teaching and assessment of EPA 7 related knowledge, skills, and behaviors, further librarian collaboration can help bolster the planning or updating of existing curricula and assessments of this entrustable professional activity.

Background

The Association of American Medical Colleges (AAMC) introduced guidelines for Entrustable Professional Activities (EPAs) in 2014 as a way to operationalize competency-based medical education by defining core professional tasks that every medical student could be expected to perform independently upon graduation[1]. The AAMC's Core EPAs describe thirteen discrete tasks, ranging from gathering the patient history and performing a physical examination to identifying system failures. The EPA framework is being adopted at medical schools across the United States, including ten pilot institutions. Early data show that new residents' performance in the AAMC's Core EPAs is of variable quality, with residency program directors reporting poor performance in several of the 13 professional activities including EPA 7 [2,3].

EPA 7, the ability to form clinical questions and retrieve evidence to advance patient care, is a foundational EPA integral to the practice of evidence-based medicine (EBM). In addition to improving patient care, the ability to formulate questions and locate evidence is an essential skill for meeting lifelong learning goals [4,5]. Yet, the teaching and assessment of EPA 7 may be suboptimal for several reasons including: "sub-optimal role models, student lack of willingness to admit uncertainty, lack of clinical context, and difficulty mastering EBM skills" [6]. While the ability of trainees to demonstrate competence in EPA 7 is an expectation, the same cannot be said of medical schools' ability to provide comprehensive training and assessment of this EPA [6,7].

Academic health sciences librarians have a history of teaching and assessing these tasks as part of EBM training and are thus well-positioned to partner with other medical educators in addressing this EPA [8,9]. To better understand the teaching and assessment of EPA 7 by health sciences librarians and help guide curriculum reform, we conducted a survey to assess the current level of engagement of US and Canadian health sciences librarians and highlight gaps and opportunities for improvement in teaching and assessing EPA 7: *Form clinical questions and retrieve evidence to advance patient care*.

Methods

A task force of eleven academic health sciences librarians working in medical education curricula across all levels (undergraduate, graduate, and continuing) developed a survey, based on a previously published instrument [10] and informed by qualitative interviews with librarians and medical educators at two of the medical schools serving as pilot institutions for the AAMC's EPA project. The

Wilder Collaboration Factors Inventory also informed the survey questions [11]. Most questions on the survey allowed respondents to add qualitative comments. The survey was administered using Qualtrics™ hosted by Penn State University. After pilot-testing with a small group of health sciences librarians, the link to the survey was electronically distributed to directors of member libraries of the Association of Academic Health Sciences Libraries (AAHSL) (N=164) via the AAHSL discussion list. The President of AAHSL asked the directors to select the librarian who was most familiar with the library's curricular involvement in the undergraduate medical education program to complete the survey on behalf of the library between October 7 and October 28, 2016. The Michigan State University Institutional Review Board ruled that this survey was exempt from human subjects protection (IRB #x16-1165e; i052241). The survey is included in Supplemental Digital Appendix 1.

Survey responses were downloaded to Excel™. Data were cleaned by removing duplicate responses from the same institution and incomplete responses. Excel™ was used to calculate descriptive statistics. Qualitative data was examined to select representative quotes to support the descriptive statistics.

Results

Of the 164 member libraries, 88 institutions responded to the survey, a response rate of 54% which is an acceptable response rate for an electronic survey [12]. The survey contained branching items, and not all respondents replied to all questions, which accounts for varying response rates in the results. Table 1 provides a summary of the publicly available characteristics of responding institutions, reflecting the diversity of academic health sciences library types, sizes, librarian faculty status, and student class sizes.

How involved are libraries in EPAs generally, and EPA 7 in particular?

Of the 88 respondents, 33 (38%) stated that their library was working with their medical school to implement Core EPAs in the undergraduate medical curriculum and an additional two libraries responded that they were independently working on a Core EPA project. A greater number of respondents (n=53, 60%), however, were either: unsure whether Core EPAs were being implemented at the institution at all, not involved in existing EPA projects, or at institutions in which no EPA work was being done.

Of those libraries who were involved in working on Core EPA focused projects (n=35, 40%), libraries were most frequently engaged in projects addressing EPA 7: Form clinical questions and retrieve evidence to advance patient care (n=34,

Table 1 Publicly Available Characteristics of Responder Institutions (n = 88), Association of Academic Health Sciences Libraries Annual Statistics 2016

Characteristic	Public Universities (n = 52)	Private Universities (n = 36)
Number of Librarians (%)		
0-10	24 (36)	14 (39)
11-20	18 (45)	19 (53)
21-30	3 (6)	2 (5)
Unknown	7 (13)	1 (3)
Librarian Faculty Status (%)		
Yes	36 (69)	6 (17)
No	6 (11)	19 (53)
Equivalent	1 (2)	6 (17)
Some, Not All	4 (8)	5 (13)
Other*	5 (10)	0 (0)
Average Class Size	162.24	152

*Other includes staff or faculty associate status or those transitioning to faculty status

63%) and EPA 9: Collaborate as a member of an interprofessional team (n=20, 37%) and were involved in other EPAs to a lesser extent. All respondents were asked if they taught or assessed the functions of EPA 7 as standard practice, regardless of whether their institution was implementing Core EPA work, and 84 libraries answered this question. Most libraries, 90% (n=76) of responding institutions indicated that the library was involved in teaching or assessing component functions of EPA 7 as part of their standard practice. Furthermore, when comparing Core EPA project-implementing libraries to those not explicitly involved in Core EPA projects, Pearson Chi Square analyses showed that there were no statistically significant differences in involvement in teaching or assessing any of the eight component functions of EPA 7 between these two groups of libraries (see Table 2).

Table 2 Association Between Libraries' Involvement in Core EPA Projects and Teaching and Assessing of EPA 7 Component Tasks (n=88)

Component Tasks of EPA 7	Teaching	Assessing
Develop a well-formed, focused, pertinent clinical question	$X^2(3) = 2.904$, $p = 0.407$	$X^2(3) = 4.240$, $p = 0.237$
Demonstrate basic awareness and early skills in appraisal of both the sources and content of medical information using accepted criteria	$X^2(3) = 3.392$, $p = 0.335$	$X^2(3) = 2.780$, $p = 0.427$
Identify and demonstrate the use of information technology to access accurate and reliable online medical information	$X^2(3) = 5.084$, $p = 0.166$	$X^2(3) = 3.581$, $p = 0.310$
Demonstrate basic awareness and early skills in assessing applicability/generalizability of evidence and published studies to specific patients	$X^2(3) = 1.676$, $p = 0.642$	$X^2(3) = 2.226$, $p = 0.527$
Demonstrate curiosity, objectivity, and the use of scientific reasoning in acquisition of knowledge and application to patient care	$X^2(3) = 7.163$, $p = 0.067$	$X^2(3) = 4.139$, $p = 0.247$
Apply the primary findings of one's information search to an individual patient(s)	$X^2(3) = 4.634$, $p = 0.201$	$X^2(3) = 6.611$, $p = 0.085$
Communicate one's findings to the health care team (including the patient/family)	$X^2(3) = 4.677$, $p = 0.197$	$X^2(3) = 6.429$, $p = 0.092$
Close the loop through reflection on the process and the outcome for the patient	$X^2(3) = 3.923$, $p = 0.270$	$X^2(3) = 2.195$, $p = 0.533$

Which EPA 7 tasks are being taught and assessed?

EPA 7 consists of eight component tasks, results indicated that libraries were primarily involved in teaching the first five tasks of EPA 7 (teaching > 50%): forming a clinical question, using information technology to access medical information, appraising sources and content of medical information using accepted criteria, demonstrating skill in assessing applicability of evidence to patients, and demonstrating curiosity and the use of scientific reasoning in acquiring knowledge and applying to care. In terms of assessment, libraries were primarily involved in assessing the first three tasks of EPA 7 (assessing >50%). Libraries reported much lower involvement in assessment across all component tasks. The EPA 7 task least taught and assessed by librarians was "closing the loop through reflection on the process and the outcome for the patient." For each of the eight component tasks of EPA 7, libraries were teaching these skills more than assessing them. For example, the task "Identify and

demonstrate the use of information technology to access accurate and reliable online medical information" was the EPA 7 component most frequently addressed by academic health sciences libraries in the medical curriculum. Of responding libraries, 87% (n=74) reported that the library was involved in teaching this component of EPA 7 while only 61% of responding libraries (n=52) reported that they assessed this component of EPA 7 (see Table 3).

Table 3 Libraries' Teaching and Assessing of EPA 7 Component Tasks (n=85)

Component Tasks of EPA 7	Teaching n (%)*	Assessing n (%)*	Difference in Involvement
Develop a well-formed, focused, pertinent clinical question	72 (85%)	49 (58%)	-27%
Demonstrate basic awareness and early skills in appraisal of both the sources and content of medical information using accepted criteria	68 (80%)	47 (55%)	-25%
Identify and demonstrate the use of information technology to access accurate and reliable online medical information	74 (87%)	52 (61%)	-26%
Demonstrate basic awareness and early skills in assessing applicability/ generalizability of evidence and published studies to specific patients	54 (64%)	35 (41%)	-23%
Demonstrate curiosity, objectivity, and the use of scientific reasoning in acquisition of knowledge and application to patient care	45 (54%)	22 (26%)	-28%
Apply the primary findings of one's information search to an individual patient(s)	41 (48%)	27 (32%)	-16%
Communicate one's findings to the health care team (including the patient/family)	29 (34%)	21 (25%)	-9%
Close the loop through reflection on the process and the outcome for the patient	24 (28%)	13 (15%)	-13%

* Not all respondents answered each item, all percentages are calculated based on 85 total possible respondents

In which stages of the curriculum are EPA 7 tasks taught and assessed?

We also probed in what stage of the curriculum a library was involved in teaching and assessing component tasks of EPA 7. For each of the component tasks of EPA 7, respondents were asked whether their library was involved in the preclinical curriculum, clinical curriculum, both portions, or not at all. For the first five EPA 7 tasks, where libraries report being the most involved, teaching in both preclinical and clinical stages of the curriculum ranged from 22-42% (task-dependent). However, teaching in the preclinical stage alone ranged from 16-27% of respondents. For these same five EPA 7 tasks, 11-20% of libraries report assessing them in both stages of the curriculum whereas 5-25% of libraries reported assessing them in the preclinical phase only (see Table 4).

EPA implementation project involvement

The 34 respondent libraries that indicated involvement in an EPA implementation project in undergraduate medical curricula were further asked to define how the involvement was initiated, funded, and led, and how information about the project was shared between librarians and the medical school faculty. Nearly half of the libraries responding to the question (n=15, 44%) reported that librarians initiated the EPA-related curricular partnerships. The leadership of the EPA project was almost equally spread between: shared leadership among librarians and medical school teaching faculty through library representation on education committees (n=16, 47%) and medical school faculty leadership alone (n=14, 41%), with some respondents reporting unique situations (n=4, 12%). The majority of libraries responding (n=27, 79%) indicated that there was no external funding for their participation in EPA activities and no line item for the project in the library's budget. When asked how information about the EPA projects were shared between the medical school faculty and librarians, responding libraries were almost evenly split between collaboration, defined as information sharing occurs regularly and leads to long-term projects between medical school faculty and librarians beyond individual class sessions (n=13, 38%) and coordination, in which information is shared pertaining only to the specific needs or tasks related to an instruction session (n=14, 41%), with several respondents indicating information sharing was limited or unknown (n=7, 21%).

The respondents who said that they were involved in EPA related projects were asked about the division of labor for teaching and assessment. Of the 34 possible respondents to this question, 76% (n=26) stated that medical school faculty and librarians were jointly responsible for teaching skills related to the EPAs. Regarding responsibility for assessment, 41% (n=14) described assessment, including planning and grading, as a joint responsibility of medical school faculty

Table 4 Location in Curriculum of EPA 7 Teaching and Assessment Activities by Librarians (n = 85)

	Teaching n (%)					Assessment n (%)				
EPA 7 Component Tasks	**PC**	**C**	**B**	**N**	**NR**	**PC**	**C**	**B**	**N**	**NR**
Develop a well-formed, focused, pertinent clinical question	27 (32)	11 (13)	34 (40)	13 (15)	--	20 (24)	11 (13)	18 (21)	34 (40)	2 (2)
Demonstrate basic awareness and early skills in appraisal of both the sources and content of medical information using accepted criteria	26 (30)	10 (12)	32 (38)	17 (20)	--	21 (25)	9 (11)	17 (20)	36 (42)	2 (2)
Identify and demonstrate the use of information technology to access accurate and reliable online medical information	27 (32)	5 (6)	42 (49)	11 (13)	--	25 (29)	7 (8)	20 (24)	30 (35)	3 (3)
Demonstrate basic awareness and early skills in assessing applicability/generalizability of evidence and published studies to specific patients	20 (24)	12 (14)	22 (26)	31 (26)	--	16 (19)	8 (9)	11 (13)	47 (55)	3 (3)
Demonstrate curiosity, objectivity, and the use of scientific reasoning in acquisition of knowledge and application to patient care	16 (19)	7 (8)	22 (26)	39 (46)	1 (1)	5 (6)	6 (7)	11 (13)	61 (72)	2 (2)
Apply the primary findings of one's information search to an individual patient(s)	14 (16)	12 (14)	15 (18)	43 (50)	1 (1)	8 (9)	9 (11)	9 (11)	56 (66)	3 (3)
Communicate one's findings to the health care team (including the patient/family)	8 (9)	13 (15)	8 (9)	54 (63)	2 (2)	6 (7)	8 (9)	7 (8)	62 (73)	2 (2)
Close the loop through reflection on the process and the outcome for the patient	6 (7)	10 (12)	8 (9)	59 (69)	2 (2)	1 (1)	6 (7)	6 (7)	70 (82)	2 (2)

Abbreviations: PC, Pre-Clinical; C, Clinical; B, Both; N, Not at All; NR, No Response.

and librarians. Eight participants (24%) were not involved in curricular assessment, indicating that it was the sole responsibility of the medical school faculty.

Barriers and challenges to EPA involvement

All libraries submitting the survey were asked to rank the significance of various barriers or challenges that may have existed relative to librarians' involvement in implementation of Core EPA projects on a four-point scale (extremely significant, more significant, less significant, or not significant). The greatest barrier to librarians implementing Core EPA projects was lack of time in the curriculum with 61 libraries (72%) responding that this challenge was either extremely or more significant. Lack of resources such as staff time or funding and a lack of existing useful models of other libraries doing EPA work were also mentioned by approximately half of the respondents as either extremely or more significant barriers. On the other hand, lack of evidence of the value of Core EPAs, "push-back" about EPA concepts by students or faculty, and lack of librarian and/or staff training or expertise in Core EPA-related content were seen as less significant or not significant barriers by the majority of responding libraries.

Change in curriculum involvement

The 34 respondents who indicated that their libraries were involved in the implementation of Core EPAs at their medical schools were asked to describe how the library's involvement in the medical curriculum had changed since the implementation of the Core EPAs. Individuals at 28 libraries responded to this question, many of them stating that involvement in Core EPA work had led to increased integration within the curriculum. One respondent indicated that the integration had come about as a result of a shared purpose and goals provided by the EPAs. Another respondent stated that EPA implementation increased librarian involvement in assessment. Some respondents also reported that involvement in Core EPA work generally raised awareness of and respect for the librarians as key partners in medical education. On the other hand, this was not a universal finding. Several respondents (n=12; 35%) said that there have been little or no changes in the library's involvement as a result of Core EPA implementation (see Table 5).

Table 5 Qualitative Comments Regarding Involvement in Curriculum

Increased Involvement in Curriculum
"We have more dedicated time in the curriculum that we did not have before."
"The librarians are more involved in conducting classes for clinical and pre-clinical courses."
"There was library involvement in the curriculum prior to the Core EPAs; however, the EPAs have definitely provided a focus for our efforts and a better set of shared language and goals."
"…allows us to […] become more involved in assessment. Assessing skills and knowledge for EPAs will require multiple points of data for each EPA and will probably require more performance and portfolio-based assessments."
"…has increased the awareness of the value of the library among teaching faculty, lent credibility to librarians' work because of the mandating of information literacy skills at a higher level, and deepened collaboration and increased partnerships with medical school faculty."
Little or No Change in Involvement in Curriculum
"Our involvement is essentially the same, as are the sessions we teach - only the specific classification of these sessions has changed."
"Involvement has evolved over time, independent of the Core EPAs."
"I guess a lot of it really is more of the usual information literacy instruction, but we are using it to satisfy some of the EPA requirements."

Discussion

While EPA 7 is directly related to librarians' expertise, librarians' access to learners for the purposes of teaching and assessing these skills across the curriculum varied. Our study highlights the vast amount of work being done by librarians to teach and assess EPA 7. However, this work was often unrecognized by curriculum leaders as a formal part of the curriculum and was not captured by existing assessment structures and systems.

Based on our findings, librarians were already regularly teaching five of the eight core tasks of EPA 7, although for most it was not directly tied to an EPA 7 project or implementation. Additionally, these curricular pieces often occurred in isolation where librarians only taught the pieces they were asked to teach and were often unaware of how it would connect to the other sessions taught in the EBM curriculum. The first five tasks of EPA 7 fall within the expertise of medical librarians, while the last three tasks may be better suited to collaboration with clinician faculty members. If a learning event is not integrated with other

components in the curriculum, then student competency acquisition related to EPA 7 may not be adequately scaffolded and supported. To enhance clarity, curricula on evidence-based medicine that are taught and led by librarians should be explicitly labeled as being part of EPA 7 or an EBM competency. Course and curriculum leaders should also be encouraged to involve librarians in the planning and structure of EBM courses. Possibly more troubling is at what times in the curriculum librarians report being involved in EBM training. While EPA 7 is a clinical expectation, over 50% of librarians' reported teaching of the content occurs only in the preclinical years, before learners are expected to practice EBM. This may work well for some institutions, but with an eye to the future, EBM education leaders should consider incorporating more librarian training in the clinical years.

Our study also identified a lack of librarian involvement in assessment of EPA 7 skills, with only 25% of respondents reporting being involved in assessing the first three EPA 7 tasks that they are teaching. Assessment that was being conducted by librarians occurred mostly in the pre-clinical years, with very little assessment of select steps of EPA 7 taking place in the clinical years. This provides an opportunity to involve librarians longitudinally throughout the curriculum utilizing the EPA framework. Since assessment drives learning, if librarians are involved in teaching these skills, they should also be contributing evidence of EPA 7 attainment from student assessments. Librarians are well-equipped to both be key assessors of student performance and to help in the development and use of existing assessment instruments for this concept.

The barriers of lack of time in the curriculum, lack of resources, and lack of staff time which were reported by respondents are not unique to EBM training. Librarians and curricular leaders should begin to think outside the box and consider innovative models of teaching content longitudinally. Librarians often wear many hats at their institutions and have many competing demands for their time as do medical school faculty and curricular directors. Working closely as collaborators and engaging with librarians as instructors for EBM content could be a way to share responsibilities and scale this engagement effectively.

Much of librarians' everyday practice in academic health sciences libraries already supports EPA 7—perhaps even without realizing it. If an institution has adopted the EPA approach, then librarians should be utilized as content experts in EPA 7. Since program directors cite EPA 7 as one of the areas in which their residents are least prepared [2,3], librarians and faculty colleagues should explore additional collaborations to strengthen student learning in this area.

While many librarians were involved in teaching of EPA 7 tasks via regular teaching of evidence-based medicine skills, future research should focus on two different areas: 1) evaluating programming to raise faculty awareness of the

benefits of collaboration with librarian colleagues in order to enhance longitudinal EBM teaching and assessment within curricula; and 2) developing better assessment methods and assessment training for librarians to begin using with their instruction to address the assessment gap.

Limitations

The views expressed in this study were only of librarians from academic health sciences libraries in the U.S. and Canada, and not hospital libraries. Future research should assess the opinions of hospital librarians who may be teaching and assessing EPA 7 clinically as students rotate through their settings. Second, the study authors also contributed their own experiences to the survey data. While this was de-identified for analysis, the authors have extensive experiences working on the Core EPA projects at their own institutions and therefore participated in the survey as respondents representing their libraries. Eliminating this data would have been a misrepresentation of what is being done in academic health sciences libraries in the U.S. and Canada. Nonetheless, the authors feel the data presented here is generalizable to the whole population of academic health sciences libraries. Additionally, we only examined competency in EBM in the undergraduate medical education context, specifically EPA 7. While teaching to and assessing competency in EBM crosses into graduate medical education, that was beyond the scope of this research. Future research should explore how this competency is taught and assessed during the transition to graduate medical education and throughout the continuum in a developmentally appropriate way.

Conclusions

This study provides insight into gaps and opportunities in teaching and assessment of EPA 7. While much work is being done both to teach and assess EPA 7, institutions could think more strategically about when, how often, and for what purposes to utilize librarians in these efforts. Librarians are already doing this work and should be called upon as partners in development of curricula, teaching, and assessment of EPA 7 in medical students.

List of Abbreviations

AAHSL: Association of Academic Health Sciences Libraries; AAMC: Association of American Medical Colleges; EBM: Evidence-Based Medicine; EPA: Entrustable Professional Activity.

Declarations

Ethics approval and consent to participate
This study was approved as exempt by the Michigan State University Institutional Review Board and no consent to participate was needed.

Consent for publication
Not applicable.

Availability of data and material
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interests.

Funding
The Association of Academic Health Sciences Libraries has agreed to fund any publication fees associated with this research. The funding body for publication fees had no role in study design, data collection, data analysis, or writing of the manuscript.

Authors' contributions
JN was a major contributor to study design, data analysis and interpretation, and in writing of the manuscript. JS was a major contributor to study design, data analysis and interpretation, and in writing of the manuscript. IKG was a major contributor to study design, data analysis and interpretation, and in writing of the manuscript. EL was a major contributor to study design, data analysis and interpretation, and in writing of the manuscript. NA was a major contributor to study design, data analysis and interpretation, and in writing of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors wish to first thank the Association of Academic Health Sciences Libraries (AAHSL) and the librarians that responded to this survey. They would also like to thank Tony Paolo, PhD; Laura Bauler, PhD; Adina Kalet, MD; Anique de Bruin, PhD; and Cees van der Vleuten, PhD for their help with statistics and editing. Finally, they would like to thank their colleagues on the AAHSL Task Force on Competency-Based Medical Education, Ruth Riley, MS; Emily Brennan, MLIS; Megan Von Isenberg, MSLS; Rikke Ogawa, MLIS; Kelly Thormodson, MLIS; and Heather Collins, MLIS for their immeasurable assistance on this project.

References

1. Association of American Medical Colleges. Core Entrustable Professional Activities for Entering Residency: Faculty and Learners' Guide. Washington, D.C.: AAMC; 2014.
2. Pearlman RE, Pawelczak M, Yacht AC, Akbar S, Farina GA. Program Director Perceptions of Proficiency in the Core Entrustable Professional Activities. J. Grad. Med. Educ. 2017;9(5):588-592.
3. Guralnick S, Yedowitz-Freeman J. Core Entrustable Professional Activities for Entry Into Residency: Curricular Gap or Unrealistic Expectations? J. Grad. Med. Educ. 2017;9(5):593-594.
4. Accreditation Council for Graduate Medical Education. ACGME Common Program Requirements. 2017; https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRs_2017-07-01.pdf. Accessed October 29, 2018.
5. CanMEDS Role: Scholar. 2015; http://www.royalcollege.ca/rcsite/canmeds/framework/canmeds-role-scholar-e Accessed October 29, 2018.
6. Maggio LA, ten Cate O, Chen HC, Irby DM, O'Brien BC. Challenges to Learning Evidence-Based Medicine and Educational Approaches to Meet These Challenges: A Qualitative Study of Selected EBM Curricula in U.S. and Canadian Medical Schools. Acad. Med. 2016;91(1):101-106.
7. Braschi E. Don't just blame the evidence: considering the role of medical education in the poor uptake of evidence-based medicine in clinical practice. BMJ Evid Based Med. 2018;23(5):169-170.
8. Walden RR. For medical literature expertise, ask a librarian. Acad. Med. 2016;91(8):1040.
9. Dorsch JL, Perry GJ. Evidence-based medicine at the intersection of research interests between academic health sciences librarians and medical educators: a review of the literature. J. Med. Libr. Assoc. 2012;100(4):251-257.
10. Blanco MA, Capello CF, Dorsch JL, Perry G, Zanetti ML. A survey study of evidence-based medicine training in US and Canadian medical schools. J. Med. Libr. Assoc. 2014;102(3):160-168.
11. Mattessich PW, Monsey BR. Collaboration: what makes it work. A review of research literature on factors influencing successful collaboration: ERIC; 1992.
12. Larson PD, Chow G. Total cost/response rate trade-offs in mail survey research: impact of follow-up mailings and monetary incentives. Industrial Marketing Management,. 2003;32(7):533-537.

3

Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation

This chapter is published as:
Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. Journal of the Medical Library Association : JMLA. 2020;108(2):219-228.

Structured Abstract

Objective
Evidence-based medicine practices of medical students in clinical scenarios are not well understood. Optimal foraging theory (OFT) is one framework that could be useful in breaking apart information seeking patterns to determine effectiveness and efficiency of different methods of information seeking. The research aims were to use OFT to determine the number and type of sources used in information seeking when answering a clinical question, to describe common patterns that are used, and identify if there are any patterns associated with higher quality answers to a clinical question.

Methods
Medical students were observed via screen recordings seeking evidence related to a clinical question and providing a written response for what they would do for that patient based on the evidence they found. The screen recordings of each search were coded using constructs from Optimal Foraging Theory to understand sources, time spent, and patterns of searching. Quality of written responses was assessed by three clinicians using a standardized rubric for this clinical scenario.

Results
The study found that half (51.4%) of study participants used only one source before answering the clinical question, while the rest consulted multiple sources. While the participants were able to successfully and efficiently navigate Point of Care Tools and Search Engines, success and speed in searching PubMed was not favorable with only half (47.8%) of searches being successful and an average search efficiency time of 6:53, compared with search efficiency times of 3:28 for Search Engines and 5:45 for Point of Care Tools. The navigation patterns of finding an answer through these sources were put into four main types. However, there was no statistically significant correlation between any one navigation pattern and the quality of an answer to the clinical question.

Conclusion
Clinically experienced medical students use a wide variety of resources when seeking answers to clinical questions. Most frequently, they rely on Point of Care tools alone or in combination with PubMed. We found no correlation between any of their resource navigation patterns and the quality of their answers to the clinical questions. Optimal foraging theory can be used as a framework to understand the information seeking practices of medical students in clinical scenarios. This has implications for both teaching and assessment of evidence-based medicine in medical students.

Introduction

Evidence-based medicine (EBM) is widely accepted as the best practice in integrating research evidence into clinical decisions for the best possible patient care [1]. However, there are many barriers to physicians implementing EBM. The two most frequently reported barriers are a lack of time and information overload [2-5]. To become excellent physicians, educators must ensure that medical students learn how to manage and apply the voluminous information available through searching and navigating the information landscape efficiently and appropriately. Studies in this area have the potential to improve the quality of EBM education and consequently of clinical care.

Current studies on medical students and information seeking focus on the resources they report using, what barriers to practicing EBM they perceive, and what technologies they use to perform this work [6-9]. Time management and lack of technical expertise were two of the most common challenges faced by medical students when seeking research evidence to support clinical decisions in the clinical context [6]. However, these studies do not give any insight into their ability to successfully navigate through preferred resources in a limited time. Understanding modern information seeking behaviors of medical students in the context of their EBM training is a first step toward addressing these significant barriers. To our knowledge, there have been no studies of how medical students spend their time on or go about navigating through multiple information resources. Understanding how our students actually approach EBM, will inform and refine EBM curriculum and enable us to audit relevant EBM behaviors and provide structured, actionable feedback in clinical settings to enhance learning.

Two related theories inform this study: Information Foraging Theory (IFT) and Optimal Foraging Theory (OFT). IFT, mainly developed by Peter Pirolli, is a framework used to explain search behavior in relation to the search environment [10]. IFT uses the concepts of gain (e.g. getting relevant results) and cost (e.g. time or money) in a highly contextualized way specific to the cognitive task to explain and describe behavior. OFT also uses the concepts of gain and cost, but specifically focuses on how to optimize spending of time (cost) to increase successfully finding relevant information (gain). Initially developed in evolutionary biology, OFT was first applied in the modern information management environment by Sandstrom (1994) and Pirolli and Card (1999) to explain user search behaviors [11,12].

In Pirolli and Card's refinement of this theory, the patch model of foraging is analogous to information seeking [11]. In the patch model, specific resources are different patches that could be used to retrieve the needed information and searchers must decide which patch, or resource, is likely to be most profitable at

first, and decide when it is time to move on to a new patch if they have found all information they need or that patch is no longer worth their time. Using this model, Pirolli and Card (1999) examined efficiency of time spent on task and effectiveness of navigation patterns. Specifically, they described strategies that optimize information seeking through trade-offs employed between minimizing time taken and maximizing answer reliability.

While this framework has not been used to examine medical student information seeking, it has been used with clinicians in an EBM context [13]. We believe OFT is particularly well-suited as a framework from which to understand and describe medical student information seeking behaviors.

The aim of this research is to understand the patterns of information-seeking in senior medical students. We sought to establish the sources and patterns of information students actually use when answering a clinical question. Specifically, this study aims to answer the following research questions:

- What sources do senior medical students use when answering a clinical question?
- What navigation patterns do medical students use to arrive at answers to clinical questions?
- Are there navigation patterns that have higher associations with better quality answers?

Methods

To study the information-seeking behaviors of senior medical students we used screen-captured recordings of an activity which took place as a part of Night-onCall. Night-onCall is a multi-station simulation experience in an Objective Structured Clinical Examination (OSCE) format. Using the 13 Core Entrustable Professional Activities for Readiness for Residency framework proposed by the AAMC, Night-onCall was designed to assess and address readiness of near graduating medical students for the next stage of training- Internship. All activities of Night-onCall were designed around 4 clinical cases [14].

Setting

We conducted this study in 2016 using participants from New York University School of Medicine at the New York Simulation Center in New York. Prior to this study, all students participating in this experience received approximately 16 hours of instruction in evidence-based medicine (EBM) as a part of the standard medical school curriculum. The study was conducted following all of their EBM training at the end of either the participant's 3rd, 4th, or 5th years. See Box 1 for a

brief description of the curriculum.

Box 1 Evidence-Based Medicine Curriculum Outline

Timing	Content	Instructional Format	Outcomes Assessment
Year 1 – Fall Pre-Clinical	Intro to Research Questions; Intro to PubMed and MeSH	Online Module; Lecture (1 hour); Hands-On Workshop (1 hour)	Whole-task assignment with written formative feedback
Year 1 – Spring Pre-Clinical	Intro to EBM Intro to Critical Appraisal	Lecture Series (3 hours)	No Assessment
Year 2 – Fall Pre-Clinical	Clinical Question Formulation; Intro to Other Databases; Critical Appraisal	Lectures (5 hours); PBL-Style Seminars (3 hours); Hands-On Workshop (1 hour)	ACE Tool; Multiple-Choice Exam
Year 2 – Winter Clinical Orientation	Intro to Clinical Information Sources	Lecture (1 hour)	No Assessment
Year 2-3 – Clinical Clerkships	EBM in Practice (Whole Task)	Asynchronous Video Lecture (1 hour)	Whole-task assignment with written formative feedback and score

Subjects

We recruited clinically experienced medical students for this study by email. After volunteering, students were provided a link to sign up for a time slot to participate and emailed background information on the research project. A total of 89 students registered to participate in this study out of 327 students eligible and invited. Of the 89 students who participated in Night-onCall, 72 were included in the final sample for this analysis. 12 were erroneously given an incorrect question to answer during this activity, 1 did not search for anything, 1 had a computer malfunction, and 3 had no recordings available. The 72 students include 35-3rd year in the four-year program, 12-graduating 3rd year in the three-year program (a highly selective, accelerated curriculum track), 36-4th year in the four-year program (standard US program), and 6-5th year in the four-year program students (students typically take an additional year to complete a Master's degree in addition to their MD).

Participation in Night-onCall was entirely voluntary, written informed consent for observation was obtained and a financial incentive was provided. Approval

for this study was obtained from the NYU School of Medicine Institutional Review Board #i14-00867.

Procedure and Materials

Following a simulated patient case requiring students to assess an actor portraying a hospitalized patient with new onset hypertension and headache, students were then seated at a computer with Internet access with 10 minutes to complete this self-paced activity. The activity provided the following clinical question: In a patient with hypertension urgency, what is the safest treatment strategy? This question arose in the interaction with the preceding simulated patient. They were required to answer the question using evidence from the literature. They were given no further instructions as to where or how to start finding this evidence. Following their search process, they were required to explain via a free-text entry box how they would proceed to treat the patient based on the evidence they found. A computer program, LogMeIn®, allowed the activity on the computer screen to be viewed in real time and recorded for analysis. This performance activity is designed to reflect a "typical" clinical encounter, including time pressures and available resources.

Analysis

The patch model of OFT was used to define the variables for extraction and analysis of the results. This model was previously used in a self-report format for clinicians [13], here we are adapting the variables to fit direct observation in medical students. In the patch model, patches are the various sources where one might forage for information and the forager must decide when they have enough information to complete the task and move on, or they have exhausted one source and still need more information and must spend time in another patch. This model allows us to describe which resources are the most efficient (i.e. time spent in finding an answer) and which navigation patterns are the most effective (i.e. selecting better sources initially). The following variables were extracted from screen recordings by one coder (JN): original sources consulted, follow-up sources consulted (open text), time spent per source, total time spent on task (seconds), and success or failure in a source (dichotomous yes/no). Sources were counted only when they were being searched or their unique features were being used (i.e. if a student used Google to find a citation and was taken to PubMed to read it, this was not counted as a PubMed search. PubMed was only counted when students used it to do a search or used database features like related articles.) Success was defined as finding any information in the source, failure was defined as being unable to find any information in the source. Independent variables included the student's class year and the quality of the written responses.

Quality of written responses to the patient case were assessed on a 5-point Likert-type scale. Because there was no pre-defined correct answer, the quality rating scale was developed by two clinicians (IF and LBK) based on reading the student responses and categorizing the quality-defining features of the responses, see Box 2 for criteria.

Box 2 Quality Rating Criteria

Quality Score	Criteria
5	Considered both urgent and emergent hypertension; gave both specific treatments and blood pressure targets.
4	Considered both urgent and emergent hypertension; gave either specific treatments or blood pressure targets, but not both.
3	Considered either urgent or emergent hypertension, but not both; gave both specific treatments and blood pressure targets.
2	Considered either urgent or emergent hypertension, but not both; gave either specific treatments or blood pressure targets, but not both.
1	Failed to provide a rational answer to the question or plagiarized.

To derive quality scores for each student, this rating scale was subsequently applied by three clinicians (AK, RC, and VS) on all 72 cases. We used the average scores of the three raters as the measure of quality for these written responses ICC=0.724, 95% CI (0.59; 0.81). ICC estimates and their 95% confidence intervals were calculated using SPSS statistical package version 24 (SPSS Inc, Chicago, IL) based on an average-measures (k=3), consistency, 2-way mixed effects model.
To answer the first research question, we will present descriptive statistics appropriate to the data type of which sources were used and in what order they were used. To answer the second question, OFT framework will be used to describe and categorize the patterns of searching in terms of success/failure in a resource, time spent, and overall navigation patterns. To answer the third question, associations between the variable navigation pattern and the variable quality of written response will be tested using one-way ANOVA. P-values < 0.05 were considered statistically significant.

Results

What sources do senior medical students use when answering a clinical question?

Half of students (n=37, 51.4%) searched only one source before answering their clinical question. The remainder of students mostly stopped after a second source (n=30, 41.7%), but a few searched a third source (n=4, 5.6%), and one searched four sources (n=1, 1.4%)

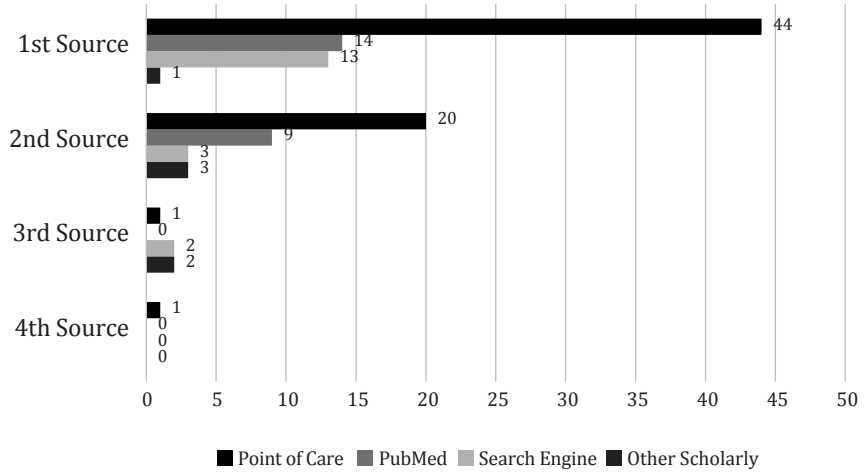
Across all 72 videos, 113 searches were done across 10 unique resources. Based on general purpose and functionality of each resource within clinical information seeking, they are grouped into four main categories: Point of Care Tools, PubMed, Search Engines, and Other Scholarly Tools. See Table 1 for specific resources included in each category.

Table 1 Source type categories and included sources

Source Type Category	Point of Care	PubMed	Search Engine	Other Scholarly
	UpToDate	PubMed.gov	Google	Google Scholar
	Epocrates	PubMed for Handhelds	Browser search bar	Web of Science
	Medscape		Bing	
	MedKit (an NYU-developed meta-search tool)			

Figure 1 displays the number, type, and order of sources used. Two main source types were found to be the most used of the four categories. Point of Care Tools were the most frequently used sources overall (n=66, 58.4%), and the most frequently used first sources (n=44, 61.1%), as well as second sources (n=20, 57.1%). PubMed was the second most frequently used source overall (n=23, 20.4%), and the second most frequently used first source (n=14, 19.4%), as well as second source (n=9, 25.7%).

Figure 1 Types and order of information sources consulted



What navigation patterns do medical students use to arrive at answers to clinical questions?

Four main source type navigation patterns emerged from these observations. The most common pattern was students using only Point of Care tools (n = 31), followed by students who used both Point of Care tools and PubMed (n = 15), students who used Point of Care tools and either Search Engines or Other Scholarly tools (n = 14), and students who did not use Point of Care tools at all (n = 12).

Time spent searching and search success

All students were given 10 minutes to complete this activity, on average they completed their searches in 6:26 ± 1:55 minutes. Time spent per search was highly variable both in order of search and depending on type of resource. Due to their skewed distribution, data for time spent searching are presented as median and inter-quartile range. Success in searching a source is defined as arriving at any answer. Out of 72 first searches, 58 (80.6%) were successful with a median time spent of 5:40 ± 3:11. Fourteen (19.4%) of the first searches were unsuccessful with a median time spent of 0:29 ± 1:13. Of the 58 students who were successful, 21 (36.2%) chose to continue to use a second source, but the majority (n=37, 63.8%) chose to stop after searching one source. All 14 students who were unsuccessful with their first source continued to a second source, leaving 35 (48.6%) students, slightly under half of the sample, who continued to a second source overall.

Out of 35 second searches, 29 (82.9%) were successful with a median time spent of 5:35 ± 4:21. Six (17.1%) of the second searches were unsuccessful with a median time spent of 0:40 ± 0:18. Of the 29 students who were successful, 4 (13.8%) chose to continue using a third source, but only 1 (16.7%) of the 6 who were unsuccessful chose to continue to a third source.

Out of the 5 third searches, 4 (80%) were successful with a median time spent of 3:05 ± 2:40. One (20%) of the searches was unsuccessful and lasted 0:27. This unsuccessful searcher was the only one to continue to a fourth source. The single fourth source search was successful and lasted 2:55.

Median time spent on unsuccessful searches was consistently lower than median time spent on successful searches. Rates of conducting a subsequent search were low for searchers who were initially successful. Rates of conducting a subsequent search drop after a searcher had conducted at least one successful search. Table 2 summarizes the median search times and percent choosing to pursue a subsequent search for both successful and unsuccessful searches.

Table 2 Information searching time and decision to use a subsequent source (Median Time and IQR)

Source	Successful Searches		Unsuccessful Searches	
	Search Time (min:sec)	Subsequent Source Used	Search Time (min:sec)	Subsequent Source Used
First	5:40 ± 3:11 (n = 58)	36.2% n = 21	0:29 ± 1:13 (n = 14)	100% n = 14
Second	5:35 ± 4:21 (n = 29)	13.8% n = 4	0:40 ± 0:18 (n = 6)	16.7% n = 1
Third	3:05 ± 2:40 (n = 4)	0% n = 0	0:27 (n = 1)	100% n = 1
Fourth	2:55 (n = 1)			

Search Outcome and Efficiency by Resource Type

Search time and success both varied widely by resource type. Students had the highest success rates when using Other Scholarly tools (100%) or Point of Care tools (95.5%). Conversely, their searches had lower success rates when using either Search Engines (68.4%) or PubMed (47.8%). Success rates in a resource type are not connected to efficiency of a resource (defined as average time spent on successful searches divided by the number of successful searches). The most

efficient resource type was Search Engine, averaging 3:28 minutes to find an answer. The least efficient resource type was PubMed, averaging 6:53 minutes to find an answer. Table 3 summarizes search time, success rates, and search efficiency.

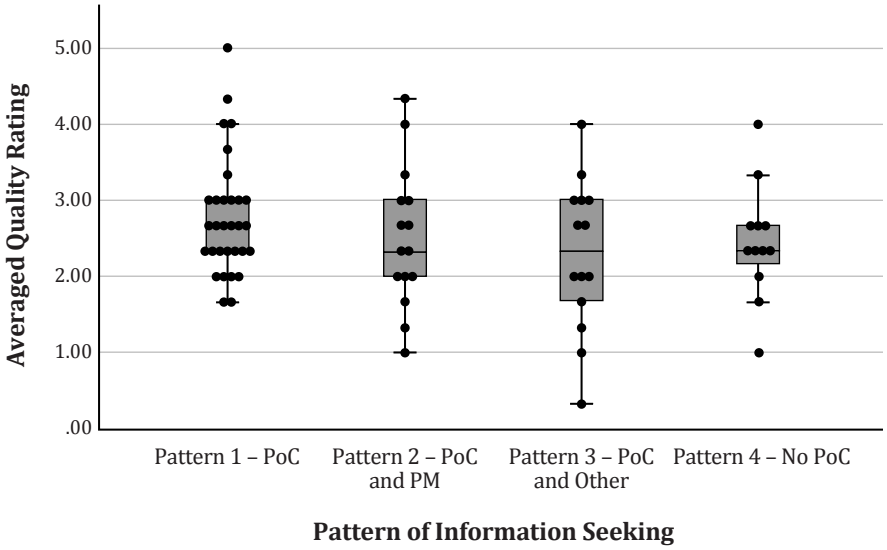
Table 3 Search time, success and efficiency by type of information sources (all searches combined)

Source Type	Search Time (min:sec)	Search Success	Average Search Efficiency
Point of Care	5:58 ± 3:52 (n = 66)	95.5% n = 63	5:45
PubMed	4:20 ± 6:54 (n = 23)	47.8% n = 11	6:53
Search Engines	1:47 ± 2:13 (n = 18)	68.4% n = 13	3:28
Other Scholarly	4.91 ± 7.83 (n = 6)	100% n = 6	5:56

Are there navigation patterns that have higher associations with better quality answers?

Quality ratings on a scale of 0-5 of the answers submitted following information seeking were approximately normally distributed, with an overall average quality rating of 2.57 (SD = .855). When analyzing all four navigation patterns, there was no statistically significant difference in average quality ratings of written responses to the clinical question as determined by one-way ANOVA ($F(3,68) = 1.228$, $p = .306$). However, the higher ratings of Pattern 1 users approached statistical significance compared with Pattern 3 users ($p = .07$). The highest average quality ratings were from those who used Pattern 1, Point of Care tools alone (2.77 ± 0.78). The lowest average quality ratings were from those who used Pattern 3, Point of Care tools and either Search Engines or Other Scholarly tools (2.29 ± .99). Figure 2 summarizes the average quality ratings and ranges for each navigation pattern.

Figure 2 Averaged quality ratings per information seeking pattern.



Abbreviation Key: PoC – Point of Care Tools; PM – PubMed; Other – Either search engines or other scholarly sources; No PoC – No inclusion of Point of Care Tools.

Discussion

In this study we operationalized the patch model of OFT by documenting effectiveness of patch selection and subsequent patch selection and efficiency by documenting time spent towards getting an answer. We found that when seeking answers to a particular clinical question in a simulated environment most near graduate medical students demonstrate relatively effective navigation patterns toward trustworthy information sources and many were able to extract from those sources a high quality written answer to the clinical question, but some do not. All students did use at least one reliable source of medical information (UpToDate, PubMed, and Other Scholarly) to find a defensible answer to the clinical question. While 15.9% of all searches were initially conducted in a search engine (not a trusted source), reliable sources were consulted as a part of each of those. This indicates that students are able to effectively identify the most reliable sources that, possibly through a combination of their explicit curriculum and also their clinical experience of what works best.

Most students minimized the time they spent on unhelpful resources and quickly moved to the next more fruitful source in their quest for an answer. This is another sign of an effective information seeker. However, the high average search time for the three reliable sources suggests where there is room for improvement in search efficiency within each of these sources. The process through which better efficiency can be achieved is called enrichment in OFT. Enrichment is when an information seeker utilizes the tools built in to each database to navigate through that source to an answer faster. For PubMed, this could mean using the Clinical Questions filters to limit to relevant study designs. Or in UpToDate, it could mean using the side navigation links to go relevant sections of the article without reading the entire article or scrolling up and down through it.

The quality of the clinical responses varies across the full range of possible levels reflecting the range in the ability of students to rapidly interpret the evidence and apply it to the patient. We had an a priori expectation that more effective and efficient navigation patterns might be directly related to the quality of the answers to the clinical question but what we found was more complex. While there was no statistically significant association across the four different patterns taken together, those who used UpToDate alone did have the highest average quality in their written responses and the lowest quality was seen for the pattern which started with Point of Care tools and then switched to multiple other sources. It is possible that concentrating on the highly curated and easily applied source leads to a better answer or, of course the students with higher quality answers may have had experience with the clinical question and were merely confirming what they already knew from experience. These findings raise many questions. We need to further explore the associations and pathways between being able to locate and navigate through a reliable source of evidence and the application of that evidence to patient care. This could be researched by having participants talk through their decision making process as they navigate through resources or by having them explain their answer and decision making process following the search. In the future we also will need to control for prior experience with the particular clinical question and explore evidence based medicine practices across clinical content.

Optimization

This is the first study to use OFT to describe and understand the information seeking behaviors of medical students. With a focus on effectiveness and efficiency as collected through source type selection and time to answer in a source, OFT is well-suited to analyze and interpret medical student information seeking. These same data elements are used in Slawson and Shaughnessy's work on patient-oriented evidence, which uses the equation "Usefulness of Medical

Information = (relevance x validity) / work" [15]. Their work posits that for one to be most effective in managing information in a clinical context, one must start with the most relevant sources that take the least time. The data elements of source type selection and timing could be used in the future to help frame instruction and design assessment instruments around real-world instead of idealized behaviors information seeking behaviors.

While in general students appear to be good at identifying reliable sources and then moving on when they are not successful, there is still opportunity for optimization of their information seeking. The success rate in Point of Care Tools is nearly perfect but not so with PubMed which is much more likely to be influenced by an individual's searching skill level. PubMed searching is consistently taught throughout the curriculum and despite the fact that students remain aware of the high reliability of this resource, clearly there is room for improvement. Current teaching strategies for PubMed within medical school curricula focus mostly on more traditional lecture hall or computer lab classes [16,17], as opposed to integration within the clinical context where students will be expected to perform these behaviors. Just-in-time teaching strategies that incorporate formative feedback need to be designed and tested.

One possibility for improving PubMed skills in a time-limited context, is to provide more opportunity for embedded librarians to give feedback to students on their own searches, teach, demonstrate, and model efficient use of this resource at the point of care. While we have used the patch model of OFT to describe information seeking patterns, the concept of enrichment could be used so that searching within a source is optimized. [11,18]. Using concepts of enrichment in this context would entail teaching and assessing behaviors like identifying specific study designs that would best answer a clinical question or using the database's built-in filters as a shortcut.

OFT is ideally suited to help understand and describe behaviors in EBM, where limited time and information overload are the key barriers to effective practice. It also has implications for informing assessment of EBM behaviors. The current range of assessment tools for these expected behaviors are limited to knowledge and skill, not yet achieving direct observation of performance [19]. Since there currently are no tools for direct observation of these behaviors, effectiveness and efficiency as operationalized in this study from OFT can be used to help frame assessments and feedback to learners within their clinical and near-clinical environments. For example, an observer might answer the questions: did they use a known reliable source and did they use that source's built-in filters will give an immediate sense of if they are effective at source selection and if they are efficient at using a source.

Limitations

This observational study was conducted with volunteer participants from one medical school in the United States. These volunteers may have been more pre-disposed to practicing clinically relevant skills for their upcoming residency and potentially performed at a different level than the general population of medical students. This was also a single clinical case and students were provided with a clinical question to answer. Generalizability across clinical content is limited. Clinical information seeking changes rapidly as tools change, evolve, and improve. While efforts were taken to be as similar to real life activities as possible, the current study was done in a time-limited simulated exam setting and should be interpreted with that context in mind.

We used a common and well-known clinical scenario among hospitalized adults- new onset hypertension with headache- therefore there was rich and detailed information available in the Point of Care Tool, which did apply directly to the patient at hand. It is likely that novice clinicians would have performed very differently in seeking information to make a clinical decision in a less common scenario, where they would have needed to rely more on a resource such as PubMed. This needs to be confirmed because it potentially has significant impact on how to tailor curriculum and clinical decision-making support for novice clinicians. Future studies could include more complicated scenarios, talk-aloud protocols, and follow-up interviews to better understand the reasoning behind the information seeking choices the students make and how their process relates to their existing knowledge on a given topic and their synthesis of the answers they found.

Conclusion

Clinically experienced medical students begin information seeking in a variety of resources. However, the majority begin in either a Point of Care tool or in PubMed. While the students may spend more time in one resource once they have found an article with an answer, they very quickly move to another resource when their initial search efforts do not have an immediate and clear answer among the search results. The students with higher quality responses answered their clinical question using Point of Care tools alone, but this was closely followed by those who used both PubMed and Point of Care tools. Using OFT to analyze and understand these patterns can help inform more effective embedded models of both instruction and assessment.

Acknowledgments

The authors would like to recognize the support and assistance of Lynn Buckvar-Keltz, MD; Ian Fagan, MD; Ruth Crowe, MD, PhD; Kinga Eliasz, PhD; Jeff Williams, MLIS, AHIP; and Dorice Vieira, MLS, MA, MPH. Their assistance and advice throughout this project at various stages was invaluable.

References

1. Djulbegovic B, Guyatt GH. Progress in evidence-based medicine: a quarter century on. Lancet. 2017;390(10092):415-423.
2. Green ML, Ruff TR. Why do residents fail to answer their clinical questions? A qualitative study of barriers to practicing evidence-based medicine. Acad. Med. 2005;80(2):176-182.
3. McCord G, Smucker WD, Selius BA, et al. Answering questions at the point of care: do residents practice EBM or manage information sources? Acad. Med. 2007;82(3):298-303.
4. van Dijk N, Hooft L, Wieringa-de Waard M. What are the barriers to residents' practicing evidence-based medicine? A systematic review. Acad. Med. 2010;85(7):1163-1170.
5. Bhandari M, Montori V, Devereaux PJ, Dosanjh S, Sprague S, Guyatt GH. Challenges to the practice of evidence-based medicine during residents' surgical training: a qualitative study using grounded theory. Acad. Med. 2003;78(11):1183-1190.
6. Twiss-Brooks AB, Andrade R, Jr., Bass MB, Kern B, Peterson J, Werner DA. A day in the life of third-year medical students: using an ethnographic method to understand information seeking and use. J. Med. Libr. Assoc. 2017;105(1):12-19.
7. Maggio LA, Capdarest-Arest N. Practising evidence-based medicine (EBM): a descriptive analysis of medical students' whole-task EBM assignments. Evid. Based Med. 2017;22(2):41-44.
8. Brennan N, Edwards S, Kelly N, Miller A, Harrower L, Mattick K. Qualified doctor and medical students' use of resources for accessing information: what is used and why? Health Info Libr J. 2014;31(3):204-214.
9. Cooper AL, Elnicki DM. Resource utilisation patterns of third-year medical students. Clin. Teach. 2011;8(1):43-47.
10. Pirolli P. Information foraging theory : adaptive interaction with information. Oxford: Oxford University Press; 2007.
11. Pirolli P, Card S. Information foraging. Psychol. Rev. 1999;106(4):643-675.
12. Sandstrom PE. An Optimal Foraging Approach to Information-Seeking and Use. Library Quarterly. 1994;64(4):414-449.
13. Dwairy M, Dowell AC, Stahl J-C. The application of foraging theory to the information searching behaviour of general practitioners. BMC Fam. Pract. 2011;12(1):90.
14. Kalet A, Zabar S, Szyld D, et al. A simulated "Night-onCall" to assess and address the readiness-for-internship of transitioning medical students. Adv Simul (Lond). 2017;2:13.
15. Slawson DC, Shaughnessy AF, Bennett JH. Becoming a medical information master: feeling good about not knowing everything. J. Fam. Pract. 1994;38(5):505-513.
16. Maggio LA. Educating physicians in evidence based medicine: current practices and curricular strategies. Perspect Med Educ. 2016;5(6):358-361.
17. Maggio LA, Durieux N, Tannery NH. Librarians in Evidence-Based Medicine Curricula: A Qualitative Study of Librarian Roles, Training, and Desires for Future Development. Med. Ref. Serv. Q. 2015;34(4):428-440.
18. Information Foraging Theory: Framework and Method, (Oxford University Press 2007).
19. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.

4

Librarian-Led Assessment of Medical Students' Evidence-Based Medicine Competency: Facilitators and Barriers

This chapter is currently under review for publication as:
Nicholson J, Plovnick C, van der Vleuten C, de Bruin ABH, Kalet A. Librarian-Led Assessment of Medical Students' Evidence-Based Medicine Competency: Facilitators and Barriers.

Structured Abstract

Introduction
We must ensure, through rigorous assessment that physicians have the evidence-based medicine (EBM) skills to identify and apply the best available information to their clinical work. However, there is limited guidance on how to assess EBM competency. With a better understanding of their current role in EBM education, Health Sciences Librarians (HSLs), as experts, should be able to contribute to the assessment of medical student EBM competence. The purpose of this study is to explore, using a grounded theory approach, the HSLs perspective on EBM assessment practices overall as well as the usefulness and feasibility of an OSCE-based EBM competency assessment led by librarians.

Methods
We trained 15 librarians from across the United States to be raters of EBM competence as part of an Objective Structured Clinical Examination (OSCE). This OSCE, Night onCall, is a readiness-for-residency OSCE used at multiple US medical schools. It is used to measure all Entrustable Professional Activities (EPAs), including EPA 7 which maps to EBM. Following their experience, we conducted focus groups to explore their perceptions of assessing medical students in this format, as well as how they might implement similar assessments at their own institutions.

Results
We identified eight themes in four broad categories that influence the success of librarians being able to engage in effective assessment of EBM: administrative, curricular, medical student, and librarian.

Conclusion
Our results inform medical school leadership by pointing out the modifiable factors that enable librarians to be more engaged in conducting effective assessment. They highlight the need for novel tools, like EBM OSCEs, that can address multiple barriers and create opportunities for deeper integration of librarians into assessment processes.

Introduction

Assessment of a physician's evidence-based medicine (EBM) ability has traditionally been tests of knowledge and skill [1,2]. Meanwhile in medical education, student assessment is evolving from focusing on knowledge to embracing the complexity of competence or the ability to apply knowledge to improve actual practice. While there are existing competency frameworks for EBM [3], there is limited guidance on how competency in this area should be assessed or who should do the assessment [2,4]. Health sciences librarians (HSLs), as primary instructors of this domain, should be but rarely are fully integrated into the program of assessment for medical students [5-7]. Recent qualitative studies on HSLs emphasize the challenges and opportunities faced both in their job tasks and educational roles [6,8]. However, HSL involvement in assessment continues to be under-developed and under-utilized. Understanding how librarians can contribute to the EBM competency assessment of future physicians will advance the modernization of that assessment and thereby improve the patient care provided in the future.

While many HSLs assess medical student EBM skills, these assessments tend to be based solely on multiple choice questions or essay-style written exams and run parallel to and therefore are poorly integrated with other assessments [5]. As a result, current EBM assessments do not provide students formative feedback on actual performed behaviors embedded within authentic clinical activities. This means they do not optimally reinforce learning and build clinical competence [1,2,9,10]. While use of an OSCE format to assess various steps of EBM has been tried, it has not always been successful. Most frequently, EBM OSCEs focus primarily on two of the five EBM steps: Appraise and Apply [11-13]. Kumaravel et al, includes the first two steps: Ask and Acquire [11] in their EBM OSCE station which uses a talk-aloud procedure and requires learners to use PubMed. Despite being yielding a reliable assessment score, the development of this station was not guided by information-seeking behavior frameworks nor with the input of librarians providing formative feedback, rendering it overly prescriptive and not aligned with real-world practices.

We developed a tool and process to assess EBM behaviors via direct observation by a health sciences librarian (HSL) within an Objective Structured Clinical Examination (OSCE) [14,15], the standardized performance-based assessments ubiquitous in medical education. This process involves an HSL remotely observing and rating the medical student's patient-specific clinical question formulation and literature-based evidence search strategy. Rating is completed using the previously described behaviorally-anchored and theory-based rubric [15].

The purpose of this study is to use a grounded theory approach to explore the HSLs perspective on EBM assessment practices overall and the usefulness and feasibility of an OSCE-based EBM competency assessment led by librarians. Through our analysis, we aim to refine the EBM assessment tool and provide solutions to barriers to wider adoption of such strategies across institutions.

Method

Data Collection & Analysis

In Spring of 2020, we engaged 15 US HSLs to participate as raters of students at medical schools using the EBM OSCE, training them to use the rubric to reliably assess sample student performances. Each HSL participated as a primary or secondary assessor. To capture diverse perspectives, recruitment of HSLs was targeted to ensure a range of years of experience, region of the US, type and size of medical school, and current involvement in EBM assessment.

In April 2022, we invited these librarians by email to participate in focus groups about their experiences. With a 2022 Medical Library Association (MLA) Research, Development, and Demonstration Project Grant we were able to offer each participant a $25.00 incentive. The focus group guide was developed based on a literature review and author expertise and refined through two rounds of testing and feedback from all co-authors. The guide invited participants to describe their roles in teaching and assessing EBM at their home institutions, gaps and opportunities in EBM assessment, and thoughts about the potential for using the video-observed OSCE and structured rubric. To elicit a deeper understanding of librarian involvement in EBM OSCEs, we included prompts on the usefulness and feasibility of this particular OSCE format as well as barriers perceived to instituting similar initiatives at their own institutions. We (JN and CP) facilitated 1-hour focus groups. All focus groups were audio recorded and transcribed verbatim for analysis. See Appendix 1 for the focus group guide.

Initially, two authors (JN and CP) independently coded the transcripts, then met to compare and discuss their codes, identify initial themes, and negotiate a formal coding structure [16]. Once the final coding structure comprised of 39 unique codes was agreed upon, they used it to complete a second round of focused coding. The Dedoose Desktop App, version 9.0.54 (SocioCultural Research Consultants, LLC, Los Angeles, CA, USA) was used to store and code the transcripts.

Reflexivity

We acknowledge that the conduct and results of this study are co-constructed among the authors and the participants. The main focus group facilitator (JN) has a master's degree in library and information science and a master's degree in public health. He has been working as a health sciences librarian doing teaching and assessment of EBM for 18 years. The focus group co-facilitator (CP) has a master's degree in library and information science and has been working as an instruction librarian for 12 years. While relatively new to EBM assessment, she has been active in information literacy and evidence-based practice assessment for Nursing and Allied Health programs throughout her career.

Results

A total of 12 librarians from 11 different medical schools participated in one of three focus groups (4-5 participants each). See Table 1: description of the HSLs and their institutional contexts. These librarians represented a range of experience in assessing EBM with majority of their assessment occurring in the Preclinical year. All participants had experience providing EBM feedback to graduating medical students using the EBM OSCE, but only three of the 11 represented institutions that formally administer this assessment activity for students.

Table 1 Description of the HSLs and their institutional contexts (self-reported)

Participant Characteristics	N (%)
Years of Experience	
< 5	1 (8.3)
6-10	3 (25)
11-15	3 (25)
16-20	3 (25)
> 21	2 (16.7)
Gender Identity	
Female	11 (91.7)
Male	1 (8.3)
Geographic Region	
Northeast	5 (41.7)
South	3 (25)
Midwest	3 (25)
West	1 (8.3)

Table 1 Continued

Participant Characteristics	N (%)
Type of Medical School	
Public	6 (50)
Private	6 (50)
Size of Medical School Class	
< 100	1 (8.3)
101-150	4 (33.3)
151-200	2 (16.7)
> 201	5 (41.7)
Feedback Given on EBM	
Pre-Clerkship	8 (66.7)
Transition to Clerkships	2 (16.7)
Clerkships	4 (33.3)
None	2 (16.7)
Institutional Participants in Night onCall	
Yes	3 (25)
No	9 (75)

The 13 primary codes and 26 sub-codes were applied a total 639 times across the three transcripts.

Thematic Analysis

In describing current and aspirational EBM assessment activities and experiences with the EBM OSCE, themes fell into four categories: administrative factors, curricular factors, medical student factors, and librarian factors.

Librarian Factors

Theme 1: Professional Role**-** All librarians reported that assessment of EBM is a part of their professional identity and they see it as an integral part of their role in education of medical students. Unfortunately, current assessment practices are often driven by factors outside of their control.

Even though all librarians strongly felt that assessment was a task they should be involved in, too often administrative factors got in the way of being able to effectively do this:

> 'If you're teaching it, you should be assessing it'
> 'I definitely feel like assessment is part of my day-to-day work and not just assessment of the students, but assessment of the impact of what I'm doing as an instructor and as a librarian, which is more of a challenge than it sounds, to show that we're having impact'
> 'I 100% think a librarian or information professional or someone that is approved by a library should be assessing the PICO question and search skills.'

All librarians reported conducting assessments of some kind, usually essay style assignments with written formative feedback a current state is also reflected in the theme Administrative Factors – Staffing and Time. The opportunity to move forward with a new and potentially less time-intensive method of assessment is a great opportunity to address these previously identified barriers.

> 'Written feedback for written assignments, although this might change because the students are not liking it very much.'
> 'We write individual feedback, they all get an individual email. They're not graded on this, but they do get that evaluation'

Librarians also expressed a desire to use updated, more relevant assessment tools:

> 'the longer, the validated instruments, so Berlin and Fresno and whatever else is out there - there have been some validated search strategy evaluation tools over the years, but they're all kind of old and they were designed at a time when you had to do everything with PubMed, like UpToDate really was kind of new, Dynamed certainly didn't exist, and they - it just doesn't reflect, as you said, what they're doing at the bedside these days'

Theme 2: Novel EBM Assessment Tool**-** All librarians expressed appreciation for the novel format of the OSCE and the opportunity to observe student behaviors. Overall, this style of EBM OSCE was seen as a great opportunity to address and work around many identified gaps and barriers.

> 'Video for this type of thing is - it's a really great modality.'
> 'I think there's a major advantage to it because when you're dealing with, particularly first and second years, they don't have anything to hang it on, they don't understand this is all connected: this will be patient care, this helps make your decisions later, this helps make guidelines that you're going to be following later…I feel like the way you did this, it's so important because they start connecting like 'Aha! Yes, now it makes sense.''

Administrative Factors

Theme 3: Professional Respect- Medical school administrators need to understand the value added by HSLs to teaching and assessing EBM competency. Librarians reported that HSLs rarely feel welcomed as assessors of medical students and EBM curriculum and assessments tended to be para-curricular and low priority:

> 'I don't want to say that the college doesn't care about EBM, but it's rare - it doesn't come up very often and things related to exams and placements into residencies - those are the things that kind of drive everything.'

HSLs are concerned that administrative priorities are more tied to student satisfaction rather than learning outcomes:

> 'My experience is the thing that's going to impact the administrators is unfortunately student satisfaction surveys. And EBM tends to be one of the lower rated areas.'

And this lack of prioritization is frustrating and feels disrespectful of the expertise involved in teaching and learning EBM skills:

> 'there's also this lack of understanding about this as a skill-set that requires expertise and repetition and learning over time. We all have advanced degrees and it took us years to get where we are, and I just see over and over: 'oh, just go talk to a librarian, in 10 minutes you'll have your skill-set up, or 'oh, you can have this one hour in the curriculum over four years, and they should know everything.'

Improved relationships with medical school administration were proposed as one solution:

> 'I think, though, you have to have a certain relationship with your school of medicine, in order to be able to talk and convince them to do this'

Theme 4: Leadership Awareness- Addressing misperceptions through raising the awareness of medical school leaders to actual medical student EBM skills can be eye-opening and transformative.
Librarians are concerned about the perception that formal EBM education or assessment is no longer needed:

> 'The whole library [has been cut out of the curriculum] because 'students don't need it. Students are smart. They know how to find information' and I'm like 'no, they really don't, and they're putting out pretty crappy research.'' 'Leaders of the curriculum are often unaware of students' actual skill level'

Being made aware of students' EBM skills performance via direct observation has led to administrators seeking out HSL assistance:

> 'One of the coordinators saw the student searching on Night on Call and was like 'oh boy, they're not doing this well at all.' So her seeing that really opened her eyes and that helped bring us into the curriculum faster than I've ever gotten invited'

The evidence collected by NOC often serves as evidence that NOC and other EBM assessment interventions are necessary:

> 'it's very impactful to see those interactions on video'

Theme 5: Staffing- Adequate health science library staffing is critical to support educational needs.

Many libraries are short-staffed which leads to severe time limitation for educational activities such as assessment. Libraries that had more librarians on staff dedicated to education (as opposed to research, clinical, or administrative duties) were able to provide more robust assessments and were able to be more deeply integrated into the curriculum. These resource challenges (staffing and time) can hold back libraries from deeper involvement with EBM assessment even when the need is recognized by the institution.

> 'We only have one librarian for the whole medical school - all 28 departments.'

HSLs often have many other duties including providing written formative feedback on assignments. Even using a rubric, these assignments are time-intensive and therefore frequently de-prioritized. Even for HSLs with educational roles, they often have to split their time among different learner groups.

> 'I wish I could do that in more of the clerkships and possibly I could, but just personally, I'm also the liaison to the hospital nurses and all the medical residents and fellows, so there might be opportunity that I just don't have the bandwidth to do.'

Curricular Factors

Theme 6: Effective Partnership- Librarians were most effective teaching and assessing EBM when partnering with physician faculty who are engaged and excited about EBM, actively practicing it themselves, and understanding of the role of the librarian in this educational collaboration.

> 'If I could partner with faculty and really design something deeper, I think it'll be much more relevant for them [students] to see that sort of background of why that evidence is necessary.'
> 'I feel like when faculty aren't quite sure how to handle the evidence-based piece they kind of pass it off to the librarian, and then they don't attend those classes, they're not there, so they're not setting the tone for the students. if the faculty member that's teaching the course isn't there, then why should the students have to be?'

Having physician role models who exemplify the integration of EBM in clinical work is key. While librarians can explain, demonstrate, and assess most of the steps of EBM, they need to work alongside physician role models able to show how they use evidence to inform discussions and decisions in the care of patients. HSLs can support clinician role models to share their process and 'talk aloud' how they refine clinical questions, what sources they use, how they search, and what factors lead them to selecting evidence.

> 'That sort of goes back to having a strong tie-in with the clinical faculty who are teaching. Having them demonstrate what the value is and where it falls into clinical practice helps reinforce our roles, and also helps reinforce our authority in assessing and providing feedback'
> 'There is a lack of role modeling on the senior clinician level of what's a good thing to do. It's like people are just doing what they can do to get by and then Med students see that and skills just continue to degrade in each generation.'

Theme 7: Time**-** Shortened and packed curricula impacted librarians' ability to effectively assess EBM. This barrier is not unique to EBM.

> 'No matter how hard I try, because I've tried for over 20 years, we're getting less and less face to face.'

Accreditation requirements and accreditor visit cycles provide powerful incentive for medical schools to create curricular time for EBM, but this pressure wanes when deadlines pass:

> 'When they went under accreditation they were asked to put more [self-directed learning] in. Like all of a sudden they're really interested in self-directed learning, and we helped a lot with that. And then that [accreditation] happened so they don't need us anymore to prove that.'

The trend toward reducing the length of medical school curricula has exacerbated the problem of finding time in the curriculum for EBM:

> 'It's interesting that several of us have talked about sort of getting squeezed out a little bit, and ours really started when we did a curriculum reorg because the faculty were fighting amongst themselves for time, and they sure as heck were not gonna give the library class time.'

Medical Student Factors

Theme 8: Learner Self-Awareness- Understanding medical student skill levels and attitudes toward EBM are critical to driving effective learning and engagement.

While HSLs are well aware that medical students are highly variable in their ability to practice the basics of EBM, students and physician faculty and leadership were mostly unaware of actual skill levels making performance data critical to advocating for a more substantial HSL education role.

> 'The students are unaware of their own skill level and what it means'

Opportunities to apply EBM skills, either by conducting literature reviews for research projects or applying skills directly in clinical practice, make a difference:

> 'I've had students come back [and say]: 'I was way ahead of a lot of people in my residency program, because I can search PubMed very well!' and it's because they've had a research project where they've had to do a literature review, and they really have something to hang it on and it's something they're interested in. And then if they publish, that's a whole other level, you know?'

Medical students' engagement with EBM curriculum is also highly variable [17-19] despite the fact that HSLs work hard to communicate the importance of EBM and its relevance to clinical care.

> 'There were a minute number who took it seriously, and [when] we asked for reflection at the end, some of them were like 'wow this is transformational, this is great, I didn't know' and then others were like 'this is a waste of time'

> ‘So we get rejected by the undergraduate students quite frequently. They don’t - they tell the Office of Education they don’t need us, they know how to search the web, so it’s you know, it’s such a sad song’
> ‘I just talked with a student who did this [assignment] a couple of years ago, and that was a big joke for him. Like I looked, and I had given him very poor feedback because he picked some really strange sources, and he said he did it to be funny.’

Raising the visibility of librarians in clinical work could have a favorable effect on student attitudes:

> ‘I feel like if they start seeing librarians as part of the team, that helps them too as they become a physician, whether they’re rotating at the hospital or not’

Discussion

We aimed to explore the health sciences librarian perspective on their role in EBM competency assessment of medical students. Eight primary themes emerged from an analysis of wide-ranging conversations with who had a shared experience of an EBM station embedded in a comprehensive clinical OSCE taken by senior medical students [14,15].

The most consistent theme in our data was that librarians are activated. They are ready to get out there and assess medical students in more robust and impactful ways. This echoes previous qualitative research on librarian roles [6,8]. There is a growing awareness of the need for consistent and extensible tools. HSLs appreciated a screen-recorded OSCE as a novel way to assess EBM competency because it addresses the perceived lack of consistency in assessment of EBM. This OSCE was seen as an interesting opportunity to set expectations and examine behaviors across schools nationally. Librarians have the skills and interests to engage in EBM assessment, but desire and often lack a pathway to collaborate with others on these types of assessment efforts.

While the librarians were excited about their roles as assessors of EBM and the potential of OSCEs, professional respect, leadership awareness of EBM skills, and limited staff emerged as consistent administrative barriers to implementing assessment plans. Most librarians felt that progress on assessing EBM competency would not be possible until these barriers were addressed by those at the administrative level and more resources were secured to support these efforts.

Themes that emerged relating to the curriculum are similar to issues that impact other competency content areas. Librarians expressed that having partnership with clinicians who are skilled practitioners of EBM led to the best outcomes driving impactful teaching, assessment, and clinical implementation of EBM skills. Additionally, although curricular time is limited this is certainly not a barrier unique to EBM. At many institutions, EBM content is taught and assessed outside of the standard curriculum. Integrating this work into the formal curricular structure would help alleviate the limited time concerns of librarians and would raise student awareness about the importance of this skill set for their future clinical practice. Despite years of progress, these themes are consistent with findings from Maggio's work [6,7,9]. Librarians are trying to shoulder the burden of EBM teaching and assessment, but in order to do so most effectively, strong clinical role models are still needed to reinforce their efforts.

Student self-awareness of the need to gain EBM competency is critical. Most librarians felt that the majority of medical students had limited awareness of their own skill level in practicing EBM. Worse than that, many medical students display poor attitudes when being taught or assessed by librarians. Medical students with poor attitudes were felt to be unaware of the impact of their attitudes both on their own learning and clinical competence and the demoralizing effect on the librarians teaching and assessing them. As has been documented in previous studies, student efficacy and self-awareness are necessary elements to effective EBM teaching and assessment [7,9].

The barriers surfaced in this study should be viewed as opportunities for improvement. Innovations such as self-paced, asynchronous, and recorded modules could be implemented to integrate EBM throughout curricula to help with both time and staffing limitations. EBM assessment programs can be used to raise awareness of the variability in competence for both medical school leadership and students. A well-designed and maintained EBM OSCE can serve as a needs assessment of student competency and a way of monitoring the impact of curricular changes.

EBM OSCEs address many of the barriers discussed, they can facilitate less time-intensive grading, they are familiar and acceptable to students, and librarians and faculty/administrators and they directly connect EBM to clinical work. Once established the assessment information captured in this style of OSCE is likely to provide convincing evidence that will increase buy-in for EBM in the curriculum. Advocacy for library resources is needed. The NOC program, because it produces comparable data across institutions that need to address the same accreditation EBM requirements, may help individual libraries and groups of librarians obtain institutional buy-in.

Limitations

There are several limitations of our study. While our sample of librarians drew from diverse locations, types, and sizes of medical schools, due to Covid-19 the focus groups were conducted a year after these librarians participated in assessing medical students using the NOC format a delay which could have influenced recollection. Additionally, with most educational programs shifting to asynchronous formats for the year, the librarian's educational contributions may have been more cut out than usual as schools shifted focus to absolute essentials and cut staffing levels. This could have influenced HSLs perceived barriers, especially their perceptions of administrative factors. As with all qualitative studies there are many possible ways to interpret the data. The two study authors who coded and analyzed the data are practicing medical librarians. They approached this study with reflexivity as to their own roles and the lens they were bringing to the tasks.

Conclusion

Librarians identified administrative, curricular, medical student, and librarian factors that acted as barriers and facilitators to effectively assessing EBM behaviors in medical students. Our results point out to medical school leaders the modifiable factors that enable librarians to be more engaged in providing effective feedback. These findings can also help librarians to advocate for themselves and their roles in assessment and highlight the need for novel tools, like a librarian-led EBM OSCE, that can address multiple barriers and create new opportunities for deeper integration of librarians into assessment processes.

Acknowledgments and Disclosures

Acknowledgments
The authors wish to thank the focus group participants for sharing their views and experiences.

Funding/Support
The authors thank the Medical Library Association for its support of this project via the 2022 MLA Research, Development, and Demonstration Project Grant.

Competing Interests
None reported.

Ethical approval
This study was reviewed and deemed to meet exempt status by the NYU Langone Health Institutional Review Board.

Disclaimers
None reported.

Previous presentations
Presented at EAHIL 2022; Rotterdam, Netherlands; June 2022.

References

1. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.
2. Albarqouni L, Hoffmann T, Straus S, et al. Core Competencies in Evidence-Based Practice for Health Professionals: Consensus Statement Based on a Systematic Review and Delphi Survey. JAMA Network Open. 2018;1(2):e180281-e180281.
3. Association of American Medical Colleges. Core Entrustable Professional Activities for Entering Residency: Faculty and Learners' Guide. Washington, D.C.: AAMC; 2014.
4. Braschi E. Don't just blame the evidence: considering the role of medical education in the poor uptake of evidence-based medicine in clinical practice. BMJ Evid Based Med. 2018;23(5):169-170.
5. Nicholson J, Spak JM, Kovar-Gough I, Lorbeer ER, Adams NE. Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students. BMC Med. Educ. 2019;19(1):330.
6. Maggio LA, Durieux N, Tannery NH. Librarians in Evidence-Based Medicine Curricula: A Qualitative Study of Librarian Roles, Training, and Desires for Future Development. Med. Ref. Serv. Q. 2015;34(4):428-440.
7. Maggio LA, ten Cate O, Chen HC, Irby DM, O'Brien BC. Challenges to Learning Evidence-Based Medicine and Educational Approaches to Meet These Challenges: A Qualitative Study of Selected EBM Curricula in U.S. and Canadian Medical Schools. Acad. Med. 2016;91(1):101-106.
8. Dorsch JL, Perry GJ. Evidence-based medicine at the intersection of research interests between academic health sciences librarians and medical educators: a review of the literature. J. Med. Libr. Assoc. 2012;100(4):251-257.
9. Maggio LA. Educating physicians in evidence based medicine: current practices and curricular strategies. Perspect Med Educ. 2016;5(6):358-361.
10. Zwolsman SE, van Dijk N, te Pas E, Wieringa-de Waard M. Barriers to the use of evidence-based medicine: knowledge and skills, attitude, and external factors. Perspectives on Medical Education. 2013;2(1):4-13.
11. Kumaravel B, Stewart C, Ilic D. Development and evaluation of a spiral model of assessing EBM competency using OSCEs in undergraduate medical education. BMC Med. Educ. 2021;21(1):204.
12. Frohna JG, Gruppen LD, Fliegel JE, Mangrulkar RS. Development of an evaluation of medical student competence in evidence-based medicine using a computer-based OSCE station. Teach. Learn. Med. 2006;18(3):267-272.
13. Tudiver F, Rose D, Banks B, Pfortmiller D. Reliability and validity testing of an evidence-based medicine OSCE station. Fam. Med. 2009;41(2):89-91.
14. Kalet A, Zabar S, Szyld D, et al. A simulated "Night-onCall" to assess and address the readiness-for-internship of transitioning medical students. Adv Simul (Lond). 2017;2:13.
15. Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. J. Med. Libr. Assoc. 2020;108(2):219-228.
16. Charmaz K. The Power of Constructivist Grounded Theory for Critical Inquiry. Qualitative Inquiry. 2017;23(1):34-45.
17. Vyas KS, Stratton TD, Soares NS. Sources of medical student stress. Educ Health (Abingdon). 2017;30(3):232-235.
18. Voltmer E, Kotter T, Spahn C. Perceived medical school stress and the development of behavior and experience patterns in German medical students. Med. Teach. 2012;34(10):840-847.
19. Byrnes C, Ganapathy VA, Lam M, Mogensen L, Hu W. Medical student perceptions of curricular influences on their wellbeing: a qualitative study. BMC Med. Educ. 2020;20(1):288.

5

"That's definitely gonna be important" Medical Student Perspectives on a Simulation-Based Evidence-Based Medicine Competency Assessment

This chapter is currently under review for publication as:
Nicholson J, Plovnick C, Magro J, van der Vleuten C, de Bruin ABH, Kalet A. "That's definitely gonna be important" Medical Student Perspectives on a Simulation-Based Evidence-Based Medicine Competency Assessment.

Structured Abstract

Introduction
We expect medical students to be able to apply evidence-based medicine (EBM) skills in the context of the clinical care of patients, but until now assessment of this domain has focused primarily on decontextualized knowledge tests. New performance-based EBM competence assessments using Objective Structured Clinical Examinations (OSCEs) are being developed and tested: Understanding how students experience and interact with this simulation-based assessment of EBM competence would enable us to improve the modality.

Method
We recruited graduating medical students from one medical school who had recently completed an immersive multi station readiness-for-residency OSCE (Night onCall) which included a case-based EBM assessment and conducted individual interviews to explore their perceptions of receiving EBM feedback. The interviews were transcribed, coded, and analyzed by three health science librarians.

Results
Students discussed their experience and perceptions in six main areas: connection to clinical practice, curricular timing and content coverage, feedback, station instructions, awareness of their own limitations, and an OSCE as a format for assessing EBM.

Conclusion
Medical students appreciated the EBM OSCE because it enhanced their learning about how to integrate EBM into clinical practice. They proposed implementing multiple such opportunities throughout medical school because it would improve their competence and provide highly impactful opportunities to build toward EBM mastery. They endorsed that this would be well-accepted by medical students.

Introduction

While evidence-based medicine (EBM) is an essential competency for practicing physicians [1,2] medical student training and assessment in this competency is inconsistent and focused primarily on written assessments of knowledge. Strategies to build authentic, contextualized EBM competency assessments are emerging [3,4]. EBM Objective Structured Clinical Evaluations (OSCEs) are one method being used to both assess competence and provide students feedback to enable development of EBM skill mastery [5-8]. However, this modality is new. We have a limited understanding of how medical students experience EBM OSCE stations. Understanding students' feedback and preferences and incorporating these perceptions into improving EBM competency assessments could improve the quality and safety of patient care provided by these individuals in the future.

To practice EBM, medical students must formulate focused, structured questions, search for related evidence, critically appraise and integrate this evidence with their own clinical experience and patient values [9,10]. Beyond the immediate impact on patient care, practice of EBM promotes lifelong learning by ensuring one keeps updated on the latest research and clinical guidance. As medical students progress through their training, they will face increasingly complex patients, and EBM helps them navigate complicated decision-making by providing a framework for grounding their reasoning in trustworthy evidence.

Assessing competency in practicing EBM requires development of standardized tools enabling direct observation and assessment of behaviors in clinically authentic settings. EBM OSCEs provide an opportunity for students to apply EBM principles in a realistic but simulated patient care scenario [7,11-13]. A key benefit of this method is the ability to observe each step in the EBM process and provide actionable feedback so that students can continue to improve their competence. Understanding the student experience will help develop better EBM OSCE stations and ensure that we maximize the educational benefits of assessing competence using this strategy.

This study aims to explore the views and preferences of medical students taking an EBM OSCE in order to describe factors that lead to a successful experience that motivates students to further refine their competence and informs future development and refinement of EBM OSCEs as an assessment strategy.

Method

Design

We chose to conduct semi-structured medical student interviews about their experiences participating in this OSCE because this method enabled us to explore individual perceptions about the experience in detail, and generate extensive guidance to improve the impact of this activity. Institutional IRB review led to the determination that this activity was primarily quality improvement. However, we did obtain informed consent and anonymized data prior to analysis to ensure participant confidentiality.

An iterative process was used to develop the semi-structured interview guide. Questions and prompts were initially developed based on a literature review and refined in discussion with co-authors to focus on the following key topics: student performance, feedback preferences, station logistics, connection to curriculum, connection to real-life behaviors, and other perceptions about assessment of EBM competency.

Setting and Participants

All 107 graduating medical students in the NYU Grossman School of Medicine Class of 2022 who completed the Night onCall OSCE were eligible to participate and were recruited via an email. A 2022 Medical Library Association (MLA) Research, Development, and Demonstration Project Grant allowed us to provide participants a $25.00 gift card as an incentive. Recruitment continued until the authors felt that data saturation had been reached, or in other words when new data points no longer appeared in the interview responses to the semi-structured questions.

Data Collection

One study author (JN) conducted these semi-structured 30-minute interviews using the question guide via Zoom and audio recorded and transcribed using the automatic transcription feature. Transcripts were verified and corrected using the audio recordings. The interviewer also kept field notes during the interviews to aid in editing and verifying transcripts. Following verification, the transcripts were anonymized.

Data Analysis

Study authors (JN, CP, JM) independently read all transcripts and developed an initial round of codes. They then met to discuss code definitions and a coding structure which when agreed upon, was applied to the transcripts using the Dedoose software (SocioCultural Research Consultants). Each transcript was

blind double-coded using open coding, the coding framework and memoing. Following coding, the authors met to discuss common themes, discrepancies in interpretation and to generate themes.

Reflexivity

We acknowledge that the conduct and results of this study are co-constructed among the authors and the participants. The interviewer (JN) has a master's degree in library and information science and a master's degree in public health. He has been working as a health sciences librarian for 18 years. The interviewer (JN), transcribers (JN, CP, JM), and coders (JN, CP, JM) are all practicing health sciences librarians actively engaged in teaching and assessment of EBM.

Result

A total of 13 graduating medical students participated in individual interviews following their experience participating in Night onCall. The 9 main codes and 12 sub-codes were applied 587 times across the 13 transcripts. See Table 1.

Thematic Analysis

Six primary themes emerged that highlight medical student experiences and preferences in participating in an EBM OSCE station.

Theme 1: EBM has a clear connection to clinical practice.

Students appreciated that they were being tested and receiving feedback on a competence they knew was important to clinical practice. They explained that their performance in this OSCE wasn't always reflective of how they would do the same thing in an actual clinical setting. In practice, they report being able to use the apps and bookmarked websites on their phones that they know and trust, as opposed to always having to open new tabs and begin searches from scratch. At the same time, they reported that participating in this OSCE helped make it clear to them when and how to use EBM in a more clinically effective way.

> *"I think when we learn these things we're like, "oh yeah, that's definitely gonna be important" but you don't realize how important until you really have both been in situations where you need to answer a question and are imminently faced - like it feels more real now that I'm going to be alone at times, and not have access to people to just ask questions to."*

Table 1 Code Frequency Distributions

Primary Codes and Subcodes	Frequency of Use	Primary Code Category Totals
Challenges in Completion	16	119
• Time Constraints	32	
• PICO Questions	28	
• Station Instructions	43	
Perceived Performance	4	106
• Overall Performance	26	
• Asking a Question Performance	25	
• Searching Database Performance	21	
o Named a Resource	28	
o Named a Mobile Device	2	
Station Expectations	14	75
• Self-Performance Expectations	14	
• Assessment Expectations	47	
Future Recommendations	62	62
Feedback to Students	24	56
• Individualized Written Feedback	13	
• Best Practice Video Feedback	19	
Timing/Frequency of EBM OSCE	52	52
Connection to Curriculum	46	46
EBM Behavior in Clinic vs OSCE	43	43
Impact of Participating	28	28
All Codes		587

"I've seen people do this even in clinical practice in my rotations, if there is a clinical question that comes up, it's important to be able to identify the question in a timely manner, and use the right terminology to find the answers that you need, and also be able to find the resources to answer your questions."

"One thing I did like about this is I feel like sometimes when I'm doing clinical encounters with patients, either in the hospital, or even during OSCEs I'm not necessarily thinking of a clinical question I can Google, it's just like more abroad [sic]. So I think one thing I liked about the station was to stop think of one question you can answer, and one question you can even make a presentation

for your co-residents, or something, because, instead of just like doing a general search and finding general information, so I like that a lot."

Theme 2: Integration of EBM OSCEs should occur earlier in the curriculum to allow for practice and mastery.

Students stressed that there was too big of a gap between when they were taught this content and the timing of this station. Three specific recommendations surfaced multiple times. First, they suggested we introduce an EBM OSCE station near the beginning of clerkships to help set clear standards for performance and time to practice during clerkships. Second, students specifically requested that we introduce an EBM OSCE station during Sub-Internships when they are most actively practicing this skill set. And third, they asked that we expand the clinical areas covered in the EBM OSCE to reflect specialties beyond primary care adult medicine.

"I feel like this would be almost something that would be useful, like before your clerkship year or during your clerkship year. I thought a lot of this stuff that we did would actually be really useful to have during your sub-I because you do have some of these responsibilities. This is when you're learning all of these responsibilities, learning more to be like an intern which I guess is the point of all these stations."

"if the purpose is for us to be able to implement something new or to grow. I think that having multiple chances to take a shot at it is always helpful. So I think it would have been helpful. I actually think it probably could have been helpful to have that before clerkship year. And just maybe have like gotten feedback on: Okay, this is what you did and here's another thing that you can do for next time. And then had the chance to get reassessed after clerkships to see if we've been able to incorporate some of the feedback."

Theme 3: Feedback is important to build and solidify competence.

Students all indicated that timely feedback was essential to the success of learning from their OSCE experience but they differed on the type of feedback they preferred. Students who felt they did well in the Night onCall EBM OSCE station expressed a desire to see a video of a best-practice model answer to the station. Those who felt like they had room to improve wanted actionable individual feedback tailored to their own performance.

"if it's individualized feedback I think I'm more likely to remember at least one of those pointers and incorporate it next time versus in the more generalized

feedback. I think, as a student as someone with a busy schedule there's always the chance that I don't even watch the 2 min video."

"I think a model is great - I don't think it needs to be individualized. I think that would be a lot of work on all of your ends and then we're all intelligent individuals and can look at what our search was like if you provide us what we searched in retrospect, and then what a model search would be like, we can all tailor our searches from there. "

Theme 4: Low self-confidence in ability and perceived skill to effectively and efficiently perform searches.

Students noted two main concerns regarding on how well the EBM competency OSCE reflected their EBM proficiency- time on task and technical proficiency. Some students believed that the time limit prevented them from demonstrating their full ability. In particular, students who reported having a background in conducting research noted that they were used to having more time to do searches and interpret and apply results. Other students reported a lack of confidence in their technical ability to perform searches using standard tools such as PubMed and attributed this low self-confidence to having had little coaching on these skills during the clinical years.

"I'm just not that adept at like…I can figure it out in PubMed, but not that quick. So I was like, there's no time, I must find the answer from a quick search."

"When I do a literature search I try to take my time with it, and given the time constraints, I had to arbitrarily pick data or pick searches that I wouldn't normally do"

Theme 5: OSCE stations on novel tasks are cognitively challenging.

While all the medical students reported they were able to adequately complete the station, they did express surprise at encountering a novel task in simulation so close to graduation. Students provided detailed recommendations for improving station instructions and they expressed a desire to have this type of stations introduced earlier in their medical school experience. They believed this would help students focus their attention on completing the tasks rather than understanding instructions.

"I remember for me feeling like: Well, I spent the whole first three minutes figuring out what I was supposed to do and then I have like six minutes to do it."

"I never read instructions well when I'm in the OSCE situation. I've always found that oral instructions at the beginning, and then reminders at the station work best for me."

"a lot of that OSCE was just very different than the OSCEs that we've had in the past. And so I think, at least for me, a lot of it was spent just trying to understand the system."

Theme 6: A simulated clinical context, like an OSCE, is an impactful way to practice and gain feedback on EBM skills.

Students reported feeling that an EBM OSCE aligned well with simulations of other clinical competencies. This helped them realize that EBM skills are clinical skills they will be responsible for practicing. All of the students requested more chances to practice and get feedback on this important set of skills.

"I think the main takeaway – I feel like there's always this divide between formulating a PICO question and then maybe doing a literature search or something like that, what we might do research-wise, and then what we actually do in the hospital. And I feel like in the hospital we're usually just going by protocol or going by what we see other people doing rather than actually sitting down ourselves and doing a literature search. And so I feel like this sort of provided a scenario when we could practice creating this link between a clinical situation and then that sitting down and literature-searching type of situation."

"My takeaway was that I still have not mastered that skill! I could definitely get better at quickly finding those answers still, or I guess finding them at all, because I didn't really find a great answer. So I guess I probably need both more practice and more instruction in the PubMed part."

Discussion

In this study of medical students' experiences and preferences of an EBM OSCE station six primary themes emerged.

Medical students were enthusiastic about the opportunity to practice and receive feedback on their EBM skills especially because it was integrated into a comprehensive clinically authentic simulation. Historically this content is most frequently taught in the pre-clinical years. Situating this assessment integrated with other clinical skills helps emphasize and deepen the connection to clinical practice [14,15].

Having recognized the clinical importance of practicing EBM, near graduating students expressed a desire to have had more frequent and earlier EBM OSCE stations. They recommended having opportunities for this assessment throughout their clinical years, at least: one at the beginning of clerkships, and one during their sub-internships. Students would be better able to practice EBM clinically and master this set of skills prior to graduation if they were given multiple opportunities to be assessed and receive feedback. Introducing this type of assessment earlier would also serve to familiarize students with this type of competency assessment, reducing the extraneous cognitive load associated with figuring out the tasks under time restraint, enabling them to more accurately demonstrate their ability to do the components of the task germane to competency in authentic clinical settings [16,17].

Students also commented that they would prefer the EBM OSCE station to feature subject matter related to their chosen specialty. By aligning and developing new EBM OSCE stations in partnership with clerkship directors, we could meet the goal of more frequent opportunities for practice, broaden the subjects covered and tailor these assessments so that, when appropriate they are relevant to the student's chosen career path.

Feedback was seen as a key component of learning from this station. However, students differ about what kind of feedback they preferred. Students that self-identified as more experienced in research wanted to be able to walk away with a video model of best practice that they could keep as a reference. Students that self-identified as weaker at this skill set were hoping for individually tailored actionable feedback based on their specific performance. This is further supported by research on the expertise reversal effect in cognitive load theory [18]. For novice learners, worked examples with step-by-step instructions and individual guidance are helpful for learning. For more advanced learners, fully worked examples with individual guidance become redundant and can lead to expertise reversal and worse performance [19-21]. Taking this into account, using a fading guidance strategy in providing feedback will be more effective for the learners [22]. These recommendations align with introducing multiple EBM OSCEs throughout medical schools. The OSCEs taking place earlier in the curriculum could have tailored feedback, and as students become more experienced and skilled they could receive less guidance.

Students did point out some frustrations and problems with this station. Their difficulties hinged on their self-reported kind of experience. Students with a heavy research background were more used to having a lot of time to search for and synthesize evidence. These students struggled with the time limit. Students with limited research experience struggled with the best ways to search for evidence. These students felt that they could not excel in this station

because of their limited technical skill. Both time limitation and technical skill are expected and desirable difficulties that force students to critically examine their habits and assumptions. Despite students reporting these as frustrations, they also reflected on them as learning opportunities. This self-reflection is a critical part of facilitating transformative learning [23]. Knowing this we can provide feedback and advice tailored to student experience and focused on raising student awareness of their proficiency or lack thereof.

Operationally, students understood the instructions and were able to complete the station. However, when pressed for suggestions, they suggested a variety of improvements ranging from announcing the instructions aloud, to reviewing the instructions for each station before the OSCE begins, to allowing preview of the instructions the week before. The common theme in their suggestions was that they were surprised to be experiencing a station that was new to them so close to graduation. Cognitive load theory is important to consider here. In performing tasks like EBM with many elements and a high degree of interactivity, the intrinsic load is high. This becomes problematic if the extraneous load of processing new instructions is also high, leading to weaker performance due to the additive cognitive load [16,18]. Instead of changing the instruction delivery, this discomfort could be addressed by having a station in this format occur throughout the curriculum, thus decreasing the extraneous load and allowing students more time to focus on the task at hand [24].

Limitations

There are several possible limitations for our study. Our volunteer sample of medical students are a snapshot of graduating medical students from one medical school. The experiences, needs, and preferences of students could differ depending on their unique backgrounds and medical school curricula. Qualitative data can be interpreted in many ways. The three study authors who coded and analyzed the data are practicing medical librarians who teach and assess EBM. We approached this study with a desired to maximize the trustworthiness of the findings through reflexivity and by incorporating memoing, field notes, independent descriptive coding, iterative discussions and adjudication of disagreements in order to come to shared, constructed interpretations. Our process did not include activities such as member checking to enhance validity. Instead, we felt that our expertise and prolonged exposure in the field when combined with thematic saturation of the data were sufficient.

Conclusion

Medical students appreciated having the opportunity to take an EBM OSCE. Students liked this OSCE and saw a great value in it as a learning experience. They recognized that the OSCE also helped them solidify how EBM integrates into clinical practice. Their experience could be improved by having multiple opportunities throughout medical school to participate and receive feedback on their performance in this OSCE. From this study we are confident that implementing a series of EBM OSCEs would be well-accepted by medical students and a powerful opportunity to both assess competence and build mastery. Ultimately, all this could lead to higher quality and safer clinical care of patients.

Acknowledgements and Disclosures

Acknowledgements
The authors wish to thank the medical students for sharing their views and experiences.

Funding/Support
The authors thank the Medical Library Association for its support of this project via the 2022 MLA Research, Development, and Demonstration Project Grant.

Other disclosures
None reported.

Ethical approval
This study was reviewed and deemed to meet exempt status by the NYU Langone Health Institutional Review Board.

Disclaimers
None reported.

References

1. Association of American Medical Colleges. Core Entrustable Professional Activities for Entering Residency: Faculty and Learners' Guide. Washington, D.C.: AAMC; 2014.
2. Lomis K, Amiel JM, Ryan MS, et al. Implementing an Entrustable Professional Activities Framework in Undergraduate Medical Education: Early Lessons From the AAMC Core Entrustable Professional Activities for Entering Residency Pilot. Acad. Med. 2017;92(6):765-770.
3. Dawes M, Summerskill W, Glasziou P, et al. Sicily statement on evidence-based practice. BMC Med. Educ. 2005;5(1):1.
4. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.
5. Kalet A, Zabar S, Szyld D, et al. A simulated "Night-onCall" to assess and address the readiness-for-internship of transitioning medical students. Adv Simul (Lond). 2017;2:13.
6. Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. J. Med. Libr. Assoc. 2020;108(2):219-228.
7. Kumaravel B, Stewart C, Ilic D. Development and evaluation of a spiral model of assessing EBM competency using OSCEs in undergraduate medical education. BMC Med. Educ. 2021;21(1):204.
8. Buljan I, Jeroncic A, Malicki M, Marusic M, Marusic A. How to choose an evidence-based medicine knowledge test for medical students? Comparison of three knowledge measures. BMC Med. Educ. 2018;18(1):290.
9. Maggio LA. Educating physicians in evidence based medicine: current practices and curricular strategies. Perspect Med Educ. 2016;5(6):358-361.
10. Maggio LA, ten Cate O, Chen HC, Irby DM, O'Brien BC. Challenges to Learning Evidence-Based Medicine and Educational Approaches to Meet These Challenges: A Qualitative Study of Selected EBM Curricula in U.S. and Canadian Medical Schools. Acad. Med. 2016;91(1):101-106.
11. Tudiver F, Rose D, Banks B, Pfortmiller D. Reliability and validity testing of an evidence-based medicine OSCE station. Fam. Med. 2009;41(2):89-91.
12. Frohna JG, Gruppen LD, Fliegel JE, Mangrulkar RS. Development of an evaluation of medical student competence in evidence-based medicine using a computer-based OSCE station. Teach. Learn. Med. 2006;18(3):267-272.
13. Fliegel JE, Frohna JG, Mangrulkar RS. A computer-based OSCE station to measure competence in evidence-based medicine skills in medical students. Acad. Med. 2002;77(11):1157-1158.
14. Bierer SB, Dannefer EF, Taylor C, Hall P, Hull AL. Methods to assess students' acquisition, application and integration of basic science knowledge in an innovative competency-based curriculum. Med. Teach. 2008;30(7):e171-e177.
15. Kulasegaram K, Manzone JC, Ku C, Skye A, Wadey V, Woods NN. Cause and effect: testing a mechanism and method for the cognitive integration of basic science. Acad. Med. 2015;90(11):S63-S69.
16. Young JQ, Van Merrienboer J, Durning S, Ten Cate O. Cognitive Load Theory: implications for medical education: AMEE Guide No. 86. Med. Teach. 2014;36(5):371-384.
17. Paas F, Renkl A, Sweller J. Cognitive load theory and instructional design: Recent developments. Educ. Psychol. 2003;38(1):1-4.
18. van Merriënboer JJ, Sweller J. Cognitive load theory in health professional education: design principles and strategies. Med. Educ. 2010;44(1):85-93.
19. Kalyuga S, Chandler P, Tuovinen J, Sweller J. When problem solving is superior to studying worked examples. J. Educ. Psychol. 2001;93(3):579.
20. Salden RJ, Aleven VA, Renkl A, Schwonke R. Worked examples and tutored problem solving: redundant or synergistic forms of support? Top. Cogn. Sci. 2009;1(1):203-213.
21. Renkl A, Atkinson RK. Structuring the transition from example study to problem solving in cognitive skill acquisition: A cognitive load perspective. Educ. Psychol. 2003;38(1):15-22.
22. Atkinson RK, Renkl A, Merrill MM. Transitioning from studying examples to solving problems: Effects of self-explanation prompts and fading worked-out steps. J. Educ. Psychol. 2003;95(4):774.
23. Mezirow J. An overview on transformative learning. Lifelong learning. 2008:40-54.
24. Pollock E, Chandler P, Sweller J. Assimilating complex information. Learning and instruction. 2002;12(1):61-86.

6

Discussion

To practice evidence-based medicine (EBM) medical students will need to learn and consistently use a critical set of behaviors in the ever-changing, increasingly complex landscape of medical knowledge. Librarians should assess medical students on this content because they are the ones most often responsible for EBM teaching in medical schools. However, as this research suggests, the current state of librarian-led assessment of EBM is sub-optimal.

In this chapter I will provide an overview of research findings from each study and explore the theoretical contributions and limitations of the studies. Then, I will highlight practical implications for implementation and considerations for future directions.

Summary of Findings

Chapter 2 provided evidence of a gap in assessment practices. We conducted a survey among Association of Academic Health Sciences Libraries (AAHSL) member libraries to assess librarian awareness of and engagement in teaching and assessing Entrustable Professional Activity (EPA) 7. The survey results showed that while 90% of respondents were regularly involved in teaching or assessing aspects of EPA 7, only 39% were explicitly engaged in a Core EPA 7 project, with librarian initiation accounting for 44% of these projects. Involvement in assessment was consistently lower than involvement in teaching, though this varied by task within EPA 7. We conclude that there is an untapped opportunity for librarians to collaborate more extensively in medical education by actively participating in the teaching and assessment of EPA 7, which can contribute to the enhancement of existing curricula and assessments related to this professional activity.[1]

Chapter 3 explored the use of Optimal Foraging Theory as a novel way to describe and understand student's behaviors within an EBM simulated scenario. The results showed that half of the participants relied on only one information source before answering the question, with point-of-care tools being the most frequently used resource. While participants demonstrated proficiency in navigating point-of-care tools and search engines, searching PubMed was less common and had a lower success rate. The study did not find any associations between information-seeking patterns and the quality of answers. The findings suggest that OFT is a valuable framework for describing and assessing the information-seeking practices of medical students. Based on the patterns observed, a rubric was developed to assess behaviors via observation at each step that are well done, partially done, or not done.[2]

Chapter 4 investigated what librarians think about implementing assessment of EBM using the theory-informed and behaviorally-anchored rubric described in Chapter 3. The analysis identified eight themes, grouped into four categories: administrative, curricular, medical student, and librarian. The themes revealed factors that influenced the success of librarians' involvement in effective EBM assessment, including facilitators and barriers, feedback mechanisms, and the need for novel assessment tools. The results provide insights for medical school leadership to engage librarians in providing effective feedback, while also highlighting the importance of innovative tools for deeper integration of librarians into the assessment process. The rubric we developed was seen as a useful tool, but a stand-alone tool without support and integration from educational leadership will not be sufficient for sustainable programs of assessment.

Chapter 5 examined medical student opinions on assessment of EBM as a part of a comprehensive OSCE and how EBM stations could be best implemented for their learning. The analysis identified six main areas discussed by the students, including the connection to clinical practice, timing and content coverage in the curriculum, feedback, station instructions, awareness of limitations, and the OSCE format for assessing EBM. The findings revealed that students appreciated the EBM OSCE as it enhanced their understanding of integrating EBM into clinical practice. They proposed implementing multiple similar opportunities throughout medical school to improve their competence and build towards EBM mastery, and they believed that this approach would be well-accepted by medical students. These insights can contribute to the improvement and implementation of performance-based EBM competence assessments. This was a novel OSCE station for these students. Prior to engaging in this experience, students did not consider the practice of EBM key to clinical practice. Fortunately, from this study we learned the impact and future potential of librarian-led assessments of EBM competence.

General Discussion

This research contributes to both theoretical elaboration and practical application in the literature in three ways: (1) development of an innovative EBM assessment tool and methodology, (2) increased understanding of medical student desires around EBM performance assessment, and (3) increased understanding of librarian-led EBM assessment practices.

Building on theories on information-seeking behaviors and theories of assessment, this research provides new approaches to assessment of EBM behaviors. The EBM assessment rubric was designed using a strong theoretical foundation to

describe observed behaviors in medical students. Prior to this, no theory-based observational instruments had been created that would assess level of EBM competence.[3,4] This is also reflected in real-world practice where studies observing use and application of EBM in a clinical setting have found that it is either not happening[5] or not recognizable because many steps become automatic and habitual.[6] Furthermore, the existing EBM teaching and competency frameworks are broad enough that critical observation of each step is not possible.[3,4,7] Having a robust elaboration of what EBM behaviors one might be able to observe is an essential first step towards being able to assess competence. Optimal Foraging Theory (OFT) provides a framework likely to be applicable to clinical information seeking. Despite being applied in other contexts, only one research paper has investigated use of OFT as a way to describe and assess the effectiveness and efficiency of clinician information seeking.[8] Originating from evolutionary ecology, OFT views information seekers as foragers who navigate among patches (i.e. databases) to find their prey (i.e. answers). Using this lens, OFT explores and explains how each action in searching is a behavioral decision point. In an ideal searching scenario, a searcher will optimize time spent gathering relevant information by initially starting at known reliable databases and leveraging database features to save time and more quickly find a satisfactory answer, rather than consulting sources that will give you the highest amount of potentially unreliable information. Time spent on any action while seeking information is a primary indicator of efficiency. A busy clinician will have limited time and will need to make choices when seeking information among several potential sources. OFT provides a way to understand those choices as trade-offs with costs and benefits, thus contributing to an assessment framework centered around effective and efficient information seeking processes. Incorporating OFT into EBM observation supports the development of more nuanced EBM assessment approaches that go beyond database mechanics.

This approach also aligns with performance-based assessment theories. Performance-based assessment highlights the need for learners to demonstrate their skills, rather than relying solely on knowledge-based tests. When thought about as a continuum of assessment, performance-based criteria are the observable behavioral indicators that can help inform competency assessment.[9,10] Performance-based assessment is frequently used on physical tasks, like technical surgical skills, and is increasingly used for cognitive tasks like communication or history-taking.[11-16] Unfortunately, existing EBM assessment tools have not yet developed to the point of being able to incorporate observed performance. There were other efforts to assess EBM competence through observed performance in the early 2000s, but these projects did not continue.[17] The lack of validated assessment tools with the ability to assess observed performance of EBM is continually noted in

the literature.[3-5,18,19] Most currently used EBM assessment tools require written search strategies for specific databases, such as MEDLINE via Ovid or PubMed.[20-22] This style of assessment does show if the learner has correct knowledge about the prescribed literature database mechanics. However, real world behaviors are not limited to one database and not all databases are equally available at all institutions. In order to realistically assess performance, an EBM assessment tool needs to be based on sound information-seeking theories and contain an elaboration of what behaviors one might expect to observe. Through breaking down the competency of EBM searching into observable behaviors, we have created a novel performance-based observational assessment tool. One strength of our rubric is that it allows for a range of performance levels and provides feedback to learners on what they could do to perform better in the future. Another strength is that it was designed to be resource agnostic so that it could be used to assess performance across an array of information sources, including future sources powered by artificial intelligence. By tailoring a rubric to observed behaviors, we were able to design an assessment tool that is extensible to different settings and that covers a wider range of possible behaviors.

While use of an OSCE format to assess various steps of EBM has been tried in other settings, it has not always been successful. Most frequently, EBM OSCEs focus primarily on the Appraise and Apply steps.[20,22-24] Only one currently used EBM OSCE includes the Ask and Acquire steps.[20] This EBM OSCE station uses a talk-aloud procedure and requires learners to use PubMed. Despite being statistically validated as offering a reliable score, this station was not developed using any information-seeking behavior frameworks nor was it developed with the input of librarians. An EBM OSCE of this style is too prescriptive. As a result, this OSCE is not able to assess competency of or provide formative guidance for real-world behaviors of learners. The EBM OSCE and assessment rubric presented in this thesis sets itself apart by uniquely providing a framework to accomplish this type of assessment.

Another factor leading to success of our proposed format was integration into a multi-station OSCE that was already assessing multiple clinical skills. This confirmed that it would be possible to have a 10-minute EBM OSCE addition to any appropriate standardized patient encounter. The format of screen recording helps address resource and time limitations since librarian raters can watch remotely and can watch the screen recordings at double speed to save time. This format also reduces implementation barriers by capitalizing on existing OSCE structures.

For medical students, few studies have investigated student attitudes to or perceptions of EBM.[25] One qualitative study tells us that many first-year medical students believe EBM to be a static field with little clinical relevance.[26] This

changes by the end of their clinical year, where perceived relevance to clinical practice increases as they experience more clinical scenarios.[27,28] Our study builds on this evidence and incorporates student views and preferences on EBM assessment. It is important to note that medical students who took this assessment felt it solidified their understanding of the connection of EBM to clinical decision making. This is a key finding if the aim is to encourage students to master these concepts and apply them regularly in practice. At the same time, the students acknowledged that timing is important. Having one opportunity to practice and receive feedback on EBM as part of an assessment is not enough, to really master these skills the students themselves would like to have multiple opportunities beginning in their clinical year.

For librarians, much can be learned from this program of research. Despite the desire to lead more EBM assessment, librarians face many barriers to implementation. [1,29] Some of the barriers are addressed by development of this rubric and format for observational EBM assessment as part of an existing OSCE. However, there are factors that need to be addressed by medical schools in order to enable their faculty to do this style of assessment. In particular, librarians need enough time and staffing to handle the workload of assessment, and they also need to be fully supported and integrated within curricular and assessment processes. These findings are consistent across multiple U.S. institutions with varying class sizes, funding streams, and geographical locations.

Limitations

In addition to the contributions, there are limitations of this program of research. First, the EBM assessment rubric focuses primarily on two of four steps of EBM: Ask and Acquire. While it is possible to get a sense of the student's competency with the Appraise and Apply steps, these are not explicitly assessed. The final step of EBM, Assess, where practitioners are asked to review their process and identify possible improvements for next time, is not covered. When this tool is integrated with a comprehensive OSCE, these final three steps of EBM are covered in detail in other stations. Second, clinician leaders of EBM teaching and assessment were not consulted. Librarian-led assessment was specifically the focus due to the nature of my background and expertise. The feedback and input of clinical EBM champions should be studied further to help develop better integrated assessment for the last three steps of EBM.

Third, this project examined EBM assessment primarily in a single institution where the librarians are well integrated in the curriculum and have strong support from medical education leadership. This level of integration certainly

contributed to the success of the project, and a tool like this would work well at institutions where the libraries are well-resourced and EBM is consistently and thoroughly integrated in the curriculum. But this will not be so at all institutions. Even the lack of standardization of teaching EBM will have an impact on how students receive and react to an EBM assessment. Future studies could explore perceptions in institutions both with limited support of their librarians and also with limited EBM integration in their curricula.

Implementation

This research was conducted with practical implementation in mind. Knowing the resource limitations that librarians face, this rubric and tool could be implemented in a much simpler way without integration into existing OSCEs if necessary. The rubric provides a framework for understanding and assessing information seeking behaviors regardless of the clinical scenario or information resources used. The format of screen recording could be done and submitted as a homework assignment by any medical student with a laptop and Internet access. Through this flexibility, it is hoped that librarians will be able to leverage this research to improve their own assessment practices. When librarians do not have full support at their institutions, both in terms of resources and integration, it is difficult to lobby for more or better circumstances without being able to collect evidence of their impact. This reinforces the value of direct observation of skills rather than collecting indirect evidence in the form of medical knowledge tests. Through using this format in a low-fidelity scenario, librarians could begin to collect and document student performance and better demonstrate their impact.

Future Directions

Generative AI will certainly create huge changes in the near future. We can expect that information sources will begin to change and evolve as these tools become more reliable and are better integrated into clinical knowledge bases. As generative AI evolves, the fundamental concepts of EBM will continue to be highly relevant and important to informed clinical decision making.

Our EBM assessment rubric was designed to be resource-agnostic and focus on the information seeking process using Optimal Foraging Theory. In the context of generative AI, the same rubric could still apply but certain questions would need to be asked and answered: which generative AI tool is a learner

using? How are they prompting the AI? Are they simply using the first information they find, or do they engage with the AI to refine their prompt to find better, more targeted information? Indeed, in the current year's exams I have already seen and assessed students with this rubric who used generative AI sources. It is obvious that the same challenges emerge. Much like with standard searching across the Internet, you can expect a range of performance and can encourage students to do better in their chosen platform. Future work should explicitly look at the influence of generative AI on practice of EBM, but at this point it is still too early in the general availability of AI.

Future work on EBM assessment will benefit from automation. As artificial intelligence improves and becomes more accessible, it will soon be possible to fully provide feedback on a screen-recorded video without human intervention. This would allow for more integration opportunities throughout the curriculum and it will enable us to scale up this process making this style of assessment possible at medical schools with extremely large class sizes. It would also free up librarian time to focus on high-touch support services, like remediation for low-performers on these exams.

Beyond the impact of AI on EBM assessment, potential future directions for research include collaborating with clinical partners to grow this rubric to more explicitly include the steps of Appraising and Applying the literature to clinical decision making. Taking it a step further, this strategy could also be integrated into scenarios that involve shared decision-making and explaining health concepts to patients in plain language and therefore enhancing health literacy.

Longer term impact of this assessment format on learners could be examined in future years by tracking learners into practice to see if they've retained or improved their skills. Impact of this assessment on librarian curricular and assessment integration should also be studied. Currently, this assessment is being used at a consortium of six medical schools, all of which are operationalizing it and utilizing their librarians differently. A follow-up study of these schools and new ones that are added to the consortium would help define the range of effective practices and inform best practice recommendations for optimal use of this rubric and format.

Conclusion

There is no simple solution to implement improved assessment of EBM behaviors. In this thesis, I have searched for a deeper understanding of how EBM assessment is conducted by librarians and experienced by medical students. Finding that limited assessment existed in the librarian community, it was necessary to

develop and provide a theory-informed and behaviorally-anchored rubric to help begin to assess EBM. Like most clinical skills, EBM does not exist in a vacuum and cannot be effectively taught or assessed by one person alone. In our testing and development, this rubric and format seems widely accepted both by librarians and the medical students they are assessing. I hope to have provided librarians with a rubric and process they can leverage at their own institutions to improve their own programs of assessment.

References

1. Nicholson J, Spak JM, Kovar-Gough I, Lorbeer ER, Adams NE. Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students. BMC Med. Educ. 2019;19(1):330.
2. Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. J. Med. Libr. Assoc. 2020;108(2): 219-228.
3. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.
4. Albarqouni L, Hoffmann T, Straus S, et al. Core Competencies in Evidence-Based Practice for Health Professionals: Consensus Statement Based on a Systematic Review and Delphi Survey. JAMA Network Open. 2018;1(2):e180281-e180281.
5. Zwolsman SE, van Dijk N, de Waard MW. Observations of evidence-based medicine in general practice. Perspect Med Educ. 2013;2(4):196-208.
6. Welink LS, Van Roy K, Damoiseaux RAMJ, et al. Applying evidence-based medicine in general practice: a video-stimulated interview study on workplace-based observation. BMC Fam. Pract. 2020;21(1):5.
7. Albarqouni L, Hoffmann T, Glasziou P. Evidence-based practice educational intervention studies: a systematic review of what is taught and how it is measured. BMC Med. Educ. 2018;18(1):177.
8. Dwairy M, Dowell AC, Stahl J-C. The application of foraging theory to the information searching behaviour of general practitioners. BMC Fam. Pract. 2011;12(1):90.
9. Rethans JJ, van Leeuwen Y, Drop R, van der Vleuten C, Sturmans F. Competence and performance: two different concepts in the assessment of quality of medical care. Fam. Pract. 1990;7(3):168-174.
10. Fastré GM, van der Klink MR, van Merriënboer JJ. The effects of performance-based assessment criteria on student performance and self-assessment skills. Adv Health Sci Educ Theory Pract. 2010;15(4):517-532.
11. Morton J, Anderson L, Frame F, Moyes J, Cameron H. Back to the future: teaching medical students clinical procedures. Med. Teach. 2006;28(8):723-728.
12. Jansen JJ, Tan LH, van der Vleuten CP, van Luijk SJ, Rethans JJ, Grol RP. Assessment of competence in technical clinical skills of general practitioners. Med. Educ. 1995;29(3):247-253.
13. Barrows HS, Williams RG, Moy RH. A comprehensive performance-based assessment of fourth-year students' clinical skills. J. Med. Educ. 1987;62(10):805-809.
14. Fink MC, Reitmeier V, Stadler M, Siebeck M, Fischer F, Fischer MR. Assessment of Diagnostic Competences With Standardized Patients Versus Virtual Patients: Experimental Study in the Context of History Taking. J. Med. Internet Res. 2021;23(3):e21196.
15. Kogan JR, Holmboe E. Realizing the promise and importance of performance-based assessment. Teach. Learn. Med. 2013;25 Suppl 1:S68-74.
16. Scheffer S, Muehlinghaus I, Froehmel A, Ortwein H. Assessing students' communication skills: validation of a global rating. Adv Health Sci Educ Theory Pract. 2008;13(5):583-592.
17. Davidson RA, Duerson M, Romrell L, Pauly R, Watson RT. Evaluating evidence-based medicine skills during a performance-based examination. Acad. Med. 2004;79(3):272-275.
18. Shaneyfelt T, Baum KD, Bell D, et al. Instruments for evaluating education in evidence-based practice: a systematic review. JAMA. 2006;296(9):1116-1127.
19. Welink L, de Groot E, Damoiseaux R, Bartelink ML. Educational strategies to enhance EBM teaching and learning in the workplace: a focus group study. BMJ Evid Based Med. 2021;26(5):247.
20. Kumaravel B, Stewart C, Ilic D. Development and evaluation of a spiral model of assessing EBM competency using OSCEs in undergraduate medical education. BMC Med. Educ. 2021;21(1):204.
21. Ramos KD, Schafer S, Tracz SM. Validation of the Fresno test of competence in evidence based medicine. BMJ. 2003;326(7384):319-321.
22. Frohna JG, Gruppen LD, Fliegel JE, Mangrulkar RS. Development of an evaluation of medical student competence in evidence-based medicine using a computer-based OSCE station. Teach. Learn. Med. 2006;18(3):267-272.

23. Tudiver F, Rose D, Banks B, Pfortmiller D. Reliability and validity testing of an evidence-based medicine OSCE station. Fam. Med. 2009;41(2):89-91.
24. Bergus G, Vogelgesang S, Tansey J, Franklin E, Feld R. Appraising and applying evidence about a diagnostic test during a performance-based assessment. BMC Med. Educ. 2004;4:20.
25. Ilic D, Forbes K. Undergraduate medical student perceptions and use of Evidence Based Medicine: a qualitative study. BMC Med. Educ. 2010;10:58.
26. Astin J, Jenkins T, Moore L. Medical students' perspective on the teaching of medical statistics in the undergraduate medical curriculum. Stat. Med. 2002;21(7):1003-1006; discussion 1007.
27. Dorsch JL, Aiyer MK, Meyer LE. Impact of an evidence-based medicine curriculum on medical students' attitudes and skills. J. Med. Libr. Assoc. 2004;92(4):397-406.
28. Bradley P, Oterholt C, Nordheim L, Bjørndal A. Medical students' and tutors' experiences of directed and self-directed learning programs in evidence-based medicine: a qualitative evaluation accompanying a randomized controlled trial. Eval. Rev. 2005;29(2):149-177.
29. Maggio LA, Durieux N, Tannery NH. Librarians in Evidence-Based Medicine Curricula: A Qualitative Study of Librarian Roles, Training, and Desires for Future Development. Med. Ref. Serv. Q. 2015;34(4):428-440.

7

Summary

Summary

Evidence-based medicine is a standard part of the curricula at most US medical schools. Yet, the librarians most often tasked with teaching EBM are frequently not included in assessment of EBM skills and therefore lack rigorous evidence of the impact of their teaching on student skills and guidance for continual improvement of the curriculum. This PhD thesis explores what opportunities exist for librarians to lead EBM assessment and what kind of tools and institutional support they would need to do this work. We provide insights into the information-seeking behaviors of graduating medical students and bring forth a theory-based practically applicable EBM assessment tool.

Chapter 1 begins by detailing the four key conceptual areas needed to support this thesis: evidence-based medicine; observational assessment in medical education; optimal foraging theory, and librarian roles in medical education. In each section I outline the history, current state, and area of opportunity relevant to this thesis. This chapter presents the over-arching research question: *How is evidence-based medicine competency assessment implemented by librarians and experienced by medical students*? Following that, I state the four subordinate research questions and present an overview of the four primary studies that comprise this thesis.

Chapter 2 explores how US and Canadian health sciences librarians are currently engaged in teaching and assessment of each step of EBM, using the elements of EPA 7 as a proxy. A detailed survey was sent to all AAHSL member libraries, representing most US and Canadian medical school libraries. The results provided a comprehensive view of the elements of EBM either taught or assessed by the librarians, and whether this was fully part of the curriculum, extra-curricular, or was para-curricular. The conclusion revealed a large gap. While many librarians were embedded in various part of the curriculum teaching many steps of EBM, very few were doing any assessment of what they were teaching. Furthermore, the librarians that were doing assessment were mostly doing it outside the view of the central medical school assessment processes and thus this information was not being captured as a part of or integrated with student portfolios or recorded anywhere other than the files of the librarian.

Chapter 3 investigates the observable information-seeking behaviors of senior medical students performing an EBM activity. Building on the gap uncovered in Chapter 2, there was a need for an EBM assessment tool that could be used to provide feedback to students to improve their learning and to assess their level of competence. By utilizing optimal foraging theory (OFT), we were able to observe and deconstruct the search behaviors of medical students as a part of an EBM OSCE where they had just seen a standardized patient. OFT

provided a theoretical framework for describing the meaningful and observable search behaviors performed by medical students, both good and bad. Through understanding what information seeking behaviors are important in this context, we were able to develop a theory-based and behaviorally anchored rubric to be used in observational assessment of medical student EBM activities.

Chapter 4 examines the needs and preferences of librarians when assessing EBM behaviors in medical students. In this study we utilized the rubric developed in Chapter 3 to assess a cohort of graduating medical students. We recruited and trained a group of librarians with varying years of experience and from a range of types and sizes of institutions across the US, to use this rubric and participate in the assessment process via an EBM OSCE. Following the librarian's participation, we conducted focus groups to explore their perceptions of this rubric and this process. Each librarian faced a variety of different institutional challenges that could hamper implementation of this style of assessment. However, all saw great possibility in having a tool to assist them in integrating themselves into existing assessment processes. By leveraging an observational rubric that conformed with existing medical school standards, great strides could be made in incorporating librarians into student assessment procedures.

Chapter 5 explores how graduating medical students feel about being assessed on EBM behaviors via observation. We sought to study their experiences and opinions because they are largely unexplored and this is an emerging area of observational assessment. Previous assessments of EBM were done under idealized, less authentic circumstances, allowing students unrealistic time and resources to perfect their submitted answers. We conducted our assessment under time limited, case based authentic albeit simulated and standardized conditions. Therefore, in completing the task, students demonstrated their intuition and learned habits as they would in a real-world clinical context.

We recruited students into a focus group who had recently taken part in this EBM OSCE as a part of a readiness-for-residency OSCE (Night onCall) prior to graduation. Instead of feeling vulnerable or exposed, as we might have expected, for not knowing the best way to perform this task, the medical students resoundingly appreciated the experience and felt it underscored how important it would be to be able to practice EBM both quickly and effectively when they enter clinical practice. This finding allays a common concern of librarians that medical students do not wish to hear from us and demonstrates: a way to provide students with the motivation to learn this material; an understanding of how librarians can help them; and the difference engaging in this type of assessment and learning the material would make in their practice. Students in our focus groups explicitly asked for more feedback and opportunities to practice EBM skills.

Chapter 6 presents a review of the findings of this dissertation research program. It touches on the theoretical and practical contributions to evidence-based medicine, observational assessment, information-seeking behaviors, and the role of the librarian in medical education. By focusing on the gaps within current EBM assessment framework, I highlight the need for new tools that allow for competency-based assessment via observation. Building on optimal foraging theory, I show how this information-seeking theory can be expanded upon and leveraged in clinical and simulated settings within the context of EBM. I then explore implementation of the rubric both from the librarian and medical student perspective. Ultimately, I offer a practical and novel option for observational assessment of EBM competency in medical students that can be leveraged by librarians who are attempting to improve their own assessment practices or become more embedded within existing medical school structures.

8

Samenvatting

Samenvatting

In de meeste geneeskundeopleidingen in de Verenigde Staten (VS) maakt *evidence-based medicine (EBM)*[1] standaard deel uit van het curriculum. Toch worden juist diegenen die in de meeste gevallen tot taak hebben EBM te onderwijzen, namelijk de bibliothecarissen, zelden bij de beoordeling van EBM-vaardigheden betrokken. Dit betekent dat zij ook geen wetenschappelijk bewijs hebben van hoe hun manier van lesgeven de vaardigheden van studenten beïnvloedt en het zonder richtlijnen voor de continue verbetering van het curriculum moeten stellen. In dit proefschrift wordt onderzocht welke mogelijkheden er zijn voor bibliothecarissen om de regie over EBM-toetsing te voeren en wat voor soort hulpmiddelen en institutionele ondersteuning zij daarbij nodig zouden hebben. We bieden inzicht in het kennisvergaargedrag van studenten in de afrondende fase van hun geneeskunde-opleiding en reiken een op theorie gestoeld instrument voor EBM-toetsing aan ter toepassing in de praktijk.

In Hoofdstuk 1 worden eerst de vier belangrijkste inhoudelijke gebieden beschreven die nodig zijn om dit proefschrift te onderschragen: evidence-based medicine, observationele toetsing in het medisch onderwijs, optimaal-foeragerentheorie en de rol van de bibliothecaris in het medisch onderwijs. In elke paragraaf ga ik in op de achtergrond, de huidige stand van zaken en de kansen ten aanzien van dit proefschrift. In het hoofdstuk wordt de overkoepelende onderzoeksvraag gepresenteerd die luidt: *Hoe worden de competenties op het gebied van evidence-based medicine getoetst door bibliothecarissen en hoe wordt dit door geneeskundestudenten ervaren?* Daaropvolgend presenteer ik de vier onderzoeksdeelvragen en geef ik een overzicht van de vier studies die in dit proefschrift centraal staan.

In Hoofdstuk 2 wordt aan de hand van de tot EPA 7[2] behorende taken onderzocht hoe Amerikaanse en Canadese bibliothecarissen in de gezondheids-wetenschappen zich momenteel bezighouden met het onderwijzen en toetsen van elke stap van EBM. Hiertoe werd een gedetailleerde vragenlijst gestuurd naar alle bij de *Association of Academic Health Sciences Libraries (AAHSL)* aangesloten bibliotheken, die samen het gros van de bibliotheken binnen de medische opleidingen van Amerika en Canada vertegenwoordigden. De bevindingen gaven een uitgebreid beeld van de EBM-aspecten die werden onderwezen dan wel getoetst door de bibliothecarissen, en maakten inzichtelijk of deze een integraal

1 Evidence-based medicine (EBM) is het zorgvuldig, doelmatig en objectief gebruiken van het best beschikbare bewijs bij de behandeling van patiënten (Sackett et al., 1996).

2 EPA 7 staat voor *Entrustable Professional Activity 7* en verwijst naar nummer 7 van de 13 gestructureerde beschrijvingen van afgebakende professionele activiteiten die door de *Association of American Medical Colleges (AAMC)* zijn opgesteld.

onderdeel uit- maakten van het curriculum of dat het extracurriculaire dan wel paracurriculaire aspecten betrof. De conclusie bracht een grote lacune aan het licht. Hoewel veel bibliothecarissen bij allerlei delen van het curriculum waren betrokken door vele stappen van EBM te onderwijzen, hielden slechts weinige zich bezig met het effectief toetsen van hetgeen ze onderwezen. Bovendien deden de bibliothecarissen die wel enige vorm van toetsing verrichtten dit hoofdzakelijk buiten het zicht van de centrale toetsprocedures van de medische opleiding om en werd deze informatie dus niet vastgelegd als onderdeel van studentportfolio's of daarmee geïntegreerd, noch werd deze ergens anders geregistreerd dan in de dossiers van de bibliothecaris.

In Hoofdstuk 3 wordt ingegaan op het waarneembare kennisvergaargedrag van studenten in de afrondende fase van hun geneeskundeopleiding tijdens het uitvoeren van een EBM-activiteit. Voortbouwend op de lacune die in Hoofdstuk 2 aan het licht was gebracht, constateerden we dat er behoefte bestond aan een EBM-toetsinstrument waarmee studenten van feedback konden worden voorzien om hun leren te bevorderen en hun competentieniveau te toetsen. Door gebruik te maken van optimaal-foeragerentheorie (OFT) konden we het zoekgedrag van geneeskundestudenten observeren en analyseren als onderdeel van een stationstoets over EBM waarbij ze net een gestandaardiseerde patiënt hadden gezien. OFT bood in dezen een theoretisch kader voor het beschrijven van het relevante en waarneembare zoekgedrag van geneeskundestudenten, zowel goed als slecht. Door te begrijpen welk kennisvergaargedrag in deze context belangrijk is, waren we in staat om een op theorie gestoelde en in gedrag verankerde *rubric*[3] te ontwikkelen die gebruikt kan worden bij de observationele toetsing van geneeskundestudenten tijdens EBM-activiteiten.

In Hoofdstuk 4 worden de behoeften en voorkeuren van bibliothecarissen onder de loep genomen bij het toetsen van het EBM-gedrag van geneeskunde-studenten. In dit onderzoek maakten we gebruik van de in Hoofdstuk 3 ontwikkelde rubric om een cohort van geneeskundestudenten in de afrondende fase van hun opleiding te beoordelen. We wierven een groep bibliothecarissen met verscheidene jaren ervaring en van verschillende instellingen van uiteenlopende dimensies binnen de VS, en trainden hen om deze rubric te gebruiken en om via een EBM-stationstoets deel te nemen aan het beoordelingsproces. Nadat deze bibliothecarissen hadden deelgenomen, hielden we focusgroepgesprekken om hun perceptie van deze rubric en dit proces in kaart te brengen. Elke bibliothecaris had te maken met een verscheidenheid aan institutionele uitdagingen die de invoering van deze specifieke toetsvorm in de weg zouden kunnen staan.

3 Een rubric is een beoordelingsschema dat gebruikt kan worden voor het beoordelen van een opdracht of taken en voor het geven van feedback (Schieving et al., 2023).

Desalniettemin zagen ze allemaal groot potentieel in het ter beschikking hebben van een instrument dat hen kon helpen zichzelf in bestaande toetsprocedures in te bedden. Door een observationele rubric die voldeed aan de bestaande normen van de medische opleiding in te zetten, kon er grote vooruitgang geboekt worden ten aanzien van de inbedding van bibliothecarissen in studentbeoordelingsprocedures.

In Hoofdstuk 5 wordt onderzocht wat geneeskundestudenten die in de afrondende fase van hun opleiding zitten ervan vinden dat zij door middel van observatie op hun EBM-gedrag worden beoordeeld. We wilden hun ervaringen en meningen graag in beeld brengen, omdat hier nog weinig onderzoek naar is gedaan en deze vorm van observationele toetsing in opkomst is. Eerdere beoordelingen van EBM vonden plaats onder geïdealiseerde, minder authentieke omstandigheden, waarbij de tijd en de middelen die studenten kregen om hun antwoorden af te ronden en in te dienen onvoldoende realistisch waren. Wij voerden onze beoordeling echter uit onder tijdsbeperkte, op casuïstiek berustende authentieke doch gesimuleerde en gestandaardiseerde omstandigheden. Hierdoor konden de studenten bij het uitvoeren van de taak hun intuïtie en aangeleerde gewoonten laten zien zoals ze dat ook in een echte klinische context zouden doen. We wierven studenten die onlangs hadden deelgenomen aan deze EBM-stationstoets voor een focusgroep. Deze toets maakte deel uit van een stationstoets waarin werd getest in hoeverre de studenten vlak voor hun afstuderen klaar waren voor hun vervolgopleiding door een nacht op oproepbasis (het zgn. *Night-onCall*-programma) na te bootsen. Anders dan we misschien hadden verwacht, voelden deze geneeskundestudenten zich niet kwetsbaar of blootgesteld daar zij niet wisten hoe ze deze taak het beste konden uitvoeren, maar waardeerden zij de ervaring juist enorm. Ook vonden ze dat de ervaring benadrukte hoe belangrijk het was dat ze bij het toetreden tot de klinische praktijk in staat zouden zijn om zowel snel als effectief EBM toe te passen. Deze bevinding neemt een veelgehoorde zorg van bibliothecarissen weg dat geneeskundestudenten niet van hen willen horen en laat zien dat er een manier is om studenten te motiveren om deze materie te leren. Ook biedt deze bevinding inzicht in hoe bibliothecarissen hen daarbij kunnen helpen, en geeft aan wat een verschil het gebruik van deze vorm van toetsen en leren van de materie in hun praktijk zou maken. De studenten in onze focusgroepen vroegen nadrukkelijk om meer feedback en mogelijkheden om hun EBM-vaardigheden te oefenen.

In Hoofdstuk 6 worden de bevindingen van het onderzoeksprogramma in dit proefschrift besproken. Hierbij wordt ingegaan op de theoretische en praktische bijdragen aan evidence-based medicine, observationele toetsing, kennisvergaargedragingen en de rol van de bibliothecaris in het medisch onderwijs. Door me te richten op de lacunes binnen het huidige EBM-beoordelingskader,

benadruk ik de behoefte aan nieuwe instrumenten die de beoordeling van competenties via observatie mogelijk maken. Door voort te bouwen op de optimaal-foeragerentheorie, laat ik zien hoe deze kennisvergaartheorie kan worden aangevuld en in klinische en gesimuleerde settingen in een EBM-context kan worden toegepast. Vervolgens belicht ik de invoering van de rubric vanuit het perspectief van zowel de bibliothecaris als van de geneeskundestudent. Tot slot bied ik een praktische en nieuwe mogelijkheid aan voor het observationeel toetsen van geneeskundestudenten op EBM-competenties die kan worden ingezet door bibliothecarissen die hun eigen toetspraktijken willen verbeteren of meer in de bestaande structuren van de medische opleiding ingebed willen raken.

9

Impact

Evidence-based medicine is a complex set of knowledge, skills, and behaviors necessary for well-informed and patient-centered clinical decision making.[1,2] Despite being taught and emphasized as critical throughout US medical school curricula, assessment has lagged behind that of other key clinical skills.[3-6] Librarians are key players in teaching EBM, and are activated and ready to fully participate in robust EBM assessment that promotes learning and measures competency.[7,8] This research is a necessary step in uncovering the gaps and creating effective solutions for assessment of EBM. But, a detailed assessment rubric, willing assessors, and engaged learners are not enough to create the culture change needed to support this work.

This program of research will have direct impacts on stakeholders at multiple stages of medical education. In this section, I describe the potential impact of this research in medical education, the field of librarianship, and society. Then, I outline strategies taken to disseminate this research and provide evidence for real-world implementation.

Impacts on Medical Education

The impact of this project is most direct for EBM researchers, teachers, and practitioners. By building on information-seeking theories to create a novel EBM behavior assessment rubric[9] this work provides a new window on the observed information-seeking behaviors of EBM learners. Implementation of this assessment rubric contributes to the validation of Optimal Foraging Theory (OFT) as a useful framework for clinical information seeking behavior. Including OFT as a foundation can inform creation and design of new future clinical information sources. By clarifying the process of how clinicians seek to answer questions, design researchers could begin to integrate these concepts into other clinical tools, like the medical record, to improve clinician workflow and streamline information seeking processes. Despite decades of advancement in electronic information sources, they remain predominantly separate silos which clinicians must attempt to navigate at the expense of their own time and energy. Beyond providing improved assessment for learning in EBM, this rubric and OSCE format give medical educators another example of a performance-based assessment that, when considered as part of a program of assessment, will assess competence. Cognitive skills, such as clinical reasoning, differential diagnosis, history-taking, or patient communication, are difficult to reliably assess. Medical educators who struggle with implementing competency assessment for these mental processes that are not immediately observable could consider first breaking down the performance into observable elements.

While there are rubrics and assessment tools for many of these competencies, there are gaps and inconsistencies. Considering breaking down a cognitive competency into observable performance tasks could be another useful tool in the toolbox towards improved assessment for learning.

For medical students, this assessment strategy provides enhanced opportunities to practice and build skills in a world where finding reliable information grows more critical and challenging daily. Despite being born digital, or possibly because of it, most medical students initially rely on the quick and easy information, clickable in the first few results.[9] This OSCE format provides an opportunity to practice in an authentic clinical simulation and receive feedback on directly observed performance.[10] A key benefit of this research is the novel way performance is practiced and reflected back to medical students to show the impact of their information-seeking behaviors. The impact on medical students will both enhance self-awareness, improve learning and create better long-term EBM practice habits.

For medical school leadership, this research highlights the promise of more fully incorporating librarians and robust EBM assessment into their curricula. This work provides guidance on what librarians need to do and how they need to be supported in this assessment work. Through enhanced incorporation of librarians, medical school leaders should expect improved EBM competence among learners, an enhanced culture of inquiry, and stronger interprofessional education collaborations.

Impacts on Librarianship

For medical librarians, the impacts of this work are wide-ranging. This program of research has the potential to enhance librarian's visibility within their medical schools by enabling development of new professional skill sets and expanding essential roles and responsibilities. Throughout this research process the role of the medical librarian has been at forefront and this work highlights one way medical librarians will continue to evolve along with and contribute to enhancing medical education.

Impacts on Society

Through incorporating librarian-led assessment of EBM, via a theory-based and behaviorally-anchored rubric, there are myriad potential long and short-term impacts to society. When practiced optimally, EBM promises to improve clinical

outcomes, reduce wasteful healthcare costs, and ensure patient safety and quality medical care. An integral step to best practice of EBM, is strong teaching and assessment, allowing medical students the opportunity to practice, get feedback, and progress to competence and mastery. This program of research offers a way to ensure continuous improvement of the EBM skills of our current medical students and future clinicians.

Dissemination and Evidence of Impact

The research outcomes have been shared both through presentations at conferences and publishing in peer-reviewed journals. Studies 1 and 2 were published in open-access journals, Studies 3 and 4 are currently under review. Paper and poster presentations have been delivered at national and international conferences: MLA (Medical Library Association) 2016 and 2023; the Ottawa Conference in 2016; the AAMC (Association of American Medical Colleges) 2016, 2018, and 2023; SHE Academy 2017; AMEE (Association for Medical Education in Europe) 2016, and EAHIL (European Association for Health Information and Libraries) 2022 and 2023.

Beyond conference presentations and publications, this research is incorporated into Night onCall, an immersive readiness-for-residency OSCE, currently deployed as part of a ten school consortium housed at the Robert D. and Patricia E. Kern Institute for the Transformation of Medical Education at the Medical College of Wisconsin and partially funded by the Macy Foundation. Through this consortium, more librarians, medical students, and medical educators are experiencing and incorporating this EBM OSCE into their programs of assessment.

References

1. Montori VM, Guyatt GH. Progress in evidence-based medicine. JAMA. 2008;300(15):1814-1816.
2. Guyatt GH, Haynes R, Jaeschke RZ, et al. Evidence-based medicine: Principles for applying the users' guides to patient care. JAMA. 2000;284(1290):R9.
3. Tilson JK, Kaplan SL, Harris JL, et al. Sicily statement on classification and development of evidence-based practice learning assessment tools. BMC Med. Educ. 2011;11:78.
4. Albarqouni L, Hoffmann T, Straus S, et al. Core Competencies in Evidence-Based Practice for Health Professionals: Consensus Statement Based on a Systematic Review and Delphi Survey. JAMA Network Open. 2018;1(2):e180281-e180281.
5. Shaneyfelt T, Baum KD, Bell D, et al. Instruments for evaluating education in evidence-based practice: a systematic review. JAMA. 2006;296(9):1116-1127.
6. Nicholson J, Spak JM, Kovar-Gough I, Lorbeer ER, Adams NE. Entrustable professional activity 7: opportunities to collaborate on evidence-based medicine teaching and assessment of medical students. BMC Med. Educ. 2019;19(1):330.
7. Maggio LA, Durieux N, Tannery NH. Librarians in Evidence-Based Medicine Curricula: A Qualitative Study of Librarian Roles, Training, and Desires for Future Development. Med. Ref. Serv. Q. 2015;34(4):428-440.
8. Dorsch JL, Perry GJ. Evidence-based medicine at the intersection of research interests between academic health sciences librarians and medical educators: a review of the literature. J. Med. Libr. Assoc. 2012;100(4):251-257.
9. Nicholson J, Kalet A, van der Vleuten C, de Bruin A. Understanding medical student evidence-based medicine information seeking in an authentic clinical simulation. J. Med. Libr. Assoc. 2020;108(2):219-228.
10. Kalet A, Zabar S, Szyld D, et al. A simulated "Night-onCall" to assess and address the readiness-for-internship of transitioning medical students. Adv Simul (Lond). 2017;2:13.

ADDENDA

Appendix One

EBM OSCE Assessment Checklist for Librarian Raters described in Chapter 3

Behavior Being Assessed	Behaviorally-Anchored Rating Scale
Question Articulation	Well Done – Question is both precise (including hypertension urgency) and accurate (including management or therapy).
	Partially Done – Question is either precise OR accurate, but not both.
	Not Done – Question is neither precise nor accurate.
Information Resource Selection	Well Done – Began searches using an authoritative source (UpToDate, PubMed, GoogleScholar, etc).
	Partially Done – Did not begin searches in an authoritative source, but ended up switching to one.
	Not Done – Did not use an authoritative source (Wikipedia, commercial website, non-peer reviewed lit).
Searched a Point of Care Tool	Yes/No
Searching Point-of-Care Tools	Well Done – Used search terms hypertensive urgency (or variation) AND demonstrated proper use of navigating tables and sections, clicking on relevant references.
	Partially Done – Used search terms hypertensive urgency (or variation), but found relevant information by scrolling through multiple articles and sections.
	Not Done – Did not use terms from the clinical question or used only natural language or used only abbreviations.
Searched a Database	Yes/No
Searching a Database	Well Done – Used both search terms hypertensive urgency (or variation) AND management AND demonstrated proper use of filters, Boolean logic, and other terms.
	Partially Done – Used search term hypertensive urgency (or variation), but DID NOT demonstrate proper use of additional search terms (like management/therapy), filters, or Boolean logic.
	Not Done – Did not use terms from the clinical question or used only natural language or used only abbreviations.

Behavior Being Assessed	Behaviorally-Anchored Rating Scale
Evidence Selection Process	Well Done – Found an answer using high quality evidence from a point-of-care resource or a recently published systematic review or RCT.
	Partially Done – Found an answer using only abstracts or low-quality evidence.
	Not Done – Unsuccessful in finding answer to clinical question OR found an answer only in a non-authoritative source.
Comments/Notes/ Suggestions for Student	[Enter here any *brief* formative feedback]
Global Performance Rating	[Scale of 0-10, with 0 being lowest and 10 being highest. Provide a rating of overall performance on this activity]

Appendix Two

Questioning Route for Librarian Focus Groups as described in Chapter 4.

In this focus group, we're going to be talking about assessing medical student performance of evidence-based medicine behaviors.

Opening Question

How long have you been working as a medical librarian?
What is your current role at your library?

Introductory Question

What are you currently doing in your library to provide feedback for EBM behaviors in medical students?

Transition Question

Are there any gaps or opportunities in your current assessment efforts?

What do you think are important considerations for assessing EBM in medical students?

Key Questions

In our roles, to some degree we are all responsible for assessing EBM behaviors. And we have all had a chance to practice assessment of medical student competence using this EBM video-based OSCE format and rubric.

Based on your own experiences, what advantages or disadvantages do you see in taking this type of approach to EBM assessment? For yourselves as the librarians? For the medical students?

What barriers would you anticipate facing in implementing this activity at our own institution?

Do you see assessment as part of your professional identity? Who should be responsible for doing this kind of assessment? Why or why not? What would help you develop this part of your identity?

Ending Question

Is there anything that we should have talked about, but didn't?

Appendix Three

Medical Student Perspectives Semi-Structured Interview Guide as described in Chapter 5.

Station Goals:

Please tell me what you recall about the clinical question station during Night-OnCall?

What do you think you did well in this station?

What were some of the difficulties you had with the station?

What would you say you personally took away from this case?

Did this case assess skills and knowledge you had learned prior to the OSCE?

Feedback:

What feedback were you given?

-What did you think about the feedback you received on this station?

-Can you recall any specifics of the feedback? How was it delivered?

Knowing you would be evaluated on your performance; did it change how you performed your search and answered the question?

What did you think you were being assessed on? [written answer vs. process]

Do you have any suggestions for improving the feedback and/or the feedback process? What would you like to have received feedback on? In what kind of format?

Logistics:

What did you think about the way this station worked?

What do you think about the timing of this station in the curriculum? Is getting feedback on this set of skills useful to you at this time? Would it help or be differently received earlier?

Do you have any suggestions for improving this case and/or this station?

Any additional thoughts about the library and how we might be able to help or support medical students more?

Acknowledgments

I would first like to thank my excellent and committed promotors Dr. Anique de Bruin, Dr. Cees van der Vleuten, and Dr. Adina Kalet for their support and guidance throughout this process. Thanks as well to Dr. Geraldine Clarebout who was critical with her guidance in the early stages of this dissertation. Not only were they all essential to the academic aspects of this work, but they also helped with the many existential crises that come along with dissertation research.

Within the NYU Health Sciences Library, I owe a deep debt of gratitude to my dear colleagues Juliana Magro, Caitlin Plovnick, and Dorice Vieira who were active collaborators and co-authors. None of this could have moved forward without them.

This work would not have been possible without the collaboration and fruitful discussions among my many librarian frolleagues* across the nation. So many frolleagues gave generously of their time, ideas, and criticism which helped refine ideas and ensure the work is meaningful and impactful to our own work community. Special thanks to those who have actively participated in my studies: Dr. Nancy Adams, Amy Blevins, Emily Brennan, Sarah Cantrell, Nicole Capdarest-Arest, Deborah Crooke, Julie Gaines, Andy Hickner, Gail Kouame, Iris Kovar-Gough, Liz Lorbeer, Liz Stellrecht, Rita Sieracki, Judy Spak, Liz Suelzer. I am honored to be able to count you all as both friends and colleagues. Thanks as well to the Medical Library Association for the partial funding from the 2022 MLA Research, Development, and Demonstration Project Grant.

This project was made possible in large part due to the support and participation of my home institution and my many thoughtful and hard-working colleagues at NYU Grossman School of Medicine. I owe a particular debt to current and former medical school, library, and NYSIM leadership: Dr. Steven Abramson, Neil Rambo, Jeff Williams, Dr. Tom Riles, Dr. Donna Phillips, and Dr. Sondra Zabar.

In addition, all of the staff and faculty at the NYUHSL contributed in both small and big ways to my work represented in this dissertation and to ensuring I had enough bandwidth to be able to complete it. I would like to especially thank Erin Latchford, Debbie Peters, and Dr. Alisa Surkis who shouldered the burden the most when I was stressed and overly busy working on my dissertation on top of my day job. There is simply not enough room to thank everyone on this one page, but I truly thought of this as a group effort supported by everyone at NYUHSL.

Last, but not least, I want to thank all of my family and friends who contributed to maintaining my emotional and mental well-being throughout the past several years. Many thanks to my parents, Barbara and Ed Nicholson, and my sister and brother-in law, Amanda and Todd Romanowski, for their support. And special thanks to my found family, Kate and Ryah Schwartz and Lee Sessions for always finding ways of making me laugh and putting anxiety in perspective. And thanks to my countless supportive friends who helped keep me entertained and didn't let me lose myself in this process.

About the Author

Joey Nicholson is a medical librarian, public health researcher, and health professions educator originally from Clarksburg, West Virginia. He holds a bachelor's in linguistics (French) from the University of California, Davis; a master's in library and information science from the University of Pittsburgh's School of Information Science; and a master's in public health from Columbia University's Mailman School of Public Health.

After starting as a medical librarian at Touro University – California in 2005, Joey embarked on a career as an academic medical librarian dedicated to improving education for library users and increasing collaboration between librarians and their academic counterparts. In 2020, he was awarded the Estelle Brodman Award for the Academic Health Sciences Librarian of the Year from the Medical Library Association.

He currently lives with his large chosen family in New York, New York. When he isn't busy running the library, he strives to see as many Tony-eligible Broadway shows as possible each year.

SHE dissertations series

The SHE Dissertation Series publishes dissertations of PhD candidates from the School of Health Professions Education (SHE) who defended their PhD theses at Maastricht University. The most recent ones are listed below. For more information go to: https://she.mumc.maastrichtuniversity.nl

Heijnens, L. (16-06-2023) Aspects of geometry, fixation and materials in total hip arthroplasty. What have we learned?

Gillespie, H. (06-06-2023) Helping students become doctors: analysing tensions and releasing opportunities in clinical workplaces

Khan, M. (16-05-2023) Overcoming barriers in the prevention of surgical site infections: a master plan employing task-based interprofessional training

Tremblay, M-L. (08-05-2023) Lights. Camera. Action. Debrief. Designing Immersive Simulation for Novices to Promote Learning

Bynum, W. (15-02-2023) Out of the Shadows: A qualitative exploration of shame in learners across the continuum of medical education

Mordang, S. (07-02-2023) Challenges in high-value cost-conscious care training of residents: Exploring the various stakeholders' roles and attitudes

Brouwer, E. (12-12-2022) Medical education without borders. The what, why and how of International Medical Programmes

Kellar, J. (26-10-2022) Becoming Pharmacists: Professional identity struggles of a profession in transition

Biwer, F. (08-07-2022) Supporting Students to Study Smart – a learning sciences perspective

Bransen, D. (22-06-2022) Beyond the self: A network perspective on regulation of workplace learning

Lee, J. (08-06-2022) The Medical Pause in Simulation Training

Kruepunga, N. (17-05-2022) Development of the caudal part of the human embryo

Cantillon, P. (28-04-2022) The Social construction of clinical education: being and becoming in clinical teams

Pieters, J. (01-04-2022) Let's talk about it:Palliative care education in undergraduate medical curricula

Jonge de, L. (28-03-2022) Is it all in the mind? Stakeholder conceptions on workplace based assessment

Beuken, J. (25-3-2022) Waves towards harmony: Learning to collaborate in healthcare across borders

Ilgen, J. (15-12-2021) Comfort with uncertainty in medical professionals. An exploration of how clinicians experience and manage dynamic problems in practice

Schut, S. (9-12-2021) The Burden of Proof - Agency and Accountability in Programmatic Assessment'

Hui, L. (6-12-2021) 'Fostering Self-Regulated Learning: the Role of Perceived Mental Effort'

Meeuwissen, S. (12-11-2021) 'Team learning at work. Getting the best out of interdisciplinary teacher teams and leaders'

Nguyen Thi, V.A. (02-11-2021) Motivating and educating health professionals to work in less attractive specialties: Findings from experiences of Vietnam

Martens, S. (15-10-2021) Building student-staff partnerships in higher education

Lestari, E. (05-10-2021) INTERPROFESSIONAL EDUCATION Lessons from Indonesia

Atherley, A. (27-09-2021) Beyond the struggles: Using social-developmental lenses on the transition to clinical training

Schillings, M. (06-07-2021) Talking about feedback: Face-to-face peer dialogue about written feedback

Wilbur, K. (05-07-2021) NO WHERE | NOW HERE: Context and Competency Expectations in Workplace-Based Training

Bendermacher, G. (02-07-2021) Navigating from Quality Management to Quality Culture

Ahmed Khan, R. (29-06-2021) Assessing curriculum viability in Undergraduate Medical Education

Chim, H.Q. (30-03-2021) Physical Activity Behavior and Learning in Higher Education

Dominguez, L.C. (23-02-2021) Persistence in surgical training: The role of job crafting and leadership

Bindels, E. (22-02-2021) DOING WELL, GETTING BETTER; Facilitating physicians' reflection on their professional performance

Iqbal, Z. (15-12-2020) All stakeholders matter in faculty development: Designing entrustable professional activities for small group facilitation

Tran, QT. (09-12-2020) Nationwide implementation of medical skills training laboratories in a developing country: studies from Vietnam

Pacifico, J. (30-11-2020) Making the Implicit Explicit: Uncovering the Role of the Conceptions of Teaching and Learning and the Perceptions of the Learning Climate in Postgraduate Medical Training.

Nishigori, H. (17-11-2020) Why do doctors work for patients? Medical professionalism in the era of neoliberalism

Oudkerk Pool, A. (06-11-2020) Competency-based portfolio assessment – Unraveling stakeholder perspectives and assessment practices

Geel van, K. (05-11-2020) Lifelong learning in radiology: all eyes on visual expertise

Stammen, L. (16-10-2020) Pursuing - High-Value, Cost-Conscious Care - The Role of Medical Education

Meulen van der, M. (15-10-2020) Assessment of physicians' professional performance using questionnaire-based tools

Matsuyama, Y. (05-10-2020) Contextual attributes fostering self-regulated learning in a teacher-centered culture: learner's professional identity formation is a trigger

Rovers, S. (16-09-2020) Growing knowledge, supporting students' self-regulation in problem-based learning

Bourgeois-Law, G. (03-09-2020) Conceptualizations of remediation for practicing physicians

Giuliani, M. (19-05-2020) A Critical Review of Global Curriculum Development, Content and Implementation in Oncology

Schreurs, S. (20-03-2020) Selection for medical school; the quest for validity

Schumacher, D. (19-03-2020) Resident Sensitive Quality Measures: Defining the Future of Patient-Focused Assessment

Sehlbach, C. (21-02-2020) To be continued…. Supporting physicians' lifelong learning