

Title: Evidence based medicine (EBM) simulation: a novel and practice-relevant approach to teaching real-time literature searching to emergency medicine residents

Running title: Evidence Based Medicine Simulation

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Abstract:

Introduction: Evidence-based medicine (EBM) and literature searching skills are competencies within the Emergency Medicine (EM) residency curriculum. Previously in our residency program, a librarian-taught literature searching instruction comprised a classroom-based overview of search engines. Learners reported low engagement and poor retention. To improve engagement, interest and skill retention, we used a novel approach: simulation to teach real-time literature searching.

Method: Based on a needs assessment of our EM residents, we created a literature searching workshop using a flipped classroom approach and high-fidelity simulation. Goals of the session were to be interactive, engaging and practice-relevant. With a librarian, we developed a brief list of EM-relevant databases, including tips for searching and links to sites / apps. Pre-readings also covered the hierarchy of evidence and formulating a good clinical (PICO) question. Residents (12 junior residents) participated in a high-fidelity simulation involving a stable patient whose management required a literature search to inform decisions. Feedback was collected on the simulation experience.

Results: Residents received the list of EM-relevant databases seven days prior and were instructed to set up and test the resources on their smartphones. The day of the session, one resident volunteered to lead the simulation; all residents participated in the search on their smart phones. Collectively, it took 4.5 minutes to find a study that adequately addressed the clinical question and manage the patient accordingly. Feedback on the simulation was positive. Students found it “very real and practical” and “immediately institutable into practice”. It helped residents learn to efficiently and effectively search the literature while managing a stable patient.

Conclusion: A flipped-classroom simulation-based teaching strategy made learning literature searching more interesting, engaging and applicable to EM practice. Based on popular demand, will continue to use this teaching method.

Need for innovation:

Competence in evidence based medicine (EBM) is a training objective in Emergency Medicine (EM) residency training.¹⁻³ Clinical practice in the emergency department (ED) is fast paced and unpredictable; searching for trustworthy evidence at the bedside must be efficient to be effective.

Residents highlighted literature searching practices in a recent EBM needs assessment. Few routinely searched evidence on shift to inform clinical decisions (median self-reported frequency of “at least once a month”, with half of residents searching “less than once a month” or “almost never”). When residents did look up evidence, they spent on average three to five minutes and most often went to medical education blogs. Residents wanted literature searching instruction to be more hands-on and relevant to EM practice. To meet residents’ needs and bring EBM into the ED, we designed an educational session focused on literature searching at the bedside, borrowing principles of task-based learning.^{4,5}

Background:

EBM has contributed to significant improvements in clinical practice and patient outcomes⁶; evidence based practice has become a hallmark of clinical excellence.⁷ Medical schools and residency programs have adopted EBM as an integral part of training.^{1,8-11}

EBM competencies for EM residents include searching for, critically appraising and applying evidence to clinical practice.^{1,2,10} Yet there are few published EBM curricula directly relevant to teaching these competencies to EM residents. One institution implemented dedicated “EBM consult” shifts in the ED, where an off-shift resident searched for literature to answer the clinical questions of on-shift staff.¹² Unfortunately, consults took longer than feasible in the work environment; this educational intervention did not meaningfully change residents’ clinical practice.¹² A recent crossover trial suggested minimal difference in time for searching and accuracy of answers when residents searched pre-appraised databases, compared with general

“google-type” searching.¹³ However with the rise of predatory journals and misinformation over the past decade, it will be necessary to efficiently distinguish reliable resources^{14-16 14,15}

To date, no EBM curricula have focused on real-time point-of-care searching or have used high fidelity simulation as a teaching tool.

Objective of Innovation:

We developed a novel EBM literature searching session focused on point-of-care searching with the goals of 1) increasing the relevance of literature searching to EM clinical practice and 2) improving the efficiency of literature searching while working in the ED. The session was designed to engage EM residents, be directly applicable to clinical practice and thereby have a lasting impact on their learning.

Development Process:

As part of a larger redesigned six-part EBM curriculum, we developed a stand-alone small group session focused on literature searching for trustworthy evidence. The curriculum, including the literature searching session, was re-developed by a senior EM resident (ICG) with a master’s degree in epidemiology and a special interest in medical education; and in collaboration with an expert EM physician experienced in health care simulation and medical education (DH). Oversight was provided by the EM program director (SD) who also completed a master’s degree in epidemiology. The session and session materials were developed in close consultation with a health sciences librarian (MT). This project is exempt from institutional ethics board review, as per the ARECCI screening tool.

This flipped-classroom session was designed for first- and second-year EM residents. The librarian and EM resident generated a succinct list of the most EM-relevant search tools (including point-of-care resources and bibliographic databases). Each tool was listed with a description of the database itself, embedded links to corresponding sites / apps and search tips.

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Students received pre-readings one week in advance of the session and were asked to set up and test the databases on their smartphones. Other pre-readings included a succinct overview of the hierarchy of evidence and how to develop a good “PICO” (population, intervention, comparison, outcome) question to facilitate effective searching.

The overall design of the session and simulation are underpinned in constructivist learning theory¹⁷: pre-readings build on an existing knowledge base (undergraduate-level EBM teaching) and learners are subsequently challenged to apply their knowledge in a new setting (the [simulated] bedside). Further, the simulation reveals a learning need (knowledge gap) and prompts residents to address this through inquiry-based real-time (and effortful) learning. Having students apply knowledge and practice skills in settings similar to their true workplace – called Task Based Learning (TBL) – allows learning to be more effective, efficient and relevant to daily work.^{4,5}

The Implementation Phase (e.g. what happened when you rolled this out?)

Eleven of 12 residents participated in this mandatory session (one second year resident was on vacation). First, a series of pop-quizz style questions were used (in the spirit of assessment for learning) to review key points from the pre-readings, clarify/address knowledge gaps, and elicit deeper discussion. Students were then given a brief opportunity to test out and set up search databases on their smartphones if they had not previously done so.

All residents were invited into the simulation lab with their smartphones. A second-year resident volunteered as leader and all others participated in various roles, including patient care and literature searching.

The case involved a patient who was acutely unwell but not hemodynamically unstable (a previously healthy adult in an acute-onset supraventricular tachycardia, who was refusing adenosine and electrical cardioversion due to prior negative experiences); in other words, the

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patient needed emergent treatment but did not require immediate action, so residents had time to search the literature to make an evidence-informed decision at the bedside (which beta-blocker or calcium channel blocker was best for rate control).

Residents worked together to identify the clinical question (PICO) and searched various resources on their smartphones for evidence upon which to base a clinical decision. The simulation was immediately followed by a debriefing where residents were encouraged to reflect on their experience. The focus was not on obtaining a “right” answer but rather on how students used point-of-care tools to get an answer. Debriefing also explored challenges and facilitators in point-of-care searching. With a new appreciation for effective and efficient literature searching at the bedside, students received a brief demonstration by the librarian on targeted searching strategies. An anonymous feedback survey was distributed at the end of the session.

Evaluation

In a collective effort, residents took 4.5 minutes from initiating the search to verbalizing a management decision (“give drug X”). Point-of-care resources, databases and search engines used by the group included: Google (± Scholar), DynaMed Plus, UpToDate, Pubmed (± Clinical Queries), Cochrane Database of Systematic Review and QxMD. In a thematic analysis of the discussion, four main challenges to point-of-care literature searching were identified: 1) learners were not used to looking up literature on a smartphone (“I wish I had my laptop!”); 2) residents realized they are unfamiliar with evidence behind some common clinical practices; 3) learners initially had difficulty identifying the reliability of different resources; and 4) UpToDate was not well linked to the primary literature (“UpToDate wasn’t helpful!”).

Ten of 11 residents filled out an anonymous feedback survey. Using a 5-point Likert scale (with 5 being “very well”), residents rated the session 4.9 for helping them appreciate the role of literature searching while actively treating a patient. Feedback from the session was

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overwhelmingly positive (**Box 1**) and 90% of residents recommended continuing to use simulation in EBM teaching. Constructive feedback elicited from residents suggested some changes for subsequent years (**Box 1**).

In end-of year feedback for the EBM curriculum (nine months post simulation), residents indicated they search for literature at the bedside more frequently than before and felt more comfortable searching for evidence.

Reflective Discussion

This is the first ever attempt to use simulation as a teaching tool for point-of-care literature searching. Among stable patients, appropriate contexts for point-of-care literature searching in the emergency department include:

1. Looking for evidence supporting well established practices
2. Looking for evidence in contexts outside the scope of guidelines / established practices
3. Looking for evidence comparing treatments (and/or their outcomes)

Students encountered challenging “sim moments”: feeling awkward standing in the simulation room searching on their phones (in real life they could step out); and being asked pointed questions by a patient (to clearly outline a PICO). In subsequent iterations we have simulated leaving the room for the literature search and have created case stems that more clearly outline a PICO.

Though the curriculum shows an impact on two levels of the Kirkpatrick model (learner satisfaction and self-reported change in behaviour)¹⁸, we do not yet have evidence of a change in patient-level outcomes or whether our intervention led to observed changes in behaviour (i.e., observing residents’ frequency of point-of-care searching while on shift). Next year, we plan to gather self-reported pre- and post-curriculum frequency and duration of searching for evidence while on shift.

In summary, we used an innovative teaching strategy to address learning needs clearly identified by our residents. Grounded in constructivist learning and TBL theories, this EBM literature searching session used flipped classroom and simulation teaching tools to make literature searching engaging, efficient and practice-relevant. With minor modifications, we will continue using this well-received instructional approach with the ultimate goal of graduating evidence based practitioners from our EM program.

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References:

1. Emergency Medicine Competencies 2018. The Royal College of Physicians and Surgeons of Canada. (Accessed May 9, 2019, at <http://www.royalcollege.ca/rcsite/documents/ibd/emergency-medecine-competencies-e.pdf>).
2. Objectives of Training in the Specialty of Emergency Medicine 2014. The Royal College of Physicians and Surgeons of Canada. (Accessed May 9, 2019, at http://www.royalcollege.ca/rcsite/documents/ibd/emergency_otr_e.pdf).
3. European Core Curriculum for Emergency Medicine 2017. Hartel C, Prosen G, Brown R, Dryver E. (Accessed May 9, 2019, at https://eusem.org/images/pdf/European_Core_Curriculum_for_EM_-_Version_1.2_April_2017_final_version.pdf).
4. Harden R, Uudlaw JM, Ker JS, Mitchell HE. AMEE medical education guide no. 7.: task-based learning: an educational strategy for undergraduate postgraduate and continuing medical education, part 1. *Med Teach* 1996;18:7-13.
5. Harden R, Laidlaw JM, Ker JS, Mitchell HE. AMEE Medical Education Guide No. 7.: Task-based learning: An educational strategy for undergraduate, postgraduate and continuing medical education, Part 2. *Med Teach* 1996;18:91-8.
6. Kamath S, Guyatt G. Importance of evidence-based medicine on research and practice. *Indian J Anaesth* 2016;60:622-5.
7. Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ* 1996;312:71-72.
8. Anderson M, Cohen J, Hallock J, Kassebaum D. Report I: Learning objectives for medical student education: Guidelines for medical schools. Washington D.C.: Association of American Medical Colleges, 1998.

9. CanMEDS Framework: CanMEDS: Better standards, better physicians, better care. The Royal College of Physicians and Surgeons of Canada. (Accessed May 9, 2019, at <http://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e>).
10. Milestones. Accreditation Council for Graduate Medical Education. (Accessed April 4, 2015, at <https://www.acgme.org/What-We-Do/Accreditation/Milestones/Overview>).
11. The emergency medicine milestone project 2015. Accreditation Council for Graduate Medical Education. (Accessed May 9, 2019, at <https://www.acgme.org/Portals/0/PDFs/Milestones/EmergencyMedicineMilestones.pdf?ver=2015-11-06-120531-877>).
12. Friedman S, Sayers B, Lazio M, Friedman S, Gisondi MA. Curriculum Design of a Case-based Knowledge Translation Shift for Emergency Medicine Residents. *Acad Emerg Med* 2010;17:S42–8.
13. Kim S, Noveck H, Galt J, Hogshire L, Willett L, O'Rourke K. Searching for Answers to Clinical Questions Using Google Versus Evidence-Based Summary Resources: A Randomized Controlled Crossover Study. *Acad Med* 2014;89:940-943.
14. Sharma H, Verma S. Predatory journals: The rise of worthless biomedical science. *J Postgrad Med* 2018;64:226-231.
15. Hawkes N. Spoof research paper is accepted by 157 journals. *BMJ* 2013;347:f5975.
16. Manca A, Moher D, Cugusi L, Dvir Z, Deriu F. How predatory journals leak into PubMed. *Can Med Assoc J* 2018;190:E1042–5.
17. Torre DM, Daley BJ, Sebastian JL, Elnicki DM. Overview of current learning theories for medical educators. *Am J Med* 2006;119:903–7.

18. Kirkpatrick DL, Kirkpatrick JD. Evaluating Training Programs: The Four Levels. San Francisco, CA: Berrett-Koehler Publishers, 1994.

Box 1. Feedback from residents on the literature searching session

Feedback from the session was overwhelmingly positive:

- “[the simulation] made me realize that I don't always know the most efficient way to lit search”
- “Demonstrating the very real and practical application of literature review made it more tangible and realistic”
- “Realistic clinical scenario [...] immediately institutable into practice”
- “It helped to highlight the importance of being able to search (do a point-of-care search) effectively and efficiently”
- “I liked it, I thought it was fun.”
- “It was really helpful looking up evidence for something we do clinically relatively often like treating AFib so I think going through similarly frequent scenarios would be helpful!”
- “I liked how we had a time crunch and it also made me think about all the medications I'm just giving to patients without knowing the evidence behind them.”

Residents also offered some suggestions for improvement, including:

- “Maybe allowing us to bring computer - easier to search on it”
- “[consider adding a] session beforehand on how to add applications to handheld devices”