

Teaching and Evaluating Point of Care Learning With an Internet-Based Clinical-Question Portfolio

MICHAEL L. GREEN, MD, MSc; SIDDHARTA G. REDDY, MPH; ERIC HOLMBOE, MD

Introduction: Diplomates in the American Board of Internal Medicine (ABIM) Maintenance of Certification (MOC) program satisfy the self-evaluation of medical knowledge requirement by completing open-book multiple-choice exams. However, this method remains unlikely to affect practice change and often covers content areas not relevant to diplomates' practices. We developed and evaluated an Internet-based point of care (POC) learning portfolio to serve as an alternative.

Methods: Participants enter information about their clinical questions, including characteristics, information pursuit, application, and practice change. After documenting 20 questions, they reflect upon a summary report and write commitment-to-change statements about their learning strategies. They can link to help screens and medical information resources. We report on the beta test evaluation of the module, completed by 23 internists and 4 internal medicine residents.

Results: Participants found the instructions clear and navigated the module without difficulty. The majority preferred the POC portfolio to multiple-choice examinations, citing greater relevance to their practice, guidance in expanding their palette of information resources, opportunity to reflect on their learning needs, and "credit" for self-directed learning related to their patients. Participants entered a total of 543 clinical questions, of which 250 (46%) resulted in a planned practice change. After completing the module, 14 of 27 (52%) participants committed to at least 1 change in their POC learning strategies.

Discussion: Internists found the portfolio valuable, preferred it to multiple-choice examinations, often changed their practice after pursuing clinical questions, and productively reflected on their learning strategies. The ABIM will offer this portfolio as an elective option in MOC.

Key Words: point of care, portfolio, evaluation, reflection, evidence-based practice

Introduction

Diplomates enrolled in the Maintenance of Certification (MOC) program of the American Board of Internal Medicine (ABIM) demonstrate their commitment to lifelong learning by completing self-assessments of practice performance

Disclosures: Conduct of the presently reported study and preparation of the manuscript were supported by the American Board of Internal Medicine and the American Board of Internal Medicine Foundation.

Dr. Green: Associate Professor of Medicine, Yale University School of Medicine, New Haven, CT, and Associate Program Director for Ambulatory Communication, Yale Primary Care Internal Medicine Program; *Mr. Reddy:* Research Associate for Practice Performance Evaluation, American Board of Internal Medicine; *Dr. Holmboe:* Vice President for Quality and Evaluation Research, American Board of Internal Medicine.

Correspondence: Michael L. Green, Yale Primary Care Residency Program, Waterbury Hospital, 64 Robbins Street, Waterbury, CT, 06721; e-mail: michael.green@yale.edu.

© 2009 The Alliance for Continuing Medical Education, the Society for Academic Continuing Medical Education, and the Council on CME, Association for Hospital Medical Education. • Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/chp.20039

and medical knowledge. To document medical knowledge assessment, they complete open-book ABIM multiple-choice examinations or similar external evaluation exercises, such as the American College of Physicians' Medical Knowledge Self-Assessment Program tests. It is expected that diplomates will need to seek new medical information to answer many of the questions, which relate to relatively new medical knowledge.

Although these knowledge assessments facilitate learning through case-based problems and links to relevant medical information, they lack the exigency of the questions that trigger learning episodes in practice.¹ In addition, they are less likely to produce practice changes, as they represent "predisposing" interventions without "enabling" or "reinforcing" components^{2,3} and remain detached from actual patient-care scenarios.^{4,5} And finally, although surveys show high levels of satisfaction with the ABIM open-book examination modules, some diplomates find that they fail to reflect that range of clinical questions they encounter in their practices and lament the lack of relevance to their personal professional development.

Compared to multiple-choice examinations, portfolios document more self-directed and personally relevant learning

episodes. Reckase defines a portfolio as a “purposeful collection of student work that exhibits to the student (and/or others) the student’s efforts, progress, or achievement in (a) given area(s).”⁶ Point of care (POC) learning has been assessed by documenting physicians’ pursuit of clinical questions with the use of portfolio-based systems.^{7–11} Although they successfully capture POC learning episodes, these portfolios suffer variously from lack of integration of evidence-based practice or limited opportunity for reflection. To allow diplomates to demonstrate their POC lifelong learning, the ABIM developed an Internet-based module that includes these elements. The module represents a portfolio in that diplomates enter a “purposeful collection” of clinical questions of their choosing; document their learning, including the acquisition, appraisal, and application of new medical information; reflect on the practice implications of each learning episode; and retrospectively reflect on the entire experience as they reconsider their POC learning strategies. We report the development, description, and initial evaluation in this article.

Methods

Portfolio Development

We began by reviewing the literature on physician learning,^{1,12–14} evidence-based practice,¹⁵ reflection in medical education,¹⁶ and POC learning portfolios^{4,5,7–10} to identify important content and features to include in the module. We then developed a written description of the potential features and functionality of the module and revised this based on review by an internal ABIM research committee. At this point, we convened an external advisory board, including experts on physician learning, continuing medical education, evidence-based practice, and physician certification. They attended a 2-day meeting at the ABIM and provided feedback on the written description of the module. We then enlisted the ABIM information technology staff to program an Internet-based prototype.

We recruited 15 internists or internal medicine residents for cognitive and feasibility testing of the prototype. Under direct observation, they entered several clinical question sequences in the module. They were instructed to “think out loud” as they encountered technical problems, navigation difficulties, ambiguous instructions, or unclear data-entry tasks. Several technical issues were discovered and resolved in preparation for the field test discussed below in the evaluation section.

Portfolio Description

Participants document their learning episodes stimulated by clinical questions via an Internet-based interface. By “clinical questions,” we specify queries that signify the need for new medical information with the following characteristics:

Questions concerning medical knowledge (such as “How effective is ultrasound screening for abdominal aortic aneurysm in reducing the risk of death from AAA rupture?”). This does not include questions about patient data (such as “What is the result of my patient’s abdominal ultrasound?”) or health-care process issues (such as “Will AAA screening be covered by my patient’s health insurance?”).

Questions stimulated by care or consideration of an actual patient or group of patients, including direct clinical care, patient-based discussions (such as rounds), supervision of trainees caring for patients, or an assessment of your practice (such as a record audit or survey of your patients). This does not include questions stimulated by your awareness of a new medical finding or your perceived need to keep up to date in a certain medical content area.

Because they may not have time to pursue and document a learning episode at the time of the clinical encounter, participants can quickly enter the clinical question in a “holding area” and return to it in the future. At this point, the questions may be edited or deleted with no commitment to pursue or document them in the module. When the participant is prepared to document a clinical question fully, he or she is guided through a series of items to document its characteristics, pursuit, and application (TABLE 1). Twenty question-triggered learning episodes must be documented to complete the module.

At this point, the participant receives a POC learning report designed to help reflect on self-directed learning. This includes a quantitative summary of the clinical-question characteristics, information-seeking behavior, practice changes, barriers, and a series of questions aimed at provoking reflection (example in the Appendix). After reviewing the report, the participant finishes by completing the action plan, in which he or she either writes up to 3 commitment-to-change¹⁷ statements regarding the POC learning strategies or confirms that the approach used currently is working.

At any point, the participant can link to several resources for assistance, including detailed instructions, help screens with explanations and examples of evidence-based practice concepts, and a wide variety of medical information resources.

Evaluation Strategy (Beta Testing)

Practicing internists and internal medicine residents participated in the beta test. We invited internists from a random sample of diplomates enrolled in MOC whose certificates were due to expire within 3 years. Internal-medicine-only certificate holders were oversampled compared to subspecialists. We also invited a sample of program directors to recruit their residents for the beta test.

Participants were required to complete all elements of the module and an Internet-based survey upon completion. The survey included multiple-choice, Likert-scale, and free-text questions about their experience with the module, including its content, usability, time requirements, value for self-directed learning, potential impact on practice, and com-

TABLE 1. Items in Clinical Question Sequence in Point of Care (POC) Learning Portfolio

Item	Description of Entrees
Stimulus for question	Choices of possible stimuli (select one)
Clinical scenario	Free text description
Clinical content area	Choices of specialty fields from American Board of Internal Medicine test question categories (select one)
Question type	General versus specific ^a (select one)
Clinical task ^b	Select one (<i>specific question only</i>)
Frame question in patient–intervention–comparison–outcome (PICO) format ^a	(<i>specific question only</i>)
Status of question	Already found medical information to answer it Still pursuing (or considering pursuing) the answer Decided not to pursue answer (select one)
Timing of pursuit	At time of clinical encounter Some time after the encounter (select one)
Time of pursuit	Time spent looking up medical information
Resources accessed	All of the information resources accessed (select all that apply from exhaustive list)
Resource tried first	First information resource accessed (select one from same list)
Resource most helpful	Information resource most helpful in answering question (select one from same list)
Reference	Reference for most helpful information resource
Bottom line answer	Free text of “bottom line” information to answer the question. Includes guidance of the type and format of response, based on the particular clinical task (<i>guidance for type and format of response for specific question only</i>)
Application for this patient	Free text of application of information to particular patient. Includes guidance on the type and format of response, based on the particular clinical task (<i>specific question only</i>)
Practice change	“I am planning to change my practice” “I am planning to seek more information before deciding to make a change” “I am not planning to change my practice because the information supports my current practice” “I am not planning to change my practice because the change is not currently feasible” (select one)
Barriers	Barriers encountered in asking question, acquiring information, appraising evidence, or applying evidence (select one from list of potential barriers)

^aGeneral questions concern general knowledge that would help clinicians better understand a particular disorder, health state, diagnostic test, treatment, or other aspect of health care. Specific questions ask for specific knowledge to inform clinical decisions or actions and include 4 components: patient, intervention, comparison, and outcome.^{34,35}

^bClinical task associate with clinical question: clinical findings, etiology or harm, manifestations of disease, differential diagnosis, diagnostic testing, prognosis, therapy, prevention.¹⁵

parison to other MOC activities. Participants received 20 points toward fulfillment of their Maintenance of Certification (if applicable) and a \$50 honorarium. The study was approved by a private institutional review board.

Results

Seventy-four participants initially enrolled in the beta test, but only 27 (36%) ultimately completed the module and survey. Responders and nonresponders were similar in terms of percent time devoted to clinical activities, percent of clinical time devoted to teaching, and percent of trainees (data not shown). However, the responders included a higher

portion of generalists than the nonresponders (83% vs. 58%, $P = .05$). Anticipating that completing the module would require too much time was the most common reason offered for dropping out. Other reasons included misunderstanding the instructions, failing to see the relevance for fulfilling medical knowledge needs, lacking sufficient access to medical information resources, and extenuating circumstances.

Of the 27 participants completing the beta test, 4 were residents, 19 were general internists, and 4 were subspecialists. The 23 internists spent 90% of their time in patient-care activities across a wide range of settings, including the hospital, intensive care units, emergency departments, offices,

TABLE 2. Self-Reported Impact of Evidence-Based Medicine (EBM) Guidances

EBM Guidance ^a	Mean Response ^b (Standard Deviation)	Percent Strongly Agree or Agree ^b
Classifying my questions (background vs. foreground, clinical task) helped me in finding, appraising, and applying the relevant medical information	3.1 (1.1)	32%
Restating my questions in the patient–intervention–comparison–outcome (PICO) format helped me in finding, appraising, and applying the relevant medical information	3.6 (0.9)	58%
The links to electronic information resources were helpful in searching for medical information	3.3 (1.0)	50%
The prompts (suggestions for relevant information to include) helped me precisely state the “bottom line” answer to my clinical questions	3.9 (0.8)	63%
The prompts (suggestions for relevant information to include) helped me precisely describe how I would or did apply the medical information to my patient	3.8 (0.9)	58%
The help screens helped me accurately document information about my clinical questions	3.9 (0.8)	63%
The help screens improved my knowledge and skills in evidence-based practice	3.9 (0.9)	68%

^aHelp screens, prompts, and response formats designed to guide participants in the EBM aspects of documenting their clinical questions.

^bLikert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

and extended-care facilities. Fifty-five percent of their clinical time included teaching.

The survey responses indicated that very few participants encountered technical problems in completing the module. Most found the instructions clearly stated (78% agree or strongly agree), navigated the module easily (70% agree or strongly agree), and entered and transmitted information over the Internet without difficulty (85% agree or strongly agree). Participants reported a median time of 10 minutes to document their shortest clinical question sequence, 20 minutes for their average clinical question, and 45 minutes for their longest clinical question. The overall range was 2–300 minutes. Specific (foreground) questions, with more items, required more time than general (background) questions. The median time required to complete the entire module, including reflecting on the point of care learning report and completing the action plan was 19 hours (range 3–120 hours).

The majority of participants found the module valuable in facilitating their patient-based self-directed learning and

evidence-based practice. Ninety-six percent would recommend the module to a colleague, and 84% would consider using it again to fulfill their requirements for Maintenance of Certification. TABLES 2 and 3, respectively, show the participants' perceived utility of components designed to facilitate evidence-based practice and components designed to promote reflection.

Among the 23 participants who had also completed an ABIM multiple-choice self-evaluation exercise, 8 (35%) found that the POC module required substantially more time, 4 (17%) somewhat more time, 5 (22%) about the same amount of time, and 6 (26%) somewhat less time. In spite of the increased time commitment for some, free-text comments revealed that the majority of participants consistently preferred the POC learning portfolio to the open-book multiple-choice examinations. They appreciated the practicality, greater relevance to their practice, guidance in expanding their palette of medical information resources, opportunities to reflect on their medical knowledge needs, and getting credit for self-directed learning related to their patients. The few

TABLE 3. Self-Reported Impact of Features Promoting Reflection

Feature	Mean Response ^a	Percent Strongly Agree or Agree ^a
Documenting the steps of asking, answering, and applying my clinical questions helped me reflect on what I learned and expand my working medical knowledge	4.0 (0.9)	84%
The data in the point of care (POC) learning report helped me reflect on my self-directed learning strategies	4.3 (0.8)	89%
The data in the POC learning report helped me identify areas for improvement in my self-directed learning strategies	3.9 (0.9)	74%
In the action plan, I identified and committed to specific changes in my self-directed learning strategies	3.9 (0.9)	63%

^aLikert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

TABLE 4. Impact of Point of Care Learning Episodes on Clinical Practice (*N* = 27 Physicians)

Impact on Practice	<i>N</i> (%)
"I am not planning to change my practice because the information supports my current practice"	205 (38%)
"I am planning to change my practice"	250 (46%)
"I am planning to seek more information before deciding to make a change"	60 (11%)
"I am not planning to change my practice because the change is not currently feasible"	28 (5%)
Total	543 episodes

dissenters noted the time requirement and tedium of some of the documentation.

Participants documented a total of 543 clinical questions: 190 (35%) general and 353 (65%) specific. As shown in TABLE 4, nearly half of the POC learning episodes resulted in a planned practice change. Upon reviewing their action plans, 14 of 27 (52%) of the participants wrote at least 1 commitment-to-change statement regarding their POC learning strategies. The 35 total commitments to change grouped into the categories of (1) obtaining access to new medical information resources (and discontinuing unhelpful ones), (2) improving evidence-based practice skills, (3) developing systems to track clinical questions, (4) improving efficiency and answering more clinical questions in real time, and (5) collaborating with colleagues in learning.

Discussion

We developed, implemented, and evaluated an Internet-based POC learning portfolio. The portfolio allows physicians to document learning episodes triggered by practice-based clinical questions; guides them in acquiring, appraising, and ap-

plying new medical information; and facilitates their reflection on a summary report of their POC learning. Beta test participants found the portfolio easy to use, helpful in facilitating evidence-based practice and promoting reflection, and more relevant than multiple-choice question knowledge assessments. They reported planning to change their practice after pursuing answers to 46% of their clinical questions. Upon completing the portfolio, 52% of participants committed to implementing changes in their practice-based learning strategies. This rate is keeping with studies of more traditional continuing medical education interventions,^{18–21} in which 58%–72% of physicians voluntarily wrote commitment-to-change statements.

Our attention to prevailing theories and empiric findings of physician learning may account for the encouraging results, including the participants' perceived utility of the POC portfolio and their frequent plans for practice changes. Physicians naturally learn and change in discreet episodes triggered by a moment of cognitive dissonance and progress through defined stages (TABLE 5).¹² The clinical-question sequence in our portfolio follows these stages and offers guidance at each stage. Secondly, in contrast to multiple-choice examinations, learning in our portfolio relates to actual patient-care scenarios. Physicians are more likely to commit to change their practice after learning episodes stimulated by reviewing the management of a patient or by an audit of their practice compared to episodes stimulated by the general impulse to scan the literature.^{4,5}

Finally, the POC portfolio facilitates reflection, which is associated with "deeper" learning¹⁶ and appears to play an important role in behavior change and professional development. Participants reflect at 3 different levels in completing the portfolio. First, considering the details of their clinical question, participants, in the parlance of Schon, "reflect-in-action."¹⁴ At this stage, they try to solve, in the moment, a new problem that lies outside of their "zone of mastery." Next, at the end of the clinical-question sequence, they "reflect-on-action" about what they learned and how

TABLE 5. Stages in Physician Learning Episodes^a

	Recognizing an Opportunity for Learning	Searching for Resources for Learning	Engaging in Learning	Trying Out What Was Learned	Incorporating What Was Learned
Geertsma et al ³⁶	Priming	Focusing	Focusing	Follow up	
Means ³⁷	Awareness	Actively seeking a solution			Problem resolution
Putnam and Campbell ³⁸		Preparing to make a change	Making the change	Solidifying the change	Solidifying the change
Garcia and Newsome ³⁹	Priming	Follow up	Follow up	Follow up confirmation	
Pathman et al ⁴⁰	Preawareness Awareness	Agreement		Adoption	Adherence
Slotnick ¹	Scanning	Evaluating	Learning	Gaining experience	Gaining experience
Evidence-based medicine ¹⁵	Ask	Acquire	Appraise	Apply	Assess

^aAdapted from Reference 12. Last row added by the authors.

they might change their practice. Finally, they reflect upon the learning process itself as they review the cumulative POC learning report. This “meta reasoning” represents an important dimension of reflective practice.²²

Our findings add to the experience with portfolios in continuing medical education. Generally, physicians undertaking portfolio-based learning find it acceptable, appreciate the flexibility, and, in comparison to their continuing medical educational activities, study a wider breadth of topics.²³ More specific to our study, 3 groups of investigators reported the assessment of point of care learning with electronic portfolios.^{4,5,7–10,24,25} Differences in the type of data reported for these 3 systems permit few quantitative comparisons.

Members of the Royal College of Physicians and Surgeons of Canada (RCPSC) may earn continuing professional development points by documenting “personal learning projects” (which may include POC learning) via an Internet-based system.²⁴ Physicians spent more time answering their clinical questions (greater than 1 hour answering 78% of them)⁴ than the physicians in our study. They were more likely to plan to change their practice after a learning episode if they spent more time on it, if they used the portfolio for a longer period of time, if they used an electronic rather than a paper version, or, as above, if the episode was stimulated by patient care.^{4,5} Consistent with our study, many participants preferred this way of documenting their learning, appreciated getting credit for learning related to their practice, and continued to use it after the study periods.^{7,8,25} Nonusers lamented that recording their learning was too time consuming, struggled with computer and Internet use with inadequate support, and perceived a bureaucratic intent.

Residents documented their patient encounters in a “Computerized Obstetrics and Gynecology Automated Learning Analysis (KOALA™)” at several programs in Canada.⁹ In addition to entering procedures and complications, they record “elements of surprise outside their knowledge and experience.” They then pose a clinical question, access on-line information resources via hypertext, summarize what they learned, and determine whether or not they will change their practice. During a 4-month pilot at 4 programs, 41 residents recorded 7049 patient encounters and 1460 critical learning incidents. Residents at 1 of the programs, which had a prior 1-year experience with KOALA, demonstrated higher “self-directed learning readiness” (measured with a validated instrument²⁶).

At an internal medicine program, residents entered their clinical questions, Medline reference links, and article summaries in the Critical Appraisal Resource (CAR), an Internet-based compendium.¹⁰ Over 10 months, residents entered 625 clinical questions and were able to obtain useful information from the medical literature on 82% them. They reported that obtaining useful data altered patient management 47% of the time (39% of total questions). The higher number in our study (practice change for 52% of questions) might indicate

that physicians in practice ask more practical or more answerable questions. Residents also used the CAR as a resource, searching the data base for information 1035 times over the study period.

By virtue of having participants document their learning episodes, all of these portfolios facilitate reflection. And the RCPSC and KOALA portfolios offer a reporting function similar to ours. However, our POC learning portfolio extends these efforts by soliciting more details about the learning episode, offering guidances (via examples and help screens) at each stage, and prompting reflection at 3 different levels (as discussed above).

What most distinguishes our portfolio is its integration of the principles and technologies of evidence-based practice. Through structured data entry and help screens, participants are guided through classifying and articulating specific questions, selecting among information resources, and applying the information to individual patients. Physicians trained in EBP ask more specific questions,²⁷ undertake more searches for evidence,²⁸ use more detailed search methods and find more precise answers,^{29,30} and select therapies supported by higher quality of evidence.³¹ Thus, we might expect participants’ reported practice changes to reflect a thoughtful consideration of the best evidence.

Interpretation of our findings should be tempered by acknowledging a few limitations. Only 27 field test subjects completed the portfolio. However, smaller sample sizes are typical for this type of beta test, which focuses on usability and utility.³² The low proportion (36%) of initially enrolled subjects who ultimately completed the portfolio may cast doubt on the overall acceptability of the module and the generalizability of the results. Although they resembled the noncompleters in a few demographic characteristics, the completers nonetheless may represent an enthusiastic select group, predisposed to adopt this type of learning portfolio. However, many of the noncompleters never actually tried entering data in the portfolio and cited *anticipating*, not actually experiencing, a large time commitment as the reason for dropping out of the beta test. The noncompleters who tried but abandoned the portfolio did so after entering just 1 or 2 questions. In our experience, participants spend much more time documenting the first 1 or 2 questions and then speed up as they gain facility with the system and familiarity with the information requirements. So, these noncompleters may have found the module less formidable had they persisted. It is also worth noting here that only 53% of the participants found the POC module more time consuming than the MCQ examinations. We have subsequently revised the instructions to alert participants that documenting the first few questions may require more time. In addition, we added a downloadable paper template that diplomates may use to write down question-related information when they are not logged in to the portfolio. Finally, in the ABIM experience, a sizable number of dropouts is not unusual in beta testing modules that ultimately gained wide acceptance.³³

Lessons for Practice

- Evaluation of POC learning with an Internet-based portfolio can be enhanced by (1) facilitating reflection upon the implications of individual learning episodes *and* upon the learning process itself; and (2) integrating guidance in evidence-based practice.
- Internists found a POC learning portfolio valuable, preferred it to multiple-choice examinations to document self-assessment of knowledge, often changed their practice after pursuing clinical questions, and productively reflected on their learning strategies.

Our measurements of planned practice changes and planned POC learning strategy changes were limited to self-reports, which remain more vulnerable to bias than more objective methods. Nonetheless, studies consistently show that physicians who formally “commit to change” are more likely to make changes than those who do not,¹⁷ suggesting that this measure may be a reasonable marker for an actual change in practice.

In conclusion, diplomates found the POC learning portfolio feasible, valuable, and preferable to open-book multiple-choice examinations in documenting their self-assessment of medical knowledge. In addition, after reflecting on their learning episodes, many committed to substantial changes in their POC learning strategies. The ABIM will offer the POC portfolio as an elective option for Maintenance of Certification as part of an extended beta test. Residency program directors may also consider using the portfolio to teach and evaluate this aspect of practice-based learning and improvement. When fully implemented, the POC learning portfolio will provide us with data to study clinical questions and information-seeking behavior from a national sample of internists and subspecialists. These results should be of interest to policy makers, continuing medical education providers, and physician learning researchers.

References

1. Slotnick HB. How doctors learn: physicians' self-directed learning episodes. *Acad Med.* 1999;74(10):1106–1117.
2. Davis DA, Thomson MA, Oxman AD, Haynes RB. Changing physician performance. A systematic review of the effect of continuing medical education strategies. *JAMA.* 1995;274(9):700–705.
3. Davis DA, Thomson MA, Oxman AD, Haynes RB. Evidence for the effectiveness of CME. A review of 50 randomized controlled trials [see comments]. *JAMA.* 1992;268(9):1111–1117.
4. Campbell C, Parboosingh J, Gondocz T, Babitskaya G, Pham B. A study of the factors that influence physicians' commitments to change their practices using learning diaries. *Acad Med.* 1999;74(10)(suppl):S34–S36.
5. Campbell C, Parboosingh J, Gondocz T, Babitskaya G, Pham B. Study of the factors influencing the stimulus to learning recorded by physicians keeping a learning portfolio. *J Contin Educ Health Prof.* 1999;19(1):16–24.
6. Reckase MD. Portfolio assessment: a theoretical estimate of score reliability. *Educ Meas Issues Pract.* 1995;14(1):12–14, 31.
7. Campbell C, Gondocz T, Parboosingh J. Documenting and managing self-directed learning among specialists. *Ann R Coll Phys Surg Can.* 1995;28:80–84.
8. Campbell CM, Parboosingh JT, Gondocz ST, et al. Study of physicians' use of a software program to create a portfolio of their self-directed learning. *Acad Med.* 1996;71(10)(suppl):S49–S51.
9. Fung MF, Walker M, Fung KF, et al. An Internet-based learning portfolio in resident education: the KOALA multicentre programme. *Med Educ.* 2000;34(6):474–479.
10. Crowley SD, Owens TA, Schardt CM, et al. A Web-based compendium of clinical questions and medical evidence to educate internal medicine residents. *Acad Med.* 2003;78(3):270–274.
11. Green ML. Evaluating evidence-based practice. In: Holmboe ES, Hawkins RE, eds. *A Practical Guide to the Evaluation of Clinical Competence.* Philadelphia, PA: Mosby-Elsevier; 2008.
12. Moore DE. How physicians learn and how to design learning experiences for them: an approach based on an interpretive review of the evidence. In: Hager M, Russel S, Fletcher SW, eds. *Continuing Education in the Health Professions: Improving Health-care Through Lifelong Learning, Proceedings of a conference sponsored by the Josiah Macy, Jr. Foundation; 2007 November 28–December 1; Bermuda.* New York, NY: Josiah Macy, Jr. Foundation; 2008.
13. Smith CS, Morris M, Francovich C, Hill W, Giesselman F. A qualitative study of resident learning in ambulatory clinic. *Adv Health Sci Educ.* 2004;9:93–105.
14. Schon DA. *Educating the Reflective Practitioner.* San Francisco, CA: Jossey-Bass; 1987.
15. Straus SE, Richardson WS, Glasziou P, Haynes RB. *Evidence-Based Medicine: How to Practice and Teach EBM.* 3rd ed. Edinburgh, United Kingdom: Elsevier; 2005.
16. Mann K, Gordon J, Macleod A. Reflection and reflective practice in health professions education: a systematic review. *Adv Health Sci Educ.* 2009;14(4):595–621.
17. Wakefield JG. Commitment to change: exploring its role in changing physician behavior through continuing education. *J Contin Educ Health Prof.* 2004;24(4):197–204.
18. Dolcourt JL. Commitment to change: a strategy for promoting educational effectiveness. *J Contin Educ Health Prof.* 2000;20(3):156–163.
19. Jones DL. Viability of the commitment-for-change evaluation strategy in continuing medical education. *Acad Med.* 1990;65(9 Suppl):S37–S38.
20. Mazmanian PE, Daffron SR, Johnson RE, Davis DA, Kantrowitz MP. Information about barriers to planned change: a randomized controlled trial involving continuing medical education lectures and commitment to change. *Acad Med.* 1998;73(8):882–886.
21. Purkis IE. Commitment for changes: an instrument for evaluating CME courses. *J Med Educ.* 1982;57(1):61–63.
22. Mamede S, Schmidt HG. The structure of reflective practice in medicine. *Med Educ.* 2004;38(12):1302–1308.
23. Mathers NJ, Challis MC, Howe AC, Field NJ. Portfolios in continuing medical education—effective and efficient? *Med Educ.* 1999;33(7):521–530.
24. Royal College of Physicians and Surgeons of Canada. *Continuous Professional Development Program Guide.* http://rcpsc.medical.org/opd/cpd/prog-guide_e.pdf. Accessed July, 2009.

25. Parboosingh J. Learning portfolios: potential to assist health professionals with self-directed learning. *J Contin Educ Health Prof.* 1996;16(2):75–81.
26. Guglielmino LM. Development of the self-directed learning readiness scale. *Diss Abstr Int.* 1977;38:6467A. <http://www.lpasdlrs.com/main.html>. Accessed July, 2009.
27. Villanueva EV, Burrows EA, Fennessy PA, Rajendran M, Anderson JN. Improving question formulation for use in evidence appraisal in a tertiary care setting: a randomised controlled trial. *BMC Med Inform Decis Mak.* 2001;1(1):4.
28. Cabell CH, Schardt C, Sanders L, Corey GR, Keitz SA. Resident utilization of information technology. *J Gen Intern Med.* 2001;16(12):838–844.
29. Rosenberg WM, Deeks J, Lusher A, Snowball R, Dooley G, Sackett D. Improving searching skills and evidence retrieval. *J R Coll Physicians Lond.* 1998;32(6):557–563.
30. Booth A, O'Rourke AJ, Ford NJ. Structuring the pre-search reference interview: a useful technique for handling clinical questions. *Bull Med Libr Assoc.* 2000;88(3):239–246.
31. Straus SE, Ball C, Balcombe N, Sheldon J, McAlister FA. Teaching evidence-based medicine skills can change practice in a community hospital. *J Gen Intern Med.* 2005;20(4):340–343.
32. Campbell NC, Murray E, Darbyshire J, et al. Designing and evaluating complex interventions to improve health care. *Br Med J.* 2007;334(7591):455–459.
33. Holmboe ES, Meehan TP, Lynn L, Doyle P, Sherwin T, Duffy FD. Promoting physicians' self-assessment and quality improvement: the ABIM diabetes practice improvement module. *J Contin Educ Health Prof.* 2006;26(2):109–119.
34. Richardson WS, Wilson MC. On questions background and foreground. *Evid Based Healthc Newsl.* Nov. 1997(November 6):6.
35. Richardson WS, Wilson MC, Nishikawa J, Hayward RS. The well-built clinical question: a key to evidence-based decisions [editorial]. *ACP J Club.* 1995;123(3):A12–A13.
36. Geertsma RH, Parker RC, Jr., Whitbourne SK. How physicians view the process of change in their practice behavior. *J Med Educ.* 1982;57(10)(Pt 1):752–761.
37. Means SP. How family physicians use information sources. In: Green JS, Grosswald SJ, Suter E, Walthall DB, eds. *Continuing Education for the Health Professions.* San Francisco: Jossey-Bass; 1984.
38. Putnam RW, Campbell D. Competence. In: Fox RD, Mazmanian PE, Putnam RW, eds. *Changing and Learning in the Lives of Physicians.* New York, NY: Praeger; 1989.
39. Garcia R, Newsom R. Learning and change among emergency physicians. *J Contin Educ Health Prof.* 1996;16(1):33–41.
40. Pathman DE, Konrad TR, Freed GL, Freeman VA, Koch GG. The awareness-to-adherence model of the steps to clinical guideline compliance. The case of pediatric vaccine recommendations. *Med Care.* 1996;34(9):873–889.

Appendix

Point-of-Care Report

Section 1

The following data pertain to all of the questions you documented as part of the POC Module

a) You documented a total of 20 clinical questions over 9.7 weeks, for an average of 2.1 questions per week.

b) You were stimulated to develop your 20 questions in the following scenarios:

	Total	Percentage
Direct care of a patient in the office or other outpatient setting	13	68.42
Patient-based discussion, either formal (such as rounds) or informal (such as discussions with colleagues)	5	26.32
Other (please specify): - Discussion with my son who is a runner	1	5.26

c) Your 20 total questions were distributed among the following ABIM question content area:

	Total	Percentage
Cardiovascular Disease	2	10.53
Gastroenterology	1	5.26
Infectious Disease	5	26.32
Rheumatology/Orthopedics	2	10.53
Endocrinology/Metabolism	2	10.53
Oncology	1	5.26
Nephrology/Urology	1	5.26

Psychiatry	1	5.26
Dermatology	1	5.26
Obstetrics/Gynecology	2	10.53
Otorhinolaryngology	1	5.26

d) Of these, 7 (36.84 %) were general (background) questions and 12 (63.16 %) were specific (foreground) questions.

e) Your 12 total specific (foreground) questions were associated with the following clinical tasks (note, clinical task is only recorded for specific questions):

	Total	Percentage
Differential Diagnosis	3	25
Diagnostic Testing	1	8.33
Therapy	5	41.67
Prevention	3	25

Section 2

The following data pertain to the subset of questions that you pursued as part of the POC Module

a) To pursue your 20 questions, you consulted the following medical information resources

	Total	Percentage
Up To Date	14	37.84
Clinical evidence*	1	2.7
Article via Google Scholar	2	5.41
Other (please specify): - LexiComp	1	2.7
U. S. Preventive Services Task Force-Guide to preventive services	1	2.7
Article via Medline or Pub Med (National Library of Medicine)	6	16.22
National Guideline Clearinghouse	6	16.22
Textbook (Electronic) - specify title: - Dermatology	1	2.7
Cochrane Library of Systematic Reviews	1	2.7
Textbook (Electronic) - specify title: - Medscape	2	5.41
Textbook (Electronic) - specify title: - Orthopedic Consult	1	2.7
Textbook (Paper) - specify title: - Essentials of Musculoskeletal Care	1	2.7

b) To pursue your questions, you consulted the following medical information resources first

	Total	Percentage
Textbook (Paper) - specify title: - Essentials of Musculoskeletal Care	1	5.26
National Guideline Clearinghouse	4	21.05
Article via Medline or Pub Med (National Library of medicine)	1	5.26
Textbook (Electronic) - specify title: - Medscape	1	5.26
Up To Date	11	57.89
Cochrane Library of Systematic Reviews	1	5.26

c) To pursue your questions, you found the following medical information resources most useful

	Total	Percentage
Textbook (Electronic) - specify title: - Medscape	1	5.26
National Guideline Clearinghouse	3	15.79
Clinical evidence*	1	5.26
Other (please specify): - LexiComp	1	5.26
Up To Date	7	36.84
Textbook (Electronic) - specify title: - Dermatology	1	5.26
Article via Google Scholar	1	5.26
Article via Medline or Pub Med (National Library of Medicine)	4	21.05

d) You spent the following amounts of time looking up information to answer your pursued questions

i) Overall

Mean: 12.3 minutes

Median: 11 minutes

Standard deviation: 4.5 minutes

Range: 5 to 25 minutes

Distribution:

1-5 minutes	5-15 minutes	15-60 minutes	2 hours	>2 hours
1	15	3		

ii) General versus specific questions (in minutes)

	Mean	Median	Standard Deviation
General	10	11.6	3.2
Specific	12.5	12.7	5.3

iii) By clinical tasks (in minutes)

	Mean	Median	Standard Deviation
Diagnostic Testing	6	6	0
Differential Diagnosis	9	10	3.6
Prevention	17.7	15	6.4
Therapy	13.2	15	2.9

iv) By first resource consulted (in minutes)

	Mean	Median	Standard Deviation
Article via Medline or Pub Med (National Library of Medicine)	15	15	0
Cochrane Library of Systematic Reviews	10	10	0
National Guideline Clearinghouse	13.3	11.5	8.9
Textbook (Electronic) - specify title:	6	6	0
Textbook (Paper) - specify title:	12	12	0
Up To Date	12.5	11	2.8

Section 3

The following data pertain to your commitments to practice change resulting from your learning episodes

a) For the following 20 questions that you pursued, you committed to change practice as follows

		Plan to change	Seek more information	Information supports current practice	Change not feasible
Total		7 (37.00%)	2 (11.00%)	9 (47.00%)	1 (5.00%)
General vs. specific questions	<i>General</i>	1 (14.29%)	2 (28.57%)	3 (42.86%)	1 (14.29%)
	<i>Specific</i>	6 (50%)		6 (50%)	
Clinical Tasks	<i>Therapy</i>	4 (80%)		1 (20%)	
	<i>Diagnostic Testing</i>			1 (100%)	
	<i>Differential Diagnosis</i>			3 (100%)	
	<i>Prevention</i>	2 (66.67%)		1 (33.33%)	

Section 4

This table lists the barriers you encountered in finding, interpreting, and applying the medical information for your clinical questions

	Total Percentage	
Other (please specify):	1	12.5
I had limited access to potentially helpful information resources	2	25
I did not have as much time as I needed to sufficiently pursue this question	1	12.5
I had difficulty searching information resources.	1	12.5
I was not certain that the information I initially obtained was sufficient (I was not sure when to stop searching)	3	37.5