Educational Strategies for Training in Quality Improvement and Implementation Medicine

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ABSTRACT

Education in quality improvement (QI) is endorsed by the Association of American Medical Colleges across the spectrum of undergraduate, graduate, and postgraduate training. QI training is also a required component of graduate medical training per the American College of Graduate Medical Education. Despite widespread recognition of the importance of QI education and high levels of trainee involvement in QI as reported by pulmonary and critical care fellowship program directors, significant barriers to the implementation of effective and meaningful QI education during training exist. This creates an opportunity for the promotion of successfully implemented QI programs. Research demonstrates that successful QI educational programs involve the teaching of key QI concepts, participation in QI projects, protected time for QI project development, and institutional support. Using QI models such as the Plan-Do-Study-Act cycle and the Standards for Quality Improvement Reporting Excellence framework for reporting new knowledge about healthcare improvements also enhances both the educational value of the QI project and prospects for wider scholarly dissemination. In this perspective article, three examples of QI projects are discussed that serve to illustrate effective strategies of QI implementation.

Keywords:
quality improvement; medical education; implementation science

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Quality improvement (QI), broadly understood, is a process of changing behavior in response to experiential learning (1). Competence in QI is an important skill for medical trainees and is crucial to improvement in clinical practice (2, 3). Most payers, including the Centers for Medicare and Medicaid Services, and health systems now require incorporation of quality into clinical practice and reporting of myriad quality metrics (4–6). Specialty boards increasingly focus on QI, and QI is now required by the American College of Graduate Medical Education as a component of graduate medical education (6, 7). QI education is also important both at the undergraduate level of medical education as stated by the Association of American Medical Colleges and at the postgraduate level per the American Medical Association with opportunities for continuing medical education credit (8, 9).

The requirement for trainee QI education, project involvement, and scholarship presents an opportunity for innovative QI scholarship in medical education.

In response to this increased emphasis on QI across the spectrum of medical education, in 2015, Kahn and colleagues surveyed pulmonary and critical care medicine fellowship program directors on attitudes regarding graduate medical training in QI (10). Although program directors recognized the importance of QI and reported widespread involvement of fellows in QI-related activities, lack of fellow interest, lack of qualified faculty, and lack of time were significant barriers to QI education (10). Furthermore, additional unanswered questions remain regarding instituting QI curricula across multiple levels of medical education. Should QI milestones be individualized to learners at various levels of training? Because QI education is not standardized across the levels of medical training, must each graduate medical-level curriculum spend time and resources providing foundational QI content to bring all learners to the same level in addition to requiring trainee QI project participation? Finally, should QI competency be demonstrated, and, if so, how?

The requirement for trainee QI education, project involvement, and scholarship presents an opportunity for innovative QI scholarship in medical education. Traditionally, formal QI education has taken the form of didactics, reading lists, faculty-led workshops, and Internet-based education tools (Figure 1) (10, 11). Although these forms of education may provide the delivery of foundational QI concepts such as those of root cause analysis and QI models such as Plan-Do-Study-Act (PDSA), traditional approaches are also passive and time consuming (12). More recently, three components of trainee QI education have been described: the teaching of QI principles, skill-building exercises pertinent to patient safety activities, and trainee participation in institutional QI projects (13, 14). For QI education to be delivered effectively, trainees must pair acquisition of key QI concepts with participation in trainee-initiated and faculty-mentored QI projects, be allotted protected time for QI project development, and receive institutional support (11, 13). Although the acquisition and demonstration of QI principles may be appropriate for those at the undergraduate level to demonstrate competency, incorporating both the acquisition and application of QI knowledge into trainee participation in institutional QI projects may be most the

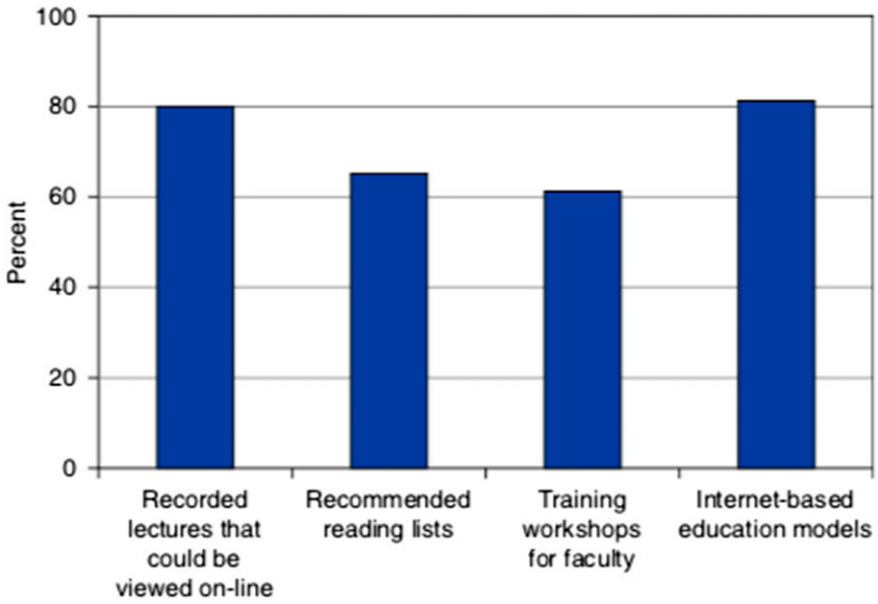

Figure 1. Components of a successful quality improvement educational curriculum as perceived by pulmonary, critical care, and sleep training directors. Reprinted by permission from Reference 10.

appropriate aspirational milestone for those at the graduate level.

In the survey of program directors discussed above, 77% of respondents believed that a QI curriculum developed by professional societies would help in instituting a comprehensive QI curriculum (10). The Institute for Healthcare Improvement (IHI), an organization dedicated to improving health and health care worldwide, provides an online curriculum for trainees for certification in QI and patient safety that delivers the foundational content for trainee-initiated and faculty-mentored QI project engagement (15). Other professional societies, such as the Association of American Medical Colleges and the American Medical Association, have done the same and developed general educational tools to assist in the acquisition and dissemination of QI expertise. Because QI education across medical training is not standardized, requiring trainee participation in these curricula ensures that all institution-specific trainees have the same requisite QI knowledge base either before or coincident with QI project participation. Some of these, specifically the IHI modules, offer certificates upon completion; this also affords the learners the opportunity to present the certificates completed during prior levels of medical training to avoid unnecessary redundancy of learning these core QI concepts in traditional educational formats when competing time demands are present.

Providing resources to medical trainees only addresses some of the barriers to QI curriculum implementation. For training programs without faculty with expertise in QI, the IHI offers an online curriculum targeted to faculty development in providing QI project mentorship. Engagement in trainee-initiated QI projects is another barrier that must be addressed. Developing QI programs centered on implementation of clinical practice guidelines (CPGs) and other QI and patient safety efforts serves to improve patient care, train health professionals in QI skills

for lifelong incorporation into clinical practice, encourage interprofessional and multidisciplinary engagement, and provide an academic exercise for trainees that can help support their career development. There are many examples of trainee projects achieving these goals (11, 16–18). Many professional specialty societies, such as the American Heart Association, have developed comprehensive QI models that include dissemination and educational tools built on CPGs (19–21). Directed QI scholarship, built on CPGs, may be able to improve patient care by both shortening the time lag between new discoveries and practice implementation and increasing use of CPG recommendations. Organizations such as the American Thoracic Society have created specific reports to help identify performance measures, such as interventions in CPGs that are supported by high levels of evidence and receive strong recommendations, that are ideal targets for QI projects (22). Because the delivery of care of many of these CPG recommendations involves stakeholders across a variety of disciplines, these projects also encourage interprofessional teamwork. CPG performance measures, however, are not the only target for QI projects; improvements and innovations in the arena of medical education are appropriate for academic scholarship.

To implement a successful QI initiative that teaches trainees QI principles, improves institutional QI or patient safety performance metrics, and results in scholarship appropriate for dissemination, both the methodology of the QI project and the reporting of the QI process must be standardized. In general, methodological components of QI initiatives must involve the following: defining the problem, identifying and involving stakeholders, performing a gap analysis, considering multiple and implementing one or a select few interventions, and evaluating the impact. Adopting formal QI cycles such as PDSA provides an appropriate methodological QI framework (23).

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It is equally important that QI initiatives adhere to a standardized reporting structure for scholarship dissemination, just as standard methodologies exist for the reporting of clinical trials (Consolidated Standards of Reporting Trials, or "CONSORT") and systemic reviews (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, or "PRISMA"). The Standards for Quality Improvement Reporting Excellence (SQUIRE) format provides this framework for reporting QI work to improve quality, safety, and value in health care (24). Retaining the traditional introduction, methods, results, and discussion structure of other scientific writing, SQUIRE 2.0 emphasizes the importance of consideration of the theory, the context, and the study of the QI initiative (24). This framework is outlined in Table 1. Importantly, although SQUIRE 2.0 contains 18 items, it may be unnecessary to include or address each item in a manuscript, and authors must individualize this framework to the individual QI project (24). Some journals, such as *BMJ*

Table 1. Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0)

Item Name	Description
Note to authors	The SQUIRE guidelines provide a framework for reporting new knowledge about how to improve healthcare
	The SQUIRE guidelines are intended for reports that describe system level work to improve the quality, safety, and value of healthcare, and used methods to establish that observed outcomes were due to the intervention(s)
	A range of approaches exists for improving healthcare. SQUIRE may be adapted for reporting any of these
Title	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient-centeredness, timeliness, cost, efficiency, and equity of healthcare)
Abstract	Provide adequate information to aid in searching and indexing
	Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions
Introduction	Why did you start?
Problem description	Nature and significance of the local problem
Available knowledge	Summary of what is currently known about the problem, including relevant previous studies
Rationale	Informal or formal frameworks, models, concepts, and/or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work
Specific aims	Purpose of the project and of this report
Methods	What did you do?
Context	Contextual elements considered important at the outset of introducing the intervention(s)
Intervention	a. Description of the intervention(s) in sufficient detail that others could reproduce it
	b. Specifics of the team involved in the work
Study of the intervention	a. Approach chosen for assessing the impact of the intervention(s)
	b. Approach used to establish whether the observed outcomes were due to the intervention(s)
Measures	a. Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability

(continued on following page)

Table 1. Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) (continued)

Item Name	Description
	b. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost
	c. Methods employed for assessing completeness and accuracy of data
Analysis	a. Qualitative and quantitative methods used to draw inferences from the data
	b. Methods for understanding variation within the data, including the effects of time as a variable
Ethical Considerations	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest

Definition of abbreviation: SQUIRE = Standards for Quality Improvement Reporting Excellence.
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Open Quality, a journal dedicated to healthcare improvement research, strongly encourages all authors to consult SQUIRE guidelines before manuscript submission; furthermore, authors must download and use the SQUIRE template to submit their manuscripts. Although not all journals require this, the authors of many QI research articles published in other journals also use this template to strengthen the methodological rigor of their work (25–27).

In 2019, Ogrinc and colleagues published the Standards for Quality Improvement Reporting Excellence in Education (SQUIRE-EDU) that were developed to improve and standardize the sharing and dissemination of innovative education-based QI initiatives (28). SQUIRE-EDU emphasizes three additional key components in education-specific QI scholarship: a description of the local education gap, a consideration of how the educational improvements affect stakeholders beyond the learners and the learning, and explanation of the fidelity of the iterative changes. Regarding this last aspect, because the intervention is expected to be modified through cycles of the QI process, explanation of the fidelity of the iterative changes refers to the adherence of the original intervention to the planned protocol and then a description of how the initial data informed future QI iterations. Awareness and use of SQUIRE 2.0 and SQUIRE-EDU will greatly enhance dissemination of QI scholarship projects.

PATHWAYS FOR QI EDUCATION EXAMPLES

We provide three examples of pathways for QI education in training programs. The first includes a didactic curriculum of evidence-based medicine (EBM) in a residency training program. The second discusses a QI intervention for improving multidisciplinary education centered on implementation of a daily rounding checklist in the medical ICU. The third discusses medical trainee involvement in QI interventions aimed at implementing new clinical protocols in pulmonary and critical care. Each of these examples demonstrates that hands-on learning

within QI projects has the benefit of multidisciplinary education and draws from the collective experience of those responsible for success in the implementation effort. The use of data within a PDSA cycle can be used as an educational tool for learners, as motivation and support from stakeholders for the intervention, and to identify areas for further QI and PDSA cycles (23).

EBM CURRICULUM

The American College of Graduate Medical Education lists developing skills in evidence-based practice as a component of the core competency of practice-based learning and improvement in graduate medical education (Figure 2) (29). Traditional EBM education includes didactic teaching and journal clubs. The optimal timing and method of delivery, however, are unknown. Evidence demonstrates that competency in EBM improves, regardless of the timing at the undergraduate, graduate, or postgraduate level (29). However, if not reinforced throughout training, these skills deteriorate (30). Trainees list the greatest barriers to developing competence in EBM as insufficient time, inadequate EBM-specific skills, poor general EBM knowledge, and poor overall attitude toward EBM (31). Although didactic teaching directly speaks to and improves EBM-specific knowledge, such as definitions of sensitivity, specificity, or number needed to treat, traditional lecture-based education does not address the other identified barriers. Consequently, when studied, lecture-based education alone does not lead to improvements in critical appraisal skills, attitudes toward EBM, or clinical practice (32–35).

We identified the internal medicine EBM curriculum at The Ohio State University as an area to investigate for the application of an innovative education-based QI project. Although the target population for this QI project involved residents, the principles of the project are broadly applicable to all trainees at the undergraduate or graduate level. Previously, the EBM curriculum consisted of a longitudinal, recurring, 1-year series of lectures administered by non-EBM content experts and a loosely structured journal club occurring quarterly. Faculty EBM content experts, in addition to internal medicine residents, were identified as key stakeholders. After an analysis, a comprehensive revision of the EBM curriculum was completed and included three separate elements: a didactic series and two distinct journal clubs. The EBM didactic series was revised, expanded, and administered by EBM content experts to address and further support the communication of EBM knowledge to trainees. After identifying elements of successful journal clubs from the literature (35–37), the program instituted a structured and faculty-led ambulatory journal club occurring quarterly that complemented and reviewed key concepts of the inpatient EBM curriculum. A

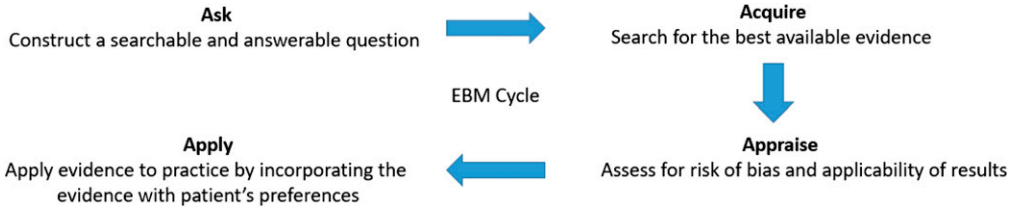

Figure 2. The evidence-based medicine cycle. Adapted by permission from Reference 50. EBM = evidence-based medicine.

structured evening journal club, focusing on subspecialty topics that are resident facilitated with a faculty preceptor, was instituted as well. This latter journal club occurs in a more informal setting at a restaurant and promotes interaction between residents with an interest in a particular subspecialty and subspecialists in that field. At the conclusion of the first year of the comprehensive revision of the EBM curriculum, residents will be assessed for EBM-specific knowledge by using a validated EBM assessment tool (38); confidence in EBM skills and attitudes toward EBM will also be assessed.

QI EDUCATION THROUGH QI RESEARCH

Engaging trainees in QI research can have a powerful impact on their education. In several studies on the efficacy of an intervention of prompting physicians to use daily rounding checklists in the ICU, trainees were an integral part of designing and executing the study (39–41). Pulmonary/critical care fellows developed a daily rounding checklist for their ICU because of concern that certain processes of care were not being discussed regularly. However, after checklist implementation, trainees observed that the checklist had poor adherence, and even when checklist items were filled out, this did not lead to the desired change in patient care (39). This led one pulmonary/critical care fellow and several residents to review the QI literature and explore various potential QI interventions, eventually deciding that an audit and feedback intervention would be appropriate for the local setting. They designed a prospective interventional study in which one ICU team was exposed to the checklist alone and a second ICU team was exposed to the checklist and one of the residents "prompting" the clinicians on that team to address checklist items. Although the primary result of the study was to demonstrate that the prompting intervention worked, reducing empiric antibiotic and mechanical ventilation duration, among other process of care improvement, and being associated with lower mortality and shorter length of stay (39, 40), another important result was the QI education received by trainees who designed the study and who served as the QI intervention itself.

Many ingredients are needed to make a successful QI research study such as the one illustrated above. The organization within which a training program exists must prioritize both research and QI for a trainee to develop a QI research study. This prioritization should include protected time for the trainee to conduct the study and develop QI research–related skills (e.g., courses in epidemiology, statistics, and mixed methods), as well as the necessary resources to increase the likelihood of success. Resources should include mentor availability (including incentives which demonstrate that mentorship is important to an institution), data collection and analysis mechanisms, and publication- and grant-writing assistance. Discrete benchmarks—short and long term—should be developed by the trainee, mentor, and training program from the outset. Finally, because much of pulmonary and critical care medicine is multidisciplinary, and because much of QI research requires consideration of multiple levels of stakeholders, access to and support from other stakeholders can enhance the research experience of trainees.

One potential pitfall of encouraging trainees to learn QI through QI research is that trainees may fall into the role of being a "worker bee." This is to be avoided if any meaningful QI education is desired. Working with a principal investigator,

experiential learning of QI through QI research should encourage trainees to *1*) formulate a research question themselves (typically, but not exclusively, from their own practice experiences), *2*) design a study to test the research question, *3*) conduct the study and collect data, and *4*) analyze results and write manuscripts. Although these steps teach basic research skills to the trainee, in the field of QI, they also teach the basic concepts, frameworks, and methods of QI. The checklist study described above was a springboard into independent research careers for the fellow and residents, ranging from basic molecular biology to clinical research to implementation science. In the latter case, the checklist study served to provide preliminary data for the fellow to successfully build an implementation science agenda focusing on adherence to evidence-based therapies for acute respiratory distress syndrome, leading to successful mentored and then independent research funding.

QI EDUCATION THROUGH IMPLEMENTATION OF NEW CLINICAL PROGRAMS

Involving trainees in implementation of new clinical programs and QI interventions is also a useful approach for training in QI and QI academic work. In these examples, medical trainees and premedical students joined each project to meet requirements for scholarly activity or to participate in QI work in an area of their clinical interest. Most projects lasted from 12 to 30 months. Phase 1 included QI education through lectures, reading, faculty mentorship on project management, QI, PDSA cycles, institutional review board submission for QI, database development and management, process measures, quality metrics versus performance measures, chart review, analysis, and processes for abstract development and manuscript preparation through the SQUIRE framework for reporting new knowledge about healthcare improvements. Residents used their elective time, and premedical students worked as summer interns, to learn about QI and to develop and move the project forward. They attended team meetings throughout the year and one-to-one meetings with the physician members of the team. Mentors were assigned to each trainee at the start of the project. Trainees developed a number of questions, including improvement in operational processes, access to care, and clinical and outcome metrics. If multiple learners were participating in the project, the project was divided into definable areas for each participant with crossover for skill development and project progress. Meetings and sequential "report out" emails allowed mentees to assess learner growth and understanding, project progress, and areas for improvement. Teamwork and open communication, as well as learner-to-learner mentorship, were encouraged and expected.

One example began as an implementation of a new clinical program and led to multiple QI projects. In 2015, the Centers for Medicare and Medicaid Services reported the decision to reimburse lung cancer screening (LCS) examinations if performed in a high-quality program that followed predetermined quality metrics. Recommendations for implementing a high-quality LCS program were published by leading specialty societies (42, 43). Implementation of an LCS program provided an opportunity to train students and residents in QI. The team reviewed available knowledge, identified the

specific initiative and process required for successful implementation, developed and provided educational interventions to all stakeholders though multiple formats, identified specific aims with identified metrics for data capture and analysis, submitted the project to the institutional review board, created a database and process for data abstraction and variable identification, and conducted analyses. Several residents presented their QI work at regional and national meetings and participated in publication of the QI interventions (44–47). Their work allowed them to think critically about QI and to develop multiple additional questions that were addressed with subsequent QI interventions conducted by them or future trainees (44–47). For the majority of trainees, their QI work solidified their future career paths and resulted in ongoing work in QI.

DISCUSSION

The increased incorporation of QI as a required part of undergraduate, graduate, and postgraduate medical training presents opportunities for innovative scholarship. Innovative QI projects can take many forms, including improvements in educational programs for trainees while improving the quality and safety of patient care and organizational performance metrics. The present perspective highlights several important components of QI scholarship to be considered in order for scholarly dissemination to be achieved. To begin with, QI projects should use standardized PDSA cycles such as the A3 or the define, measure, analyze, improve, and control approach (48, 49). In addition, structured reporting of projects should also use a standardized reporting methodology such as SQUIRE 2.0. An awareness of these elements before QI project initiation will enhance the prospects of scholarly project dissemination. The present perspective discusses several examples to illustrate innovative QI projects used in education settings with medical trainees that can serve as blueprints for future QI work with trainees and academic QI submissions.

Author disclosures are available with the text of this article at www.atsjournals.org.

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