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Quality Improvement Education for Health Professionals: A Systematic Review

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Abstract

Effective quality improvement (QI) education should improve patient care, but many curriculum studies do not include clinical measures. The research team evaluated the prevalence of QI curricula with clinical measures and their association with several curricular features. MEDLINE, Embase, CINAHL, and ERIC were searched through December 31, 2013. Study selection and data extraction were completed by pairs of reviewers. Of 99 included studies, 11% were randomized, and 53% evaluated clinically relevant measures; 85% were from the United States. The team found that 49% targeted 2 or more health professions, 80% required a QI project, and 65% included coaching. Studies involving interprofessional learners (odds ratio [OR] = 6.55; 95% confidence interval [CI] = 2.71-15.82), QI projects (OR = 13.60; 95% CI = 2.92-63.29), or coaching (OR = 4.38; 95% CI = 1.79-10.74) were more likely to report clinical measures. A little more than half of the published QI curricula studies included clinical measures; they were more likely to include interprofessional learners, QI projects, and coaching.

Keywords

quality improvement, education, health professionals, systematic review

Quality improvement (QI) education for health professionals must be effective to improve health care delivery and patient outcomes and to achieve the Institute for Healthcare Improvement (IHI) Triple Aim.[1-3] From undergraduate medical education through Maintenance of Certification, physicians must achieve and continue to demonstrate competency in performance improvement.[4-6] More recently, the Accreditation Council for Graduate Medical Education's Next Accreditation System has launched Clinical Learning Environment site visits designed to align graduate medical education and practice efforts in QI.[7]

Boonyasai et al[8] published the first systematic review of QI curricula for health professionals; they concluded that QI knowledge, attitudes, and involvement in QI activities improved when a variety of teaching strategies (eg, lectures, discussions) were used, but few studies measured clinical impact. They noted curricula with positive clinical outcomes included those with QI tools and coaching on QI methods; access to clinical performance data and implementing interventions via small tests of change were frequently but not consistently associated with beneficial clinical outcomes. They recommended that published QI curricula include more IHI knowledge domains,[9] clearly describe key curricular features, use a controlled study design, and include traditional educational as well as clinical outcomes.[8] Recent reviews have summarized QI education interventions specifically targeted to physician trainees[10] and the rigor of such curricula.[11] Curricular factors that predicted success in the Wong review included learner buy-in, adequate teacher expertise and role-modeling, mixed teaching methods,

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adequate curricular time to include project completion, and a supportive institutional culture.

Studies describing QI curricula that have been published since 2007 vary broadly in scope, program, and learner type, with mixed results regarding program impact on learner competency and patient outcomes. Several opinions have been put forward that suggest key features of QI curricula for health professionals.[2,12] Past reviews have not focused on a multidisciplinary group of learners despite recommendations that interprofessional learning should be part of QI educational efforts; they have inconsistently focused on required QI project completion despite the observation that effective curricula include didactic experiences and project work.[12] The Boonyasai review noted a connection between positive outcomes and in-person faculty coaching but did not specifically abstract coaching as an independent curricular variable.[8] For the present study, the research team performed an updated systematic review to assess the trend of reported outcomes and curricular features in the published studies. The team aimed to evaluate relationships between an interprofessional learner cohort, and required QI project completion and coaching as components of the curriculum because it was hypothesized that these features result in increased QI competence and positive outcomes from QI activities. Coaching was defined as expertise provided to teams in applying QI methods during the educational intervention, which may or may not include a required QI project. This study sought to answer 2 key questions: (1) What is the percentage of studies reporting clinical processes or clinical outcomes as the highest-level outcome? (2) What is the association between studies reporting clinical processes or clinical outcomes as the highest-level outcome and the prevalence over time of 3 key curriculum features (ie, interprofessional education, required QI project completion, and coaching)?

Methods

Eligibility Criteria

Studies were included if they described a curriculum that teaches QI methods, tools, or theory (defined as a set of principles that involve knowledge, skills, and methods used to evaluate and implement change in a health care system using a systems-based approach[13]). Included curricula had to target health care professionals and their trainees/students, and studies also had to include a comparative evaluation (ie, pre-post evaluations, nonrandomized or randomized controlled evaluations). *Health care professional* was defined as any practitioner or member of a team who provides direct medical care to patients. Studies were excluded if they did not (1) occur in North America, Western Europe, Australia, New Zealand, or Japan; (2) teach QI theory, methods, or tools; (3) describe a curricular or other educational intervention; (4) target health care professionals and/or their trainees/students; (5) include original data; (6) have a full article available for review; (7) publish the results of a comparative evaluation; or (8) publish in English. Although the search started at January 1, 2007, the studies in the Boonyasai review published before this date also were included to provide a more complete review.

Literature Search

An expert librarian conducted the literature search in MEDLINE In Process and Other Non-Indexed Citations (Ovid) and MEDLINE (Ovid), Embase (Ovid), CINAHL (EBSCOhost), and ERIC (eric.ed.gov, EBSCOhost). The search strategy combined subject headings and keywords related to QI with subject headings and keywords related to curriculum and education. Additional keywords, subject headings, and publication type limits were used to restrict the search to articles in which an educational intervention or curriculum was assessed or evaluated. Medical subject headings used included total quality management, patient safety, systems theory, "quality assurance, health care," medical errors, curriculum, "education, professional," faculty, inservice training, preceptorship, "schools, health occupations," "students, health occupations," and teaching. Additional terms were used to search for concepts relating to systems-based practice, process improvement, QI, and QI methodologies. The search included any studies published from January 1, 2007, to December 2013 in all languages. Studies published before January 1, 2007, were retrieved from an existing systematic review,[8] and their data were re-extracted and appraised. The research team also manually reviewed the citations in the relevant articles. (The complete search strategy is listed in online Appendix A, available at http://ajmq.sagepub.com/supplemental.)

Study Selection

The research team collated initial references in citation files, removed duplicates, and screened titles and abstracts against eligibility criteria using DistillerSR software (Evidence Partners Incorporated, Ottawa, Canada). Studies were reviewed in duplicate. Disagreements in the initial screening of titles and abstracts were automatically included. Potentially eligible studies were then reviewed in full text following a similar procedure. Disagreements in full-text screening were reconciled by discussion, consensus, or by the principal investigator (SRS).

Data Extraction

Data were extracted from included studies using a standardized form developed based on the protocol. This form

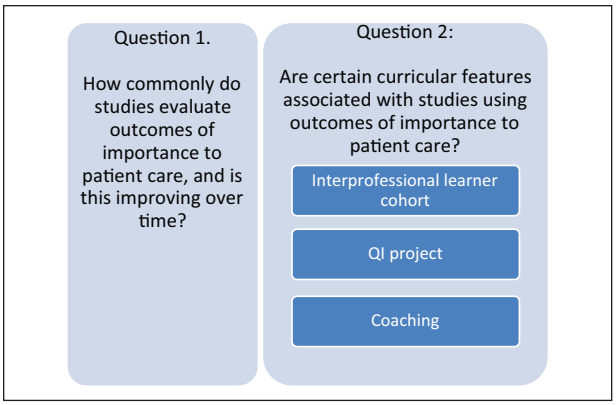

Figure 1. The analytical framework of the systematic review. Abbreviation: QI, quality improvement.

was tested using a small sample of randomly selected studies, from which all reviewers extracted data. The first author (SRS) evaluated each extraction form; data discrepancies were reconciled by discussion (between SRS, JMK, and AS) or by the first author (SRS). Data extracted from each study included study demographics and setting (eg, funding source, study design, geographic location, local setting), learner attributes (disciplines, mix of practitioners vs trainees), teacher attributes (expertise), and curriculum attributes (content categorized by IHI domain content and specific QI tools; specific QI collaborative models, resources, and educational methodologies). The highest-level outcome reported for each study (per a modified Barr-Kirkpatrick hierarchy, with level 1 as reaction, level 2a as change in attitudes, level 2b as gain in knowledge/skills, level 3 as change in behavior, level 4a as change in clinical process measure, and level 4b as change in clinical outcome) also was abstracted.[12]

Data Synthesis

The analytical framework of this systematic review is depicted in Figure 1. A meta-analysis was not conducted because of the heterogeneity in study design, outcome measures, and curricular and learner types. Data were synthesized following a metanarrative approach,[14] and descriptive statistics were used when appropriate. To evaluate the association between the 3 a priori chosen curricular features and outcomes level 4a/4b, odds ratios (ORs) and 95% confidence intervals (CIs) were estimated following the approach described by Bland and Altman.[15]

Results

Search and Selection Results

A total of 9415 possibly relevant citations were identified; 99 met the eligibility criteria and were included (Figure 2); study demographics are listed in Table 1. (The complete list of studies is listed in online Appendix B, available at http://ajmq.sagepub.com/supplemental.) Among the included studies, 50% were focused on a specific cohort of health profession trainees. Only 32% of studies were controlled, and the remainder used a pre-post study design; 36% of studies did not include sufficient detail to allow any conclusions to be drawn regarding teacher expertise or role. Studies varied widely in the level of detail when describing educational methods used to implement the curricula.

"Health care as a process, system" and "variation and measurement" were the most common IHI content areas included in the curricula[9]; "social context and accountability" was the IHI domain least likely to be included in the curricula reviewed. Among the curricula, 49% included 4 or more IHI knowledge domains; 42% included 2 or 3 domains, 7% included only 1 domain, and 1 study did not provide enough description to make any conclusions regarding the IHI content.[16] Of the 43 studies with level 2a, 2b, or 3 outcomes as the highest outcome measured, only 15 (35%) provided validity evidence for the assessment tool used.

Key Questions

Question 1: How Commonly Do Studies Evaluate Outcomes of Importance to Patient Care (4a and 4b), and Is This Improving Over Time? In all, 31% and 22% of studies reported a clinical process (4a) or clinical outcome (4b), respectively, as the highest level outcome assessed. Following these, knowledge (2b) was the most frequently reported highest level outcome (27%). Only 3% of studies included behavioral change (3) as the highest level outcome; 3% and 13% reported end-of-experience feedback (1) and modification of attitudes (2a), respectively, as the highest level outcome reported. Although the number of published studies increased between 2005 and 2013, the number of studies reporting clinically relevant outcomes decreased, even though the number of studies requiring QI project completion increased (Figure 3). Data were insufficient to statistically evaluate the significance of time trends.

Question 2: What Is the Association Between Studies Reporting Clinical Processes or Clinical Outcomes as the Highest Level Outcome and the Prevalence Over Time of 3 Key Curriculum Features (ie, Interprofessional Education, Required QI Project, and Coaching)? QI curricula were more likely to report clinical process (4a) or outcome measures (4b) when the learner cohort was interprofessional (OR = 6.55; 95% CI = 2.71-15.82), the curricular intervention included coaching (OR = 4.38; 95% CI = 1.79-10.74), and when the curricula included a QI project (OR = 13.60; 95% CI = 2.92-63.29); see Figure 4. No conclusion could be drawn regarding the relative importance of these 3 curricular

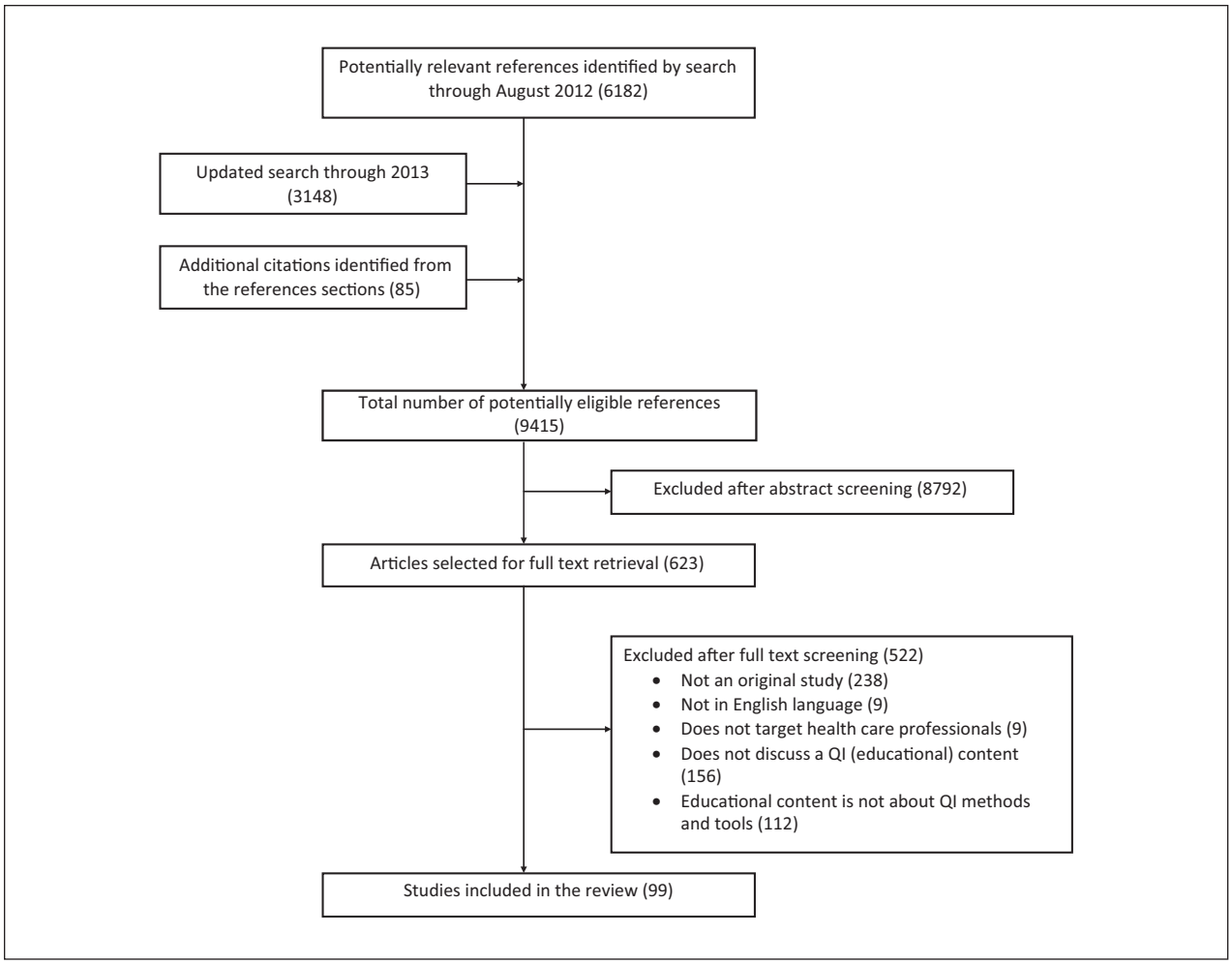

Figure 2. Study selection process.
Abbreviation: QI, quality improvement.

elements given the wide CIs. There is no clear trend over time for interprofessional education or required QI project; however, there is a downward trend for coaching as part of the QI education intervention (Figure 3).

Discussion

The aim of this systematic review was to evaluate the prevalence of QI curricula with clinical measures and their association with several curricular features. Although prior work classified outcomes dichotomously[8] (clinical process or patient outcome), this study applied the modified Barr-Kirkpatrick hierarchy of educational outcomes. This evaluation framework better captures the aspirational link[17] as well as the tension[18] between improving the evidence (here, the evidence for what works in QI education) and improving the process of care. Unfortunately, no conclusions could be drawn regarding the efficacy of curricular elements on outcomes because of heterogeneity in study design and setting as well as insufficient information to know whether individual studies were powered to detect results. This review provides insight into the epidemiology of recent QI curricula and report of outcomes; it suggests strategies for development and publication of new QI curricula that are methodologically robust, aligned within the Barr-Kirkpatrick framework, and can further scholarly advances in QI education. To the research team's knowledge, this study is the first to demonstrate the association of measuring clinically relevant outcomes with interprofessional learning and coaching. The team believes that these findings provide a rationale for adopting such strategies when feasible.

This review defined "health care professional" broadly and thus included studies not only of physicians or physician trainees but of other members of the health care team, including nurses, pharmacists, respiratory therapists, and many others. The Institute of Medicine report

Table 1. Characteristics of QI Curriculum Studies (n = 99).

Characteristics	Percentage of Studies
Year of publication	
1995-1999	2%
2000-2004	19%
2005-2009	35%
2010-2013	43%
Funding source[a]	
Government	43%
Private foundation	30%
Private industry	5%
Other	10%
Unknown	26%
Geographic location	
United States	85%
Non-US	13%
Both	1%
Setting[a]	
Educational	50%
Inpatient	19%
Outpatient	33%
Mixed inpatient/outpatient	17%
Study design	
Pre-post	67%
Nonrandomized controlled	21%
Randomized controlled	11%
Learner disciplines and mix[a]	
Trainee physicians	44%
Nontrainee physicians	41%
Both nontrainee and trainee physicians	9%
Trainee nurses	8%
Nontrainee nurses	37%
Other team members	41%
Interprofessional learners	49%
Teacher expertise[a]	
Physician	45%
Nurse	14%
QI systems engineer	16%
Other health professional	23%
Not clearly reported	36%
Curriculum attributes: IHI content areas[a,9]	
Health care as a process, system	88%
Variation and measurement	79%
Customer/beneficiary knowledge	13%
Leading, following, and making change	45%
Collaboration	61%
Social context and accountability	9%
Developing new, locally useful knowledge	29%
Professional subject matter	31%
Curriculum attributes: specific QI tools/methodologies[a]	
PDSA	67%
Lean	10%
Six Sigma	6%
Change Management	7%
Curriculum attributes: specific QI collaborative models	
IMPROVE/IDEAL	2%
IHI Breakthrough Collaborative model (traditional, virtual, or modified)	16%
Other	4%
Curriculum attributes: teaching methods during training[a]	
Didactic presentations (eg, lectures)	72%
Interactive experiences (not specific to project work)	70%
Audiovisual materials (eg, exclusive of lectures)	14%
Self-study and/or review of materials	34%
Curriculum attributes: projects and coaching	
QI project required as part of intervention	80%
Coaching described as part of intervention	65%
Highest reported outcome level[12]	
Level 1	3%
Level 2a	13%
Level 2b	27%
Level 3	3%
Level 4a	31%
Level 4b	22%

Abbreviations: IHI, Institute for Healthcare Improvement; PDSA, Plan-Do-Study-Act; QI, quality improvement.
[a]Categories not mutually exclusive.

Bridge to Quality[13] highlights the discordance between the expectation that health care professionals work in interdisciplinary teams in practice and the typical absence of interdisciplinary education to prepare them to do so. Only half (49%) of the published educational interventions in this review that focused on improving systems of care did so in the context of interprofessional teams, with a decrease in the percentage of studies reporting such a cohort over time. Regardless of the clinical context (a collaborative,[19] hospitals redesigning care to reduce door-to-balloon times in patients with ST-elevation myocardial infarction,[20] the acute care setting,[21] or the classroom[22]), many conclusions regarding team effectiveness are based on hypotheses from popular management and quality

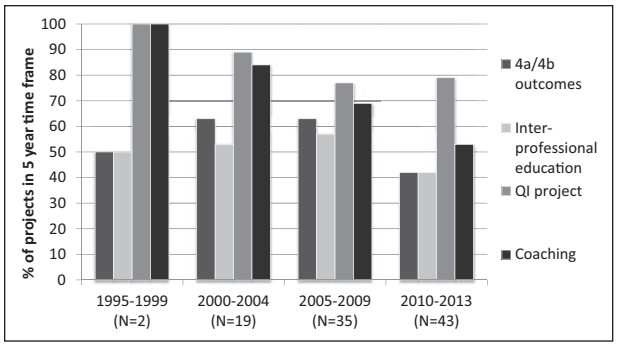

Figure 3. Time trend for clinically relevant (4a/4b) outcomes and key curricular features.
Abbreviation: QI, quality improvement.

theories rather than on empirical evidence. Studies are in need of stricter operational definitions than, for example, "effective representation of each involved discipline."

Change in organizational practice and benefits to patients are the highest levels of educational outcomes[12]; however, this review found an overall decrease in the percentage of studies reporting clinically relevant (4a/4b) outcomes despite an increased number of published studies. It would seem, at first glance, to be desirable that more studies report on clinical processes and/or outcomes, but several cautions are appropriate. It is possible that a clinical process (4a) or clinical outcome (4b) may not be the most relevant measure.[23] Although this review was not designed to determine appropriateness of the outcome reported, one study discussed efforts to increase the use of a patient-reported scale of depressive symptoms (4a) but reported a knowledge (2b) outcome via the Quality Improvement Knowledge Application Tool (QIKAT).[24] It is also possible that studies missed an appropriate opportunity to report a clinical process (4a) or clinical outcome (4b). The second caution is that few studies are designed to demonstrate a link between the educational intervention and a clinical outcome.[25] Another study assessed both geriatrics fellows' knowledge (2b) via the QIKAT as well as change in a clinical process (4a) via documentation of cognitive assessment, demonstrating improvement in knowledge (2b) but not in a clinical process (4a). In this and other instances, another study design may have been better suited to assess the link between intervention and outcome[26] as well as whether improvements, if reported, were sustained over time.

Including a real-world QI project with an interprofessional team and longitudinal coaching within QI curricula are resource intensive and more complex to implement. The decrease in coaching, interprofessional learning, and 4a/4b outcomes in studies published most recently (2010-2013) likely reflects the increased resources and complexity to incorporate these elements as compared with offering stand-alone QI curricula that focus on knowledge acquisition. The research team was surprised to see the increase in the number of curricula requiring QI projects despite the drop in measured 4a/4b outcomes because they had expected curricula with QI project completion to be more likely to report clinically relevant measures. Similarly, it is possible that researchers with studies requiring QI projects measured but opted not to report 4a/4b outcomes because of the resources required. This study suggests that inclusion of coaching and interprofessional learning, albeit resource intensive and complex, are associated with measured patient outcomes. Definitive conclusions cannot be drawn regarding the efficacy of the 3 key elements on clinical outcomes, but the research team believes that these strategies are worth the extra investment in resources, execution, and careful assessment. Less interprofessional education could result in more difficulties for health care professionals to translate knowledge and skills effectively into real-world settings; more studies with projects in the absence of coaching could mean that learning is compromised.

Although this study demonstrated an association between report of clinical process and outcomes measures and key curricular attributes, it was unable to identify an association with several others, including teacher expertise, teaching method, or QI methods because of the lack of study detail. With regard to teacher expertise, most studies referenced "faculty" or "facilitator," with little description provided. Previous work has noted that sufficient expert faculty to support QI curricula is one of the most frequently cited practical considerations in training programs.[27] Studies also lacked details about the educational strategies used. Amid innovations such as flipped classrooms,[28] this study demonstrates that the majority of published curricula still relied heavily on didactic instruction. As noted in prior reviews,[8,11] most interventions lacked sufficient description to allow replication. Although many studies reporting specific QI methods used the Plan-Do-Study-Act cycle, this was often described in insufficient detail or application, an observation that has been made elsewhere,[29] which reflects a lack of methodological rigor and standard reporting.[30] The difficulty in ascertaining how faithful an effort remained to an original model (eg, the IHI Breakthrough Collaborative) is a frequent limitation that makes it difficult to understand what components of a collaborative model were predictive of outcomes.[31,32]

Another potential variable on QI education outcomes is the time between the education intervention and time of outcome measurement. The research team was unable to meaningfully abstract the time between the end of the education intervention and the measurement because this information was not clearly described in the majority of studies (even for studies measuring 2a-3 outcomes); for

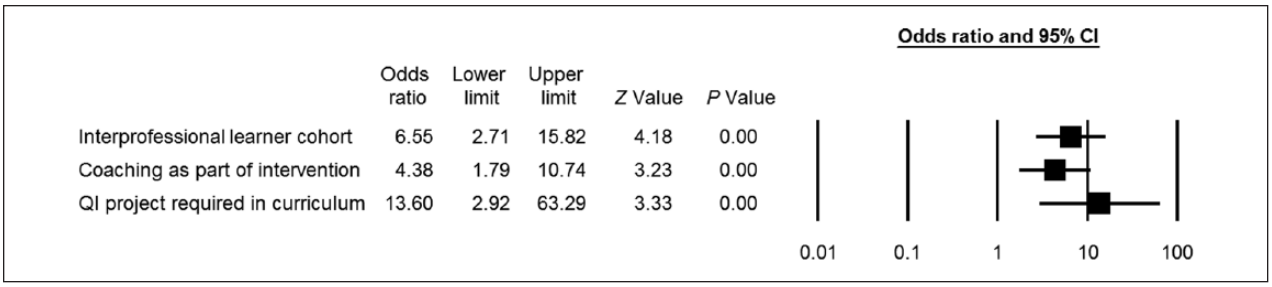

Figure 4. Association between curricular features and clinically relevant outcomes (4a/4b) reported.
Abbreviations: CI, confidence interval; QI, quality improvement.

studies that were not simple pre-post design, the line between the end of the education intervention and the measurement is often blurred, especially for those in which teams completed QI projects with coaching and multiple Plan-Do-Study-Act cycles.

Limitations should be considered in interpreting the results of this review. First, as in any review, relevant studies may have been missed, and because the search strategy was limited to published studies, publication bias is similarly acknowledged. As noted elsewhere, there are also vagaries in deciding when an intervention truly included QI, made all the more so by the paucity of description of the educational intervention. The research team also acknowledges that certain aspects of the curricula (such as presence of coaching in the educational intervention) may have been misclassified. The team sought to overcome this by having a double review at every stage of data abstraction. Nevertheless, this remained challenging, especially for categorization of curriculum content according to IHI domains.

Conclusion

Although health care delivery organizations seek to develop and implement effective educational strategies and plans, no universal solution exists. A little more than half of QI curricula evaluate outcomes most proximal to patient care. Curricula that addressed clinical outcomes were more likely to include coaching and involve interprofessional learners. More rigorous reporting of methodology in QI curricula studies and careful selection of study design is needed to investigate the hypothesis that these strategies are worth the extra investment in resources and execution. Educators developing curricula that lead to knowledge transfer alone is not sufficient given the current gaps in delivering high-value health care. Future studies should design, deliver, and evaluate QI curricula that assess application of QI knowledge, with the goal of demonstrating knowledge application in a real-world delivery system that achieves better patient care and better patient experience at lower cost.

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Declaration of Conflicting Interests

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