Lessons Learned from Continuous Quality Improvement Training for Third Year Medical Students

Adam Mastrocola, Helen Wu, Biju Wang, Robin H. Pugh Yi, Bruce Gould

Abstract– Purpose: **The University of Connecticut School of Medicine developed a continuous quality improvement (CQI) curriculum for which third year medical students conducted independent CQI projects. The current study analyzes outcomes of and student's reflections on projects conducted between 2005 and 2018. Results are intended to inform future design of medical student education about CQI.**

Materials and Methods: **An analyst abstracted data from printed slides of students' CQI Symposium poster presentations and conducted content analysis.**

Results: **A total of 979 third year medical students conducted the CQI projects included in this study. Projects addressed key issues in clinical care quality and demonstrated understanding of using plan-do-study-act research.**

Conclusion: **The current study provides an example of how a medical school responded to the call to restructure clinical education to prepare the workforce to measure care quality and work to improve quality continuously. Results show that medical students have the ability to conduct CQI projects with practical value in clinical settings in underserved communities. Students learned the importance of CQI and key skills for implementing CQI studies in clinical practice. Future training efforts should address these issues by ensuring preceptor skills, allotting more time for CQI training, and formally integrating CQI into medical education curricula.**

Keywords– **Continuous Quality Improvement, Plan-Do-Study-Act and Medical Students**

I. INTRODUCTION

SINCE the seminal Institute of Medicine's (IOM) 2001 report, "Crossing the Quality Chasm [1], recommended redesigning health care systems to improve care quality, continuous quality improvement (CQI) has emerged as a core strategy for improvement in health care quality. As the field emerged, the Association of American Medical Colleges (AAMC) called for a ''collaborative effort to ensure that the next generation of physicians is adequately prepared to recognize the sources of error in medical practice and to engage fully in the process of continuous quality improvement (CQI) [2]. CQI aims to change health care delivery at the organizational level to improve health care. The approach shifts the focus from changing individuals to changing processes, and from assigning blame to developing solutions [3]. A central component is encouraging and empowering frontline staff to identify root causes of quality problems and to propose, develop, and implement solutions[4].

CQI programs address the questions, "What are we trying to accomplish?", "How do we define improvement?" and, "What changes can we make that will result in improvement" [3]. The goal of CQI is to increase adherence to best practice guidelines in order to improve health outcomes [5]. The CQI model for improvement relies on the Plan-Do-Study-Act (PDSA) model. This approach involves defining a problem, implementing a small change, assessing the impact of that change, refining the intervention based on acquired data, implementing successful changes throughout the organization and disseminating results to inform other organizations[3]. The approach has successfully supported several efforts, including reducing hospital admissions among patients with chronic conditions, reducing emergency department use among older patients, and increasing workforce capabilities, capacity, and enthusiasm[6].

A central focus of IOM's *Crossing the Quality Chasm* was "restructuring clinical education to be consistent with the principles of the 21st-century health system"[1]. Several efforts have been made to answer this call to integrate CQI teaching into medical school curricula [7], [8].

With its capacity to improve care quality, CQI has potential to reduce disparities and increase equity in care quality. Over the past decade, several efforts have been made to apply CQI to reducing disparities. Results indicate that CQI approaches can reduce disparities when clinicians are trained to apply CQI methods. For example, the Health Disparities Collaborative reviewed project results and found its rapid QI approach resulted in improved clinical processes and outcomes [9]. Other researchers have emphasized the need to apply CQI to address disparities [10], [11], [12].

Adam Mastrocola is a resident physician at Connecticut Children's Hospital.

Helen Wu is an associate professor in the Department of Psychiatry and at the Connecticut Convergence Institute for Translation in Regenerative Engineering at the University of Connecticut Health Center.

Biju Wang is a graduate research assistant at the Connecticut Convergence Institute for Translation in Regenerative Engineering at University of Connecticut Health Center.

Robin H. Pugh Yi is President of Akeso Consulting, LLC. (Email: Robin@Akesoconsulting.com)

Bruce E. Gould is Associate Dean of Primary Care and Director of the Connecticut Area Health Education Program at the University of Connecticut School of Medicine.

The senior member of the research team led development of a CQI curriculum including a quality improvement project that occurred in the first and second year of medical school in the student's ambulatory continuity practice in a program that trains students to provide primary care to underserved communities. Student projects were shown to be effective in improving outcomes of diabetes care in ambulatory practice [7]. The curriculum was modified in response to student and faculty feedback and integrated into the third-year internal medicine ambulatory clerkship in 2005.

II. MATERIALS AND METHODS

Training Each project spanned the entire third year, with one or two students rotating at a particular site and its associated project during each five-week block. Site directors advised students on selecting project topics and met with students to discuss CQI.

As an introduction to basic core topics in CQI, prior to starting at their ambulatory site, students were provided with a slide presentation on CQI to review independently. Topics included the purpose of CQI, operationalizing quality, data collection methods, data sources that can inform quality measurement, root cause analysis, and others. The curriculum did not address general experimental design or analytic methods, since these topics were part of the general medical curriculum. Rather, the CQI materials emphasized the importance of applying these methods to improving clinical practice quality.

Students chose project topics and methods in collaboration with the clinical director of their teaching site and based on assessment of patients' needs. Emphasis was on completing plan-do-study-act cycles that would improve practice quality in the short-term. At the end of the year, students produced posters presenting their project results at the annual UConn School of Medicine Dean's Symposium on CQI. The current study analyzes outcomes of projects conducted between 2005 and 2018, as well as students' reports on factors affecting project success. Results are intended to inform future design and implementation of medical student education about CQI.

Ethics: The University of Connecticut institutional review board determined that this study was exempt from review.

Statistics: Excel was used to calculate descriptive statistics about student projects.

III. RESULTS

Analysis

Researchers conducted content analysis of 103 medical student CQI projects conducted between 2005 and 2018. Analysts abstracted data about project design, patient population, data collection, and outcomes from printed slides of student CQI Symposium poster presentations.

Findings

A total of 979 third year medical students participated in teams that conducted the CQI projects included in this study. During the first and third year of the study, only three projects were completed. During the fourth year, four projects were completed. In all other years, student teams completed between seven and ten projects.

The analyst categorized projects as targeting administration, chronic disease management, primary care, prevention/screening, opiate screening, other, or a combination of these categories. Of the 103 projects, 57 of them (55%) focused on prevention/screening. Not surprisingly, given that the projects were conducted at primary care internal medicine offices, 28 (27%), and 22 (21%) of projects were focused on primary care and chronic disease management, respectively.

The analyst also assessed which disease or diseases each project targeted. Categories were: Cancer, high cholesterol, depression, diabetes, hypertension, osteoporosis, pneumococcal vaccination, asthma, and "other." Table 1 presents frequencies of these focus areas in students' projects.

Table I: Focus of CQI projects

Disease of focus	Frequency
Cancer	9
High Cholesterol	5
Depression	4
Diabetes	20
Hypertension	5
Osteoporosis	9
Pneumococcal vaccination	11
Asthma	28
Other	11
Total	**103**

Student CQI Project Methods

A total of 25 projects were observational; 77 were interventional; and one could not be categorized following barriers to implementation. Of the interventional projects, four included a control group. Most interventional projects assessed pre-post-test change, partly due to time constraints and having access to relatively small samples of potential study participants.

A majority of projects (n=65, 63%) completed at least one PDSA cycle. Of the 38 project teams who did not complete a PDSA, 22 provided information about barriers to completion, with some groups facing one major barrier and others facing multiple barriers. The most frequently reported barrier to completion was lack of time (n=12, 55%). Other barriers included difficulty with data analysis (n=6, 27), poor communication among group members or between students and mentors (n=6, 27%), and difficulty with mentoring (n=4, 18%). Communication issues included having little face-to-face interaction with students who worked on the same project during a different rotation. Mentoring issues included lack of preceptor availability, expertise, or investment in projects. A small subset of projects required formal IRB approval. Some students identified delay in IRB approval as a barrier to completion.

Student CQI Project Results

A total of 98 projects defined key outcomes. One project was a needs assessment; one established baseline data, and three did not generate testable hypotheses or operationalize outcome variables. These included 18 clinical and 86 process outcomes. Some projects included both clinical and process outcomes. Examples of targeted clinical outcomes included Hemoglobin A1C level, LDL cholesterol level, blood pressure, Asthma Control Test (ACT) score. Examples of targeted process outcomes included vaccination rate, imaging test ordered, counseling provided to patient and/or documented in chart.

A total of 97 projects included statistical analyses of intervention effects on outcomes. Of these, 97 (100%) presented descriptive statistics, and 48 (49%) presented inferential statistics. Half of projects that included statistical results (n=48) included analyses of bivariate associations between interventions and targeted outcomes. These analyses included chi-square, T-test, ANOVA, and odds ratios. An additional 2 projects (2%) applied multivariate statistics to assess more complex relationships between predictors and outcomes. A total of 19 (19%) projects demonstrated statistically significant results in the desired direction. A total of 10 projects demonstrated increases in recommended clinical screenings; 3 projects demonstrated increases in adherence to recommended vaccination guidelines; 3 projects demonstrated increases in proper documentation. The remaining projects demonstrated impacts on physician education, hemoglobin A1C level, and patient no show rates.

Analysts assessed the impact of all projects, regardless of design, by conducting content analysis of students' results and conclusions sections. Projects could target more than one type of outcome. Table II summarizes the types of change reported.

Table II: Outcomes achieved by CQI projects

Type of Change Achieved	n	%
Patient education	27	26
Clinic personnel education	44	43
Improved practice process	29	28
Increased referrals	1	0.97
Lessons learned	95	92

Nearly all groups (n=95, 92%) provided reflections on the CQI curriculum experience, with emphasis on what students most valued learning about CQI. A recurring theme from student reflections was that simple, low-cost interventions could result in quality improvement. For example, placement of educational posters in patient exam rooms led to a statistically significant increase in vaccination rates with Pneumovax. Another recurring theme was that the small study sample size limited the inferences that could be made from study findings. Several students reported that poor communication among the student CQI project team and lack of time to collect and analyze data were barriers. Students reported that they had learned the importance of developing clear study questions and plans for project implementation.

IV. DISCUSSION

This retrospective analysis yielded several valuable lessons about teaching CQI to medical students. The training was brief and provided only for students, not mentors. Mentoring varied in detail, focus, mentor engagement, and mentor skills. Not all mentors provided training on study design or data analysis. Mentors varied widely in communication frequency and project engagement, from minimal discussion regarding research topics, to in-depth discussions of research methods and findings.

Students' time with projects was limited by the length of rotation. Therefore, project progress depended on students' communication as groups rotated to and from a mentor site. Project quality and completion varied according to communication with peers regarding continuity. IRB approval was sometimes a lengthy process, allowing little time for project implementation and completion before the end of the academic term. Results indicate that students would benefit if mentors received formal training in CQI, plan-do-study-act project planning and implementation, and providing guidance students with guidance about project management and coordination.

The current study provides an example of how a medical school responded to IOM's call to restructure clinical education to prepare the workforce to measure care quality and work to improve quality continuously. Results show that medical students have the ability to conduct CQI projects with practical value in clinical settings in underserved communities. Projects analyzed for this study addressed how to improve quality of primary clinical care for high-priority diseases. Students' observational studies demonstrated the need for CQI in clinical practice. The experience taught students core skills for implementing CQI studies in clinical practice, and the opportunity to observe that simple, low-cost interventions can improve care quality and patient outcomes.

V. CONCLUSIONS

Students' reflections show that they appreciated the opportunity for experiential learning in plan-do-study-act cycles for CQI. The experience taught students key lessons regarding the importance of project planning and team communication. Variations in mentoring skills and activities indicate that future efforts to teach medical students CQI should include training mentors in CQI methods and project management, and best practices in overseeing students' CQI projects.

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