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## Currents in Pharmacy Teaching and Learning

journal homepage: <https://www.journals.elsevier.com/currents-in-pharmacy-teaching-and-learning>



Experiences in Teaching and Learning

### Providing quality improvement training in an advanced pharmacy practice experience elective

Pamela Mathura<sup>a,\*</sup>, Dillon H. Lee<sup>b</sup>, Ann Thompson<sup>c</sup>, Natalie McMurtry<sup>d</sup>, Narmin Kassam<sup>e</sup>

<sup>a</sup> Alberta Health Services, and University of Alberta Department of Medicine, 8440 112 Street, Edmonton, AB T6G 2B7, Canada

<sup>b</sup> University of Alberta, 2-35, Medical Sciences Building University of Alberta, 8613 114 St., Edmonton, AB T6G 2H7, Canada

<sup>c</sup> University of Alberta, Experiential Education Faculty of Pharmacy and Pharmaceutical Sciences, University of Alberta, 3-281 Edmonton Clinic Health Academy, 11405 87 Ave NW, Edmonton, AB T6G 1C9, Canada

<sup>d</sup> Alberta health Services, 14<sup>th</sup> Floor Seventh Street Plaza, 10030-107 Street, Edmonton, AB T5J 3E4, Canada

<sup>e</sup> University of Alberta, Department of Medicine, Clinical Department of Medicine, Alberta Health Services, 13-103 Clinical Science Building, 11350 - 83 Ave. NW, Edmonton, AB T6G 2V2, Canada

#### ARTICLE INFO

##### Keywords:

Clinical leadership  
Improvement science  
Pharmacy practice  
Pharmacy experiential education  
Quality improvement education

**Background and purpose:** Quality Improvement (QI) science is a burgeoning component of healthcare systems and the practice of pharmacy. There is limited published literature on the implementation of QI training in undergraduate pharmacy education. We describe the development and implementation of QI training in an experiential course.

**Educational activity and setting:** A QI curriculum was developed for an existing eight-week pharmacy practice elective experience for year four pharmacy students. The curriculum was divided into two, four-week blocks, combining didactic instruction and applied learning activities. A partnership between university departments and a local health organization provided a QI preceptor along with an interdisciplinary clinical team in an acute care setting to improve clinical services.

**Findings:** Six students have completed the elective along with completing three QI projects. The Kirkpatrick 4 level model guided course evaluation. A curriculum strength was no additional cost or educational burden on the faculty of pharmacy and pharmaceutical sciences. Students recognized benefit from (1) course flexibility and independence to learn, (2) clear expectations and weekly guidance from the preceptor, (3) alignment of weekly readings and real-time application of QI concepts, and (4) the Institute for Healthcare Improvement education modules. Reducing the number of assigned tasks per week and improving availability of the clinical QI team to support student learning were identified as areas for improvement.

**Summary:** This elective course demonstrated a starting point from which QI education can be formally included in pharmacy undergraduate education.

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#### Background and purpose

Quality Improvement (QI) and patient safety have become an essential component of healthcare delivery and are recognized as core

\* Corresponding author.

E-mail addresses: [mathura@ualberta.ca](mailto:mathura@ualberta.ca) ([pam.mathura@ahs.ca](mailto:pam.mathura@ahs.ca) (P. Mathura)), [dillon1@ualberta.ca](mailto:dillon1@ualberta.ca) (D.H. Lee), [athompson@ualberta.ca](mailto:athompson@ualberta.ca) (A. Thompson), [natalie.mcmurtry@albertahealthservices.ca](mailto:natalie.mcmurtry@albertahealthservices.ca) (N. McMurtry), [nkassam@ualberta.ca](mailto:nkassam@ualberta.ca) (N. Kassam).

<http://dx.doi.org/10.1016/j.cptl.2020.11.013>

Available online xxx

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competencies for health professions education.<sup>1</sup> Health education must not only prepare students to provide quality care, but also teach students how to improve the health system.<sup>2</sup> The Institute of Medicine has indicated that each healthcare team member should be well versed in QI, such that the quality and safety of care can be continuously improved.<sup>3</sup> Despite this growing awareness, difficulty integrating QI education in the core curricula of most health professions education remains challenging.<sup>4</sup> The overloaded undergraduate curricula, the insufficient number of trained faculty and clinical preceptors with adequate expertise to instruct and mentor students,<sup>5</sup> and minimal QI experiential education integration within clinical rotations are a few hurdles identified.<sup>6</sup> However, a recent study involving undergraduate medical students suggested that successful QI curricula combine didactic and experiential teaching, integrate the QI curriculum into clinical training, and offer flexible timeframes.<sup>7</sup>

Advancing quality improvement concepts in pharmacy education are included in the Association of Faculties of Pharmacy of Canada Educational Outcomes, most recently revised in 2017. The Leader-Manager outcome within these outcomes states that pharmacy graduates are able to work with others to apply QI strategies and techniques to optimize care.<sup>1</sup> The American Association of Colleges of Pharmacy and the Center for the Advancement of Pharmaceutical Education also formally endorse QI as an educational outcome.<sup>8</sup> While it is clear that education in QI and safety concepts are essential components of a pharmacist's training, there is variation of educational programs currently offered.<sup>9</sup>

In Canada, the University of Saskatchewan developed a classroom-based curriculum that is designed to support undergraduate students from various health professions (nursing, nutrition, pharmacy, occupational and physical therapy) to work together on system-based problems using QI methods and tools to improve patient care.<sup>4</sup> There is limited data in the literature regarding the implementation of QI training in undergraduate pharmacy education and QI training in an advanced pharmacy practice experience (APPE) mandatory elective courses. Described herein is one example.

The purpose of this course was to optimize pharmacy student's learning; thus, a QI training curriculum that delivers both didactic and experiential learning was developed. We describe the structure of the QI curriculum, provide key strengths and weaknesses of the course, and share both student and QI team experience. Our hope is to encourage others to establish and implement similar pharmacy QI educational opportunities that leverage existing courses and partnerships with local health organizations.

## Educational activity and setting

In 2016, a regional physician QI leadership coalition was established to innovate approaches that would develop physician QI leaders. This coalition strategically joined two health system partners, a western Canadian university department of medicine and a provincial health organization regional medicine program, located in Edmonton, Alberta, Canada. Medicine specialty physicians and clinical organizational leaders established a pathway to increase faculty physician QI capability through pursuing QI projects in hospitals. The QI projects undertaken were aligned to organizational strategic priorities and were co-led by physicians and an operational executive leader who supported an interdisciplinary frontline QI team. To enhance QI literacy and application of QI, a consultant was hired as a dedicated coalition resource. This QI consultant's educational role was to teach an introductory improvement science workshop to the coalition composed of faculty physicians, operational leaders, and core internal medicine residents, along with providing QI project mentoring.

The executive director of the regional medicine program who co-led the coalition also regularly participated as a preceptor for the APPE mandatory elective in the faculty of pharmacy and pharmaceutical sciences (FoPPS) at this university in the area of leadership. With a desire to expand QI training beyond medical education, a unique collaboration was established between the university FoPPS, the university department of medicine, and the provincial health organization regional medicine program. The QI consultant dedicated to the aforementioned coalition was asked to be the pharmacy QI APPE elective consultant preceptor and to design the QI curriculum along with determining QI projects in which pharmacy students could participate in an acute care hospital setting.

Prior to the development of this APPE in QI, the consultant did not work with pharmacists in QI initiatives and there was no formal didactic or experiential QI education offered to the FoPPS students, nor did the QI consultant have connections to the FoPPS. With the re-designed doctor of pharmacy curriculum, there is minimal room for additional content (like QI) in the on-campus, didactic curriculum, and faculty expertise in QI is limited. Therefore, an APPE in QI would offer an opportunity to gain and practice foundational QI skills for year four students who are interested in improvement science.

The rationale for selecting the existing 320 h, eight-credit mandatory APPE course for pharmacy students was the flexibility of completion in any clinical setting, adaptability to work on organizational clinical priorities, no other competing course demands, and senior students' previous clinical background knowledge. Furthermore, this approach did not require training a cohort of pharmacy faculty before implementing the curriculum, and consequently, mitigated cost barriers associated with training and maintaining pharmacy faculty experience with improvement science. By partnering with a preceptor who specializes in QI, the pharmacy faculty member was not required to have QI knowledge. Additionally, pharmacy students were aligned directly with a frontline QI physician leader and an interdisciplinary team to work on an organizational improvement priority, where the preceptor concurrently taught and mentored both the students and the frontline team. The clinical QI teams consisted of physicians, medical residents, nurses, and other allied health providers.

The goal of this elective was to<sup>1</sup> provide basic QI literacy and apply knowledge in real-time within clinical settings through collaborating with an interdisciplinary frontline team,<sup>2</sup> offer mentorship by a specialized QI preceptor, and<sup>3</sup> provide leadership experience and teach students how to improve patient outcomes from system-level changes.

**Table 1**  
Quality improvement projects.

Year	Project title	Aim	Scholarly output
2018	Ensuring adequate nutritional intake while reducing oral nutritional supplement wastage	Reduce the number of oral nutritional supplement initially ordered and unopened at patient bedside	Regional and national poster presentation
2019	Improving the use of oxygen on general internal medicine units	Increase the number of appropriate weaning orders while reducing the number of in hospital days that patients are on oxygen	Regional poster presentation
2020	Sustaining reductions of urea blood test ordering: the transition from paper based to electronic interventions	Determine interventions within a hospital electronic health system to sustain and continue a reduction in urea blood test ordering	Regional poster pending

*Quality improvement curriculum development*

The QI APPE eight-week timeline was from March to the end of April annually and was capped at two students per year, both starting at the same time to allow for peer-assisted learning. Working in pairs on a single QI project (Table 1) allowed for the tasks to be divided among students, where one student was assigned as a task leader and the other student was required to review and revise as required. This also ensured timely completion of the project objectives despite the brief course time frame. The QI curriculum was divided into two, four-week blocks that combined didactic instruction using weekly one-hour, face-to-face lecture, readings, assignments, student reflection, online Institute for Healthcare Improvement (IHI) Open School modules (<http://www.ihl.org/education/IHIOpenSchool/Pages/default.aspx>), and applied learning activities related to the QI projects (Table 2). Each week had defined learning objectives to guide the student through the QI project cycle. For the IHI modules, students were given the flexibility to independently acquire QI knowledge at their own pace in their own location; however, the in-person weekly lectures by the preceptor, as well as scheduled QI team meetings, were mandatory.

The first block provided the foundational improvement science knowledge necessary for the students to complete a thorough investigation of a clinical problem. The students participated in the Evidence-based Practice for Improving Quality (EPIQ) in-person workshop,<sup>10</sup> which was taught by the QI preceptor to learn foundational improvement science. The EPIQ workshop was selected because it allows pharmacy students to be a part of a team of learners and participate in a simulation-based collaborative learning approach, where the completion of sequential QI tools results in the development of an aim statement and a Plan-Do-Study-Act (PDSA) cycle/intervention plan.<sup>10</sup> To ensure that pharmacy students' basic QI knowledge was similar to that of the frontline QI team, students also completed three online health organization developed QI modules. These health organization modules provided further training in process mapping and Lean concepts and were completed concurrently with the IHI Open School online modules. For block 1, students were expected to conduct a literature review to obtain background knowledge, clearly define the clinical problem under investigation, and to identify best practices. To build an understanding of the local processes and gaps, the students worked closely with the QI team to develop a measurement plan to collect and analyze baseline data, and to complete QI tools (e.g. fishbone diagram, 5-whys, process mapping, and force field analysis).

For the second block, the data collected in block 1 informed the students' development of the first improvement cycle, which was implemented by the clinical QI team. The students completed the data collection and analysis for cycle 1, then drafted the plans for

**Table 2**  
Weekly reading topics and activities.

Block	Week	Reading topics	Activity
1	1	Introduction to QI, Improvement Science and Philosophy	-Complete the Evidence-based Practice for Improving Quality Workshop -Complete 3 health organization QI modules -Start the Institute for Healthcare Improvement Open School modules
	2	Conceptual Frameworks and QI Giants: Model of Improvement, Donabedian, Deming and Stewart QI Purpose, Challenges, Ethics and the QI Story Board	-QI team introduction meeting and problem explained -Literature review started
	3		-Literature review completed -Complete QI tools with team members -Collect and analyze baseline data with QI team members
	4		-Develop a current state report that includes both problem and aim statements -Present to the health organization hospital and program specific quality council committee
2	5	Measurement and Graphical Displays: Run Chart, Pareto chart, Statistical Process Control	-Draft a plan do study act plan with team members -Develop intervention components with team members
	6	Change Management, Organizational behavior and Leadership	-Complete Institute for Healthcare Improvement Open School modules -Complete improvement cycle 1 and assessment (includes graphics- i.e. run charts as required)
	7	Implementation Science and Plan Do Study Act	-Draft improvement cycle 2 and recommended next steps
	8	Sustaining Improvement and Publishing QI	-Draft a project poster and abstract -Preceptor and QI team review and complete as required

Project Poster Presentation (scheduled outside of course time, based on QI conference schedule).

QI = quality improvement.

improvement cycle 2 along with recommendations. To complete the course, students were not required to achieve the project aim as that may require several improvement cycles, but they were required to complete improvement cycle 1. To demonstrate a summary of QI knowledge acquisition, students developed a project poster and an abstract as the final course assignment. Following the review by the preceptor and the QI team, the students completed revisions as required, and both documents were submitted to regional and national QI conferences.

**Evaluations**

Kirkpatrick's 4-level model guided this course evaluation (Table 3).<sup>11</sup> Students' course perceptions of the preceptor's ability to deliver the QI content were assessed through the online university FoPPS midpoint and final course evaluation. In addition, the preceptor informally solicited feedback at week four and week eight to determine the student's comfort with QI tools and methodology. To assess student learning, the preceptor reviewed the assigned weekly activities and evaluated students' behavior changes. This was done in real-time using in-person observation of how students worked within QI teams, as well as how students facilitated a meeting that reported the project findings and recommendations to a quality council committee. Lastly, the students' final assignments (i.e. a poster and an abstract) were assessed for the application of QI knowledge and project aims achieved. To assess the QI team members' perceptions of the QI curriculum, at the next team meeting after student completion, the preceptor informally asked and documented team members' views.

**Findings.**

The course has been offered for the last three years (2018–2020) with six students self-selecting this course and three projects completed to date. This study was reviewed for its adherence to ethical quality improvement and evaluation project guidelines by utilizing the Project Ethics Community Consensus Initiative (ARECCI) screening tool, and guidelines from Alberta Innovates-Health Solutions.<sup>12</sup> Also, student feedback was obtained as part of the university FoPPS course evaluation and assessment process. However, verbal consent was provided by each student and QI team member to share their APPE QI curriculum feedback as cumulative responses along with the ability to withdraw participant comments as required.

Categorized textual comments from students as documented on the FoPPS evaluation at course midpoint and final provided feedback on the preceptor's role and course experience. Students rated (using a Likert scale) various preceptor attributes, and also had opportunity to provide free-text comments outlining aspects of the course that they enjoyed and areas for improvement, including<sup>1</sup> course flexibility and the independence to learn at their own pace and in their own location,<sup>2</sup> clear expectations and weekly guidance from the preceptor,<sup>3</sup> alignment of weekly readings and real-time application of QI concepts, and<sup>4</sup> the IHI and health organization QI modules served as another point of resource. Areas of course improvement included<sup>1</sup> a large number of assigned tasks per week to compensate for the brief course time frame and<sup>2</sup> the limited availability of the QI team to assist with the completion of various QI tools and data collection.

**Table 3**  
Program evaluation.

Kirkpatrick's model level	Broad course objective(s)	Data collection method/instruments	Timing
1	REACTION -Students' anecdotal perception of both the didactic and experiential QI learning activities -specifically focusing on what they liked and/or disliked about the training	-Weekly Student reflection - 1:1 check in meeting (informal interview) - Midpoint and Final preceptor and site evaluation (completed by student using the university online evaluation system)	Weekly  Midpoint- Week 4  Final- Week 8
2	LEARNING AND CONFIDENCE -Student can complete QI tools (cause- and- effect, process map, etc.) and documents (implementation plan, poster and abstract)	-Preceptor observation and review of the QI activities/tasks	Weekly, after the completion of each task
3	APPLICATION AND IMPLEMENTATION -Student can develop a current state summary report, synthesizing all baseline findings -Student can lead one QI team meeting sharing the current process gaps, explaining QI methods used and provide recommendations for improvement interventions to the health organization clinical quality council committee -Support the clinical QI team to launch and assess the first test of change cycle	-Preceptor observation and review of the QI activities/tasks (current state summary report) -Informal feedback gathered from the QI team	After the completion of meeting and test of change-cycle 1 (week 5)
4	BUSINESS IMPACT -Project aim statement developed and approved by the health organization project leader -Complete one test of change cycle with measurement and analysis -Draft test of change-cycle 2 or provide recommendations for next steps	-Preceptor observation and review of the QI activities/tasks (improvement cycle audit tool and statistical analysis)	After the completion of improvement cycle, week 8

QI = quality improvement

Informal student feedback on the course was obtained at week four and eight during the preceptor and student course review. All of the students (6/6) anecdotally reported positive learning experiences and the majority of the students (5/6) stated that QI training should be formally included in the undergraduate pharmacy curriculum. Additionally, informal feedback regarding the course from the clinical QI team was collected by the preceptor after student elective completion. The QI teams' perceived benefits of the course included<sup>1</sup> access to unbiased and unique perspectives from pharmacy students regarding the clinical problem under investigation and<sup>2</sup> the students' dedicated focus to the project, which expedited completion of the improvement project. The areas of improvement for the course, as shared by the frontline QI team members, included<sup>1</sup> the fast pace of the course, which provided insufficient amount of time for the frontline QI team members to support the students comprehensively and<sup>2</sup> the limited number of QI team meetings (on average 3 QI team meetings with the students were held) due to the brief time frame of the course.

## Discussion

This paper describes a novel approach to developing an eight-week (320h) QI training curriculum using an existing APPE that provided a focused educational timeframe as no other pharmacy courses were taken during this elective. This unique QI APPE leveraged a collaborative partnership between the university pharmacy and medicine departments and the local health organization. It also required a trained QI preceptor and interdisciplinary frontline QI team to provide QI and clinical mentorship. The QI curriculum offered both a didactic and experiential learning opportunity that positioned pharmacy students to be a part of a clinical interdisciplinary frontline QI team led by a physician QI leader. This firsthand learning approach provided the opportunity for students to apply QI knowledge to improve healthcare delivery and ultimately, improve patient outcomes, while also gaining a deeper understanding of the change management complexities associated with improvement implementation. A similar approach has been developed at the University College London Medical School to train undergraduate medical students in QI; this program combined a brief half-day seminar with experiential training provided by a physician QI leader supported by a clinical interdisciplinary team to improve clinical service.<sup>7</sup>

Strengths of this QI elective training approach were no additional cost or educational burden to the pharmacy faculty as existing elective course infrastructure was used to deliver the elective experience. The challenge associated with this elective was the reliance on a single preceptor that consequently reduces the number of students who can participate in this course and limits further enrollment expansion. Further, the reality and complexity associated with the clinical environment to resolve a problem in eight weeks was an ambitious undertaking. This required swift acquisition of QI knowledge and application, which often made it difficult for both the students and QI teams to complete all tasks required.

The limitations of this study were the small number of students that have been involved in this course, which may affect the generalizability of our findings. Also, there was no inclusion of a formal course evaluation that objectively assessed student QI knowledge acquisition and student perception of the QI curriculum. Because we plan to continuously offer the APPE to pharmacy students, we will be developing a pre and post Quality Improvement Knowledge Assessment Tool-Revised (<http://www.squire-statement.org/index.cfm?fuseaction=Page.ViewPage&pageId=509>) to objectively assess student acquisition of QI knowledge. In addition we will develop a questionnaire to gather student course perception that is administered in the absence of the preceptor. Also, the authors plan on reviewing any areas of curriculum overlap to decrease duplicated student workload while in the course. Further, we plan to determine the feasibility and effectiveness of the EPIQ workshop to train pharmacy students in year one to four in basic improvement science.

## Summary

Improvement science is an important and burgeoning component of healthcare systems and the practice of pharmacy. Using an existing pharmacy practice experiential elective allowed for the development of a structured QI curriculum that offers both didactic and experiential learning that is integrated with frontline clinical care delivery. The strategic partnership between the university and the health organization facilitated the linkage between improvement science and clinical practice delivery. This greatly enhanced student experience and educational outcomes achieved concerning QI competencies. Overall, this course has been well received and has been an inspiring collaborative approach to teaching foundational QI methodology to undergraduate pharmacy students.

## Authorship contributions

P.M. Mathura was responsible for conception and design of study, acquisition of data, analysis and/or interpretation of data and drafting the manuscript.

D.H. Lee, A.T. Thompson, N.M. McMurtry and N. Kassam responsible for revising the manuscript critically for important intellectual content.

P.M. Mathura, D.H. Lee, A.T. Thompson, N. McMurtry and N. Kassam provided approval of the version of the manuscript to be published.

## Declaration of Competing Interest

None

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