RESEARCH

Quality Improvement and Safety in US Pharmacy Schools

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Objective. To catalog the methods in which quality improvement (QI) and safety are taught in schools and colleges of pharmacy in the United States and showcase exemplar QI programs.

Methods. This descriptive, multi-phase study included an online questionnaire, syllabi review, and phone interviews. The study was approved by the University of Arizona Institutional Review Board (IRB). One representative from each US pharmacy school accredited by the Accreditation Council for Pharmacy Education (ACPE) was invited to participate. Participants indicated the type of QI education their school provided via online questionnaire. Following questionnaire completion, syllabi were requested from the schools and phone interviews were scheduled with a school representative to obtain additional information. From the data, exemplars were chosen using a predetermined, evidenced-based rubric.

Results. Of the 136 schools contacted, 56 (41.2%) completed the survey. Of the responding schools reporting their QI and safety offerings, 41 (73.2%) had a required session/module; 24 (42.9%) had a required course; 21 (37.5%) had an elective course; 21 (37.5%) had an introductory pharmacy practice experience (IPPE), advanced pharmacy practice experience (APPE), or internship; 17 (30.4%) had a required project; 17 (30.4%) had interprofessional education integrated into their course; 15 (26.8%) had an error laboratory; and 11 (19.6%) offered postgraduate training.

Conclusion. Many of the responding US schools of pharmacy expose students to some aspect of QI and/or safety, most often via class session or module. The exemplar programs serve as examples of how QI can be further integrated into pharmacy curricula.

Keywords: quality improvement, quality measurement, quality control, safety, medication error reduction.

INTRODUCTION

Quality improvement (QI) includes organized and ongoing actions to create measurable progress in the improvement of the health and wellbeing of patients.^{1,2} Quality and safety are important components of a pharmacist's role, as they allow for continuous development of processes and procedures to provide the best form of patient care.^{1,3} It is imperative that during their education, pharmacy students be trained to have the key skills for improving quality of services and reducing potential errors, methods of improving the quality of care received by patients, and specific training to improve patient and medication safety during their professional careers.^{4,5} Ultimately this helps patients achieve an optimum level of care.

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The primary focus of the Accreditation Council for Pharmacy Education (ACPE) with regards to Doctor of Pharmacy (PharmD) students in the United States (US) is to advance the quality of pharmacy education. The application of quality metrics is included within ACPE accreditation standards.⁶ The American Association of Colleges of Pharmacy (AACP) and the Center for the Advancement of Pharmaceutical Education (CAPE) officially support QI education.⁷ In 2006, the Pharmacy Quality Alliance (PQA) was created to promote the improvement of patient health outcomes and has established performance measures that recognize pharmacy quality.⁸ Clearly, education in QI and safety concepts are essential components of a pharmacist's training.

Previous studies have reviewed the least-covered areas of QI in schools of pharmacy across the United States, the extent to which QI is taught, and initiated a direct comparison of QI education among ACPE-accredited and non-ACPE-accredited schools of pharmacy.⁵ The curriculum and extent of QI teaching varies widely among the ACPE-accredited and non-ACPE-

accredited schools of pharmacy.⁵ Frequently covered QI topics with regards to safety include how to identify areas for improvement, medication error prevention and reporting, organizations involved in quality, and methods for implementing QI initiatives.⁵ Some schools report not providing any education in QI, while others report having a year-long course and project dedicated to this topic.⁵

Providing quality education on QI and safety allows students to learn important skills that will assist them in reducing the number of errors made during their career. Schools perceived to be demonstrating exemplary QI and safety education have not yet been explored or described.^{7,8} Given the wide variation of QI and safety education across schools of pharmacy, the identification of exemplary programs would provide other programs with ideas for how they could improve their own QI and safety curricula. By highlighting characteristics of innovative and comprehensive QI and safety education in this paper, we hope that programs will be inspired to make changes to their curricula, thereby improving QI and safety education that pharmacy students receive. This study provides an additional perspective by displaying the variance in the components of QI education among ACPE-accredited schools of pharmacy in the United States. The purpose of this project was to catalog the various methods in which quality improvement is being taught in colleges and schools of pharmacy in the United States and showcase exemplar QI programs.

METHODS

This cross-sectional, mixed method, descriptive study targeted one educator from each US school or college of pharmacy that was ACPE accredited or in candidate status. To be eligible for participation, each participant had to have been a faculty member, staff member, or representative from a US pharmacy school that was ACPE-accredited or in candidate status as of January 1, 2016. A list of ACPE-accredited and candidate status pharmacy schools was downloaded from the ACPE website.⁶

The project was first discussed at PQA's Academic Affairs Committee (AAC) meeting. The AAC is made up of representatives from 51 pharmacy schools in the US who teach or perform research in quality and safety. Members of PQA were invited to participate in the study by entering their information into a web-based questionnaire. The investigators contacted members of the AAC who did not provide data and again invited them to participate. In addition to PQA participants, faculty members, staff members, or representatives from the remaining pharmacy schools were invited via email to enter their information into the web-based questionnaire if they were willing to participate. These additional accredited or candidate status schools were found via

the ACPE website.⁶ Representatives who taught or conducted research in QI and/or safety were identified via a web-based search for schools that did not have PQA AAC representation. These faculty members were also invited to participate. If a QI or safety representative could not be identified at a school, emails were sent to the school's dean with a request for the dean to either respond to the survey or forward the request to an appropriate faculty member. If there was no response, two additional emails were sent two weeks and four weeks after the initial email. All invitations sent by email included a statement indicating that filling out the web-based form was considered consent to participate in the study, as well as a consent to participate document per the University of Arizona's Institutional Review Board specifications.

In the Google document, or initial data collection form, participants indicated their name, the name of the college or school of pharmacy they represented, and the type of QI education their college provided (ie, required course, elective course, required class session or module, QI project or practicum, QI or error laboratory session, interprofessional class session or module, interprofessional course, IPPE/APPE/internship, integrated throughout, postgraduate training) via predetermined categories requiring a yes or no answer. The initial questionnaire did not specifically request details of projects or other types of QI education; however, respondents were presented with the opportunity to elaborate on any item their school offers. If the respondent indicated that his or her college or school had any form of QI content in their curriculum, syllabus copies for the appropriate course(s) were requested via email. If a representative felt he or she could not provide the requested information and materials, the researchers recommended that the person confer with others at their college to ensure completeness and accuracy of the information provided.

While syllabi were being received, requests for telephone interviews were also sent in order to gain more detailed information about QI and safety offerings. A semi-structured interview guide, which was created by the authors, was used. Phone interviews were conducted by three of the authors.

Using the information obtained from the initial questionnaire as well as any available syllabi or completed phone interviews, each program was evaluated using a predefined rubric (Table 1). The rubric was created through an evidence-based literature search with the following terms: quality, safety, pharmacy, teaching, education, curriculum, and learning. Literature directly related to pharmacy students was found to be limited. Six articles were found. Therefore, a broader search for quality and safety education among health care professionals was conducted. Within this search, common themes were

Table 1. Rubric for the Evaluation of Quality Improvement and Safety Education in US Pharmacy Schools and Colleges

Program Element	Point Allocation
QI/safety course type	
No course	0
Required course/module	1
Elective	2
Required course	3
Interprofessional activities related to QI/safety	None=0 Session/module=1 Interprofessional course=2
Introductory pharmacy practice experience/Advanced pharmacy practice experience/internship	No=0 Yes=1
Post-graduate training (residency/fellowship)	No=0 Yes=1
Evidence of knowledge development	No=0 Yes=1
Student self-assessment and reflection	No=0 Yes=1
Error laboratory	No=0 Yes=1
Project/practicum	No=0 Yes=1
Project required for all students	No=0 Yes=1
Project length	Semester long=1 Year long=2
Project done with a preceptor in the health professions field	No=0 Yes=1
Project presented as a poster	No=0 Yes=1

discovered in an analysis of improved outcomes for quality improvement education. From this search, nine additional articles were collected and analyzed. The rubric was then created based on theoretical concepts and proven strategies that have demonstrated learning advancements among professional health care students within the articles. The content validity of the rubric was addressed by aligning the components that were created to the elements found in the literature search that had significant evidence for student enhancement.

A point system was developed based on the degree of student exposure and activities. Points were allocated for each specified element that a program either directly stated that they had through the survey or that the investigators could confirm based on syllabi review and/or phone interview. Once point allocation was complete, programs were ordered based on total point value. Each pharmacy school was eligible to receive points in multiple categories if there were different offerings included in the curricula. The top-ranking program in each category was then selected to be an exemplar. The prespecified

exemplar categories were as follows: required course, elective course, semester-long project, interprofessional project, interprofessional course, simulation laboratory, and internship/fellowship. Each of these categories represented teaching modalities that had been demonstrated to enhance student learning.^{2,4}

Once exemplars were chosen, each exemplar program representative was contacted with a request to review a completed write-up about their program. This enabled them to provide details that may have been missed in reviewing the syllabi and/or phone interviews, as well as to correct any misinterpretations.

In addition to the identification of exemplars, descriptive statistics were used to show the proportion of responding schools that had each of the specified elements of QI and/or safety education. The percentages were calculated using Excel. The number of respondents that indicated they had a particular element of QI or safety education was divided by the total number of respondents to derive these percentages. Descriptive statistics were also used to determine response rate. The calculated

percentages were intended to provide additional details of the QI and safety education at US pharmacy schools. This study was approved by the University of Arizona's IRB.

RESULTS

A total of 136 colleges and schools of pharmacy were contacted and 56 (41.2%) responded to the survey (Table 2). Twenty-nine (52%) of these schools were public institutions and 27 (48%) were private institutions (Table 2). The program length of the schools also varied, with five 3-year programs (9%), one 3½-year program (2%), 48 4-year programs (83%), and four 6-year programs in which students were admitted directly from high school (7%).

Of the responding schools, 41 (73.2%) reported a required QI session or module; 24 (42.9%) reported a required QI course; 21 (37.5%) reported an elective QI course; 21 (37.5%) reported either an IPPE, APPE, or internship in QI; 17 (30.4%) required completion of a QI project; 17 (30.4%) reported some element of interprofessional education integrated into their course; 15 (26.8%) reported having students participate in an error laboratory session that was related to medication safety or QI; and 11 (19.6%) reported offering postgraduate training in QI. During phone interviews, we determined that only two schools surveyed had required all students to complete a poster presentation directly related to QI and/or safety. There were 17 pharmacy schools (30.4%) that reported some element of interprofessional collaboration with other educational colleges (nursing, medicine, etc.) integrated into their course. Fifteen schools (26.8%) reported having students participate in an error laboratory session that was related to medication safety or QI.

Of the 27 schools that submitted syllabi, 22 were selected for further study, and phone interviews were conducted. Seven of the 22 schools were selected as ex-

emplars for the categories previously reported based on point allocation from the literature-based rubric (Table 3). Total scores on the rubric ranged from one to 11 points out of a possible 17 points, and the average score was six points. For each exemplar category, the college or school with the highest point value was chosen as the exemplar. The exemplar programs and their corresponding rubric scores are described in detail in Table 4. Exemplars were selected to represent the following categories: Elective Course, Simulation Laboratory, Internship/Fellowship, Interprofessional Course, Semester-Long Project, Interprofessional Project in a Required Course, and Year-long Project in a Standalone, Required Course.

DISCUSSION

The most important result from this study was that a majority of the responding programs offered required class sessions or modules in quality and/or safety, although most did not offer a full QI/safety course (required or elective). This is encouraging because previous research described the need to make QI education of pharmacy students a priority.⁵ Previous research has shown that student self-reported knowledge and attitudes were strongly associated with the length of QI education.⁸ Future research should assess the impact of direct practice-related outcomes, such as ability to identify and address medication errors and the ability to improve medication use systems to create a culture of safety. Creating a culture in which pharmacy students develop a 'safety mindset' while in school will help them to establish a career-long focus on promoting optimal health through continuous improvement.

While 30% of the programs surveyed reported that students completed a QI or safety project as part of a requirement, we discovered through faculty interviews and

Table 2. Demographics of Colleges/Schools of Pharmacy Survey Respondents

Type of School	n (%)
Public	29 (52)
Private	27 (48)
Total	56
Program Length	n (%)
3-Year	5 (9)
3.5-Year	1 (2)
4-Year	48 (83)
6-Year	4 (7)
Total ^a	58

^a Two colleges/schools of pharmacy offer multiple options for program length. Each option was included individually in the overall total

Table 3. Number of Respondents Incorporating Different Elements of Quality Improvement Education in US Pharmacy Schools and Colleges (n=56) ^a

Program Element	n (%)
Required session/module	41 (73.2)
Required course	24 (42.9)
Elective course	21 (37.5)
IPPE/APPE/internship	21 (37.5)
Project	17 (30.4)
Interprofessional elements	17 (30.4)
Error lab	15 (26.8)
Post-graduate training	11 (19.6)

Abbreviations:

IPPE=introductory pharmacy practice experience

APPE=advanced pharmacy practice experience

^a Presented as n (%)

Table 4. Details About Each Quality Improvement (QI) Program Exemplar

Category: Elective Course

Exemplar: Campbell University (8 points)

Description: Through a one-credit hour elective in the Campbell University College of Pharmacy and Health Sciences (CPHS) curriculum, Dr. Robert Cisneros helps students focus on decreasing medication errors and improving safety as well as increasing empathy when errors occur. This course is currently taught as a three-hour class weekly for five weeks. A typical class includes a 30-40 minute lecture in addition to third year pharmacy student group discussions regarding examples of safety issues found in the literature of the Institute for Safe Medication Practices (ISMP) newsletter.⁹ Each student group near the end of the course is also assigned a different actual medication error description and presents a 20-minute root cause analysis regarding the actual reported errors, focusing on: what happened, how did the error get through the system, and how can the system be improved to minimize the changes that the error could happen again. The course also used videos which include: "Beyond Blame,"¹⁰ videos related to Eric Cropp and Chris Jerry,¹¹ and elements from Pharmacy Quality Alliance's (PQA) EPIQ resource.⁸ Discussion also takes place regarding disclosure and apology after errors, using the "Little Book of Empathy"¹² from the Sorry Works! Organization.¹³ CPHS is an academic member organization of PQA.

Representative: Bob Cisneros, PhD; cisnerosr@campbell.edu

Category: Simulation Lab

Exemplar: North Dakota State University College of Health Professions (5 points)

Description: At the North Dakota State University College of Health Professions, faculty have integrated medication error focused simulations into a required hands-on course sequence to give students experience dealing with errors and patient safety. Their laboratory simulation is designed to teach and assess practical application of the skills necessary to become a pharmacist. Three simulations were designed to model institutional, community, and long-term care settings. For each setting, students investigate a staged room to determine the cause of each medication error. All rooms have audio recordings of individuals who had been interviewed regarding the associated error. Audio clips could be heard from a pharmacy manager, pharmacist, pharmacy technician, charge nurse, nurse, certified nurse assistant, safety officer, mother, roommate, advanced pharmacy practice experience student, or emergency medical technician. Once the students independently identify the errors, they discuss their findings within their team. After students rotate through all three simulations, faculty facilitate a debriefing of the activity. The debriefing focuses on potential causes of each medication error, strategies to prevent similar errors in the future, and a reflective discussion on how medication errors are prevented in pharmacies as seen during internships or introductory pharmacy practice experiences. Reflective discussions typically focus on job roles, workflow, technology, culture of safety, and disclosure of errors to patients.

With permission, faculty adopted the Healthcare Professionals Patient Safety Assessment instrument, a survey used to evaluate the impact of a patient safety and medical fallibility curriculum on medical student's knowledge, skills, and attitudes.¹⁴ Researchers who developed the instrument found that a patient safety and medical fallibility curriculum affected the knowledge, skills, and attitudes of medical students and students demonstrated sustained improvement when required to apply knowledge and practice skills in interactive sessions or role-playing.

Representative: Jeanne Frenzel, PharmD, PhD, RPh; jeanne.frenzel@ndsu.edu

Category: IPPE, APPE, Internship, or Post-Graduate Training

Exemplar: Purdue University College of Pharmacy (11 points)

Description: Purdue University College of Pharmacy was selected as an exemplar because of quality and safety opportunities for pharmacy students outside of the classroom. This program offers a competitive safety research internship for first and second year pharmacy students over the summer. The program allows the student to participate in an original safety research project and to present a project poster. Purdue University College of Pharmacy also provides two post-graduate, two-year fellowships in partnership with the pharmaceutical industry and FDA that incorporate medication safety with regulatory sciences. In addition, Purdue faculty have participated in the Pharmacy Quality Alliance (PQA)/CVS Fellow program to mentor individual pharmacy students on a quality or safety project.

Representative: Kyle Hultgren, PharmD; khultgre@purdue.edu

Category: Interprofessional Course

Exemplar: Virginia Commonwealth University (VCU) (9 points)

Description: Second year pharmacy students at the VCU School of Pharmacy participate in a semester-long interprofessional course with third year nursing and first year medical students. The course is structured as three units: quality in the workplace, error in the health care system, and improving health care. As a part of the course, groups of 6 or 7 students from different health professions complete a project as well as evaluate cases dealing with medication errors and safety. As a part of these case-based exercises, students from the different professions are able to work together to determine what may have caused the problem and identify potential solutions. The capstone project for the team includes evaluating quality of care in terms of structure, process, and outcomes along with creating and sustaining a safety culture. By seeing the perspective of other members of the health care team, students are more prepared for collaboration in quality improvement efforts as a whole.

Table 4. (Continued)

<p>Representative: Laura Morgan, PharmD, MEd, BCPS; lamorgan@vcu.edu</p> <p>Category: Semester-Long Project</p> <p>Exemplar: Washington State University (WSU) College of Pharmacy (10 points)</p> <p>Description: As a part of this flipped classroom required course, pharmacy students work in groups to complete a Failure Modes and Effects Analysis (FMEA) on an assigned high-risk medication. Students are able to use the Institute for Healthcare Improvement (IHI) website's FMEA tool to help complete the analysis and generate a report.¹⁵ The final result is a group presentation on the results of the analysis.</p> <p>This program also offers an interprofessional interaction with pharmacy, nurse practitioner (NP), and physician assistant (PA) students on a situation, background, assessment, and recommendation (SBAR) project revolving around a specific topic such as pediatrics, geriatrics, or other high-risk populations. This project requires students to evaluate a case involving a quality or safety problem. They then work together to solve the common therapeutic concerns identified and determine what needs to be addressed to reduce future errors. The goal of this assignment is to practice good clinical decision making using real world examples among health professions.</p> <p>Representative: Brenda Bray, MPH; bbray@wsu.edu</p> <p>Category: Interprofessional Project in a Required Course</p> <p>Exemplar: The University of Wisconsin - Madison School of Pharmacy (11 points)</p> <p>Description: The University of Wisconsin - Madison School of Pharmacy was selected as an exemplar because the curriculum incorporates an interprofessional project related to QI/safety. As a part of the Safety and Quality in the Medication Use Process course required for third year pharmacy students, groups consisting of pharmacy, industrial systems engineering, biomedical engineering and public/population health students are formed. In these groups, students join forces with an outside preceptor that may either be a pharmacist or other practicing professional to complete a real-world project. For this project, students evaluate a medication error, complete a full root cause analysis (RCA), and propose an intervention to reduce the incidence of the error. While the semester allotted for the course does not allow time for implementation of the proposed solution, students complete a full risk analysis and present posters on their proposed plans and anticipated results. Working with these unique interprofessional teams allows pharmacy students to see an outsider's perspective on the quality improvement process and is an invaluable educational experience.</p> <p>Representative: Michelle Chui, PharmD, PhD; michelle.chui@wisc.edu</p> <p>Category: Year-long Project in a Stand-alone, Required Course</p> <p>Exemplar: The University of Arizona College of Pharmacy (11 points)</p> <p>Description: With the understanding of potential for bias by listing the University of Arizona College of Pharmacy as an exemplar, our familiarity and experience with their QI curricula as well as the program's point accumulation per the point allocation rubric has deemed its inclusion necessary. At the University of Arizona, all students in their second year of pharmacy school are required to participate in a year-long course in quality and safety. As a part of this course, students form small groups and complete a real-world quality improvement project with a practicing professional (ie, a pharmacist, physician or nurse). Throughout the year, students learn the process and effects of quality improvement as well as project management as they work to create, implement, and evaluate a quality improvement project for their preceptor's practice site. At the end of the year, students create posters about their projects which are presented at a school-wide poster day, with many students subsequently taking their posters to local and national levels.</p> <p>Representative: Terri Warholak, PhD, RPh, CPHQ, FAPhA; warholak@pharmacy.arizona.edu</p>

syllabi review that many of these projects may not fully expose students to the challenges facing a practicing pharmacist with regard to the QI process. The ACPE standards require that accredited colleges of pharmacy introduce students to research design.⁶ Focusing this required research on QI and safety and requiring students to complete poster presentations prepares them to continue to enhance safety and quality after graduation. In addition, previous research indicated that students perceive that they learn more when a real world project is included in the QI curriculum.⁸ This application has also been shown to further enhance student experiences when their work is

culminated into a poster.^{16,17} However, the limited amount of literature to support the completion of projects and posters may also introduce the potential for selection bias because the authors were only able to select from a small pool of literature data. Further research is needed to fully assess this impact.

There were also a limited number of pharmacy schools that offered exposure to QI and safety content through error laboratory sessions, despite a demonstrated need for robust instruction on medication error prevention in pharmacy curricula.¹⁸ Future research should examine the impact of such instruction, but we hypothesize that

these experiences, in combination with other methods of teaching, are key in preparing students to handle QI and safety concerns after graduation.

The findings of this study suggest that there are several pharmacy schools that integrate interprofessional education into their quality and safety curriculum. This finding is similar to that reached by Kiersma and colleagues in which the authors concluded that, in recent years, many programs have added a focus on interprofessional partnerships in the teaching of QI as a necessary step in influencing patient safety.¹⁹ This development is important because the need for quality education and safety extends beyond pharmacy schools, with literature demonstrating an absence of quality and safety training for information among medical and nursing students.^{20,21} Future studies should focus on determining the optimal modes for interprofessional instruction and assess the impact of this instruction on student and practitioner behavior. Assessing the impact of QI and safety education on students' behavior is especially important because an investigation by the Clinical Learning Environment Review (CLER) program discovered that medical residents and fellows were responsible for less than 1% of submissions to the center's patient safety reporting system, and that medical residents and nurses were using the patient safety reporting system to investigate errors against patients.²⁰ The center also stated that they frequently encounter chief residents and faculty members who do not know how to conduct a root cause analysis or other quality improvement activity.²⁰

The exemplars highlighted by this study provide examples of courses, projects, and activities that are currently in place at programs across the United States. Each of these programs includes evidence-based features from the literature that demonstrate benefit in student learning. The exemplar descriptions can serve as guidance for pharmacy schools that would like to establish, revise, or enhance their own QI program. Best practice models and exemplar institutions in interprofessional education have been described previously by Bridges and colleagues, although not specifically in the setting of quality and safety.²¹ They determined that a successful interprofessional experience included the opportunity for participants to appreciate other professionals' roles while understanding their own professional identities.²¹ In recent years, health care organizations have devoted significant efforts to QI and patient safety. However, less attention has been dedicated to the understanding of how students learn about quality and safety.¹⁹ This is important because as students progress to become professional practitioners, they will inherit the responsibility

of initiating and enforcing quality efforts. Thus, they must develop a foundation of knowledge and skills during their schooling, and pharmacy faculty members must be prepared to provide this foundation. Future research in this area should examine the preparedness of faculty members to teach these topics in a meaningful way and evaluate the longitudinal effects of QI and safety education on the individual efforts of practitioners during their professional career.

Response rate was a major limitation of this study, with 56 of 136 (41.2%) pharmacy schools responding to the online questionnaire and interview requests. However, the distribution between public (29) and private (27) schools of pharmacy is fairly even (52% vs 48%). One potential explanation for this is that some of the contact information obtained was incorrect or out of date. Programs not involved in PQA did not have a designated point of contact. This required that invitations to participate be sent to representatives or deans identified by searching the web. Additionally, there lies the possibility of bias in that the schools that responded to the initial survey may not have provided a syllabi or completed a phone interview. For these programs, rubric points were allocated solely based on their responses to the survey. Thus, these programs may have earned more or less points if they had provided additional materials.

CONCLUSION

This multi-phase study provides examples of the ways QI education is addressed among ACPE-accredited pharmacy schools in the United States. Each of the schools that responded to this study provided students with some level of exposure to quality and safety, although the total amount of instruction varied widely. Many pharmacy schools taught students about this subject using a required class session or module. This may not be adequate to prepare students for their professional careers. The exemplars outlined here provide examples of how programs may incorporate additional QI and safety education into pharmacy curricula and serve as potential models for other colleges and schools of pharmacy that desire to implement QI and safety training or revise their own curriculum within their institution.

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