TEACHERS' TOPICS

Assessment of Student Performance and Perceptions of Learning in a Medication Use Evaluation Project

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Objective. To describe and assess student perceptions and performance on a medication use evaluation (MUE) team project.

Design. Following a 1-hour MUE lecture in a 62-student patient safety course, student teams (n=14) were assigned a medication safety or quality issue. Teams worked with a mentor to design an MUE to address the issue. The deliverable was a verbal presentation recorded as a webinar.

Assessment. Presentations were assessed by 2 reviewers for content and style. Mean score was 45.0 +/- 2.7 of 50 points. Students rated level of agreement that they could perform MUE-related skills pre- and postproject (n=35 and 34, respectively) on a 5-point Likert scale. Students perceived improved ability to design an MUE after project completion (median 3 vs 4; $p=0.003$). Student comfort with sample determination, data, collaborators, study limitations, and potential project impact also improved.

Conclusion. Teams achieved the objective of successfully designing an MUE, and related enabling outcomes (ie, supportive activities that contribute to designing an MUE), as measured by evaluators and student perceptions.

Key Words: Medication use evaluation; medication safety; pharmacy informatics

INTRODUCTION

The American Society of Health-System Pharmacists (ASHP) defines medication use evaluation (MUE) as “a performance improvement method that focuses on evaluating and improving medication-use processes with the goal of optimal patient outcomes.”¹ Applications of MUE can range from evaluation of the use of a specific medication or class of medications, assessment of specific steps of the medication use process (ie, selecting, procuring, ordering, dispensing, administering, or monitoring), or appraisal of patient care based on disease state. MUE can be broadly used to determine whether medication use is safe and effective compared to a standard of care at the site, rather than specific patient level; typically this aim is accomplished using observational study designs.¹⁻² MUE activities are required for accreditation by The Joint Commission (TJC) and are often coordinated and conducted by pharmacists. Multiple recent examples of pharmacist-coordinated MUE projects in various therapeutic areas, in both institutional³⁻⁷ (eg, assessing effectiveness of a vancomycin dosing nomogram) and managed care⁸⁻¹⁰ (eg, assessing whether tamoxifen is being used for

evidence-based, off-label indications) settings, are available in the literature.

MUE is not explicitly described in the Accreditation Council for Pharmacy Education (ACPE) Standards and Guidelines for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree; however, several topics related to MUE are described in Appendix B of the standards (ie, suggested didactic topics) including “managing and improving the medication use process” and “continuous quality improvement programs.”¹¹ Similarly, the Center for the Advancement of Pharmaceutical Education (CAPE) Educational Outcomes describe activities inherent to MUE such as “utilizing...resources to optimize the medication use system, applying standards, guidelines, best practices, and established process related to safe and effective medication use, and utilizing continuous quality improvement techniques in the medication use process.”¹² Activities related to MUE have also been recommended as components of pharmacy informatics education.¹³ Accordingly, one of the enabling program-level outcomes (ie, outcomes representing specific skills that support a higher level objective) at Manchester University College of Pharmacy is that students are able to “design a medication use evaluation.”

Despite the important role of MUE in management of medication use in health systems, a review of the literature

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identified few examples of how this topic is integrated into curricula at schools and colleges of pharmacy.¹⁴⁻¹⁶ The purpose of the curricular innovation described in this paper was for students to successfully design an MUE. The objectives of the paper are to describe the longitudinal MUE team project, to determine whether students met project outcomes, and to determine whether the assignment improved student perception of their ability to design an MUE.

DESIGN

The MUE team project took place in a required, 62-student, 2-credit hour course focused on patient safety and pharmacy informatics in the fall semester of the second professional year. The first half of the course focused on adverse drug events, including causes, prevention, reporting, and assessment. The second half of the course was devoted to informatics and related issues including use of practice-based research and risk communication. Prior to this course, students completed a 2-credit hour drug information course in the fall semester of the first professional year where they were introduced to relevant study designs in clinical and social sciences literature among other drug information-related topics. The course was taught concurrently with 3 integrated pharmacotherapy modules (pharmacokinetics, central nervous system, and cardiovascular) and a population health course.

Midway through the semester, students attended a 1-hour didactic class session focused on MUE. The objectives of the lecture were that students (1) identify clinical (ie, safety or quality) issues that could be good candidates for MUE, (2) identify an appropriate research question given the clinical issue being addressed, (3) design an effective MUE given the clinical issue, (4) identify appropriate recommendations based on results, and (5) describe strategies for overcoming common pitfalls. These objectives were designed to address the ACPE Appendix B topics and achieve the Manchester University Pharmacy program outcome of being able to design an MUE. Students were not expected to have any knowledge or understanding of MUEs prior to class. Material was presented as an approximate equal mixture of lecture and active learning. Activities included audience polling and quiz questions using an audience response system, small group discussion and brainstorming, and practice using a guided example. The guided example focused on an MUE scenario involving use of rasburicase for tumor lysis syndrome, and students, working in teams, focused on developing several aspects of the MUE (eg, designing the study, defining the patient sample). The topic was selected because the instructor had recently completed an MUE in this area. It was intended to illustrate application

of MUE to actual practice and the potentially significant impact of this work. The classroom activity, correlating to the third lecture objective, involved application of knowledge to design of an actual MUE, thus representing learning at a high level according to Bloom's Taxonomy (ie, create-to generate, plan, and produce in order to construct new structure).¹⁷ It was determined that additional activities outside of lecture would be required to assess whether students met this objective.

The primary objective for this team project was for students to design an MUE to address a clinical pharmacy issue. According to the enabling objectives (ie, supportive objectives representing specific aspects of MUE design) developed to help determine successful MUE design, students should be able to: develop a research question; select a study design; determine patients to include and exclude; determine appropriate data to collect; identify endpoints to measure; determine potential interdisciplinary collaborators; identify study limitations; and state how the results could be used. Enabling objectives were developed from a review of ASHP MUE guidelines,¹ course faculty experience, and input from a community representative on the Manchester University Pharmacy Curriculum Committee, who was also a clinical pharmacy coordinator at a nearby hospital.

Students worked in previously assigned learning teams of 4 or 5 students formed on an annual basis and used at the college throughout the doctor of pharmacy curriculum. For the academic year when this project took place, teams were designed primarily to distribute student strengths according to Gallup StrengthsFinder 2.0.¹⁸ Grade point average (GPA), sex, race, and preferred learning styles were also taken into consideration. Each team was assigned a single clinical issue related to medication safety, quality, or formulary management (see Table 1 for a list of MUE topics for 2013). Topics were assigned in a blinded fashion by team number prior to grouping of students. The teams were instructed to design an MUE to address the assigned issue. All scenarios were set at a 500-bed community hospital using a mixed model of clinical pharmacy specialists, unit-based pharmacists, and pharmacy operations specialists. A description of available technologies, such as computerized physician order entry (CPOE), electronic medical record (EMR), and others was also provided. A community hospital setting was selected because students were preparing for their institutional introductory pharmacy practice experience (IPPE). This setting reflected the most common site students would encounter.

The students were advised to begin by researching background information and to generate a list of background questions in order to help them better understand

Table 1. MUE^a Team Topics and Scores

Team	Topic	Scenario
1	Aliskiren	Aliskiren is a non-formulary medication at the hospital. What is the scope of its use and is it being used in appropriate patients?
2	BCMA ^b	The hospital recently added BCMA for all inpatients. Is BCMA being used effectively? How has this change impacted medication safety?
3	CPOE ^c	The hospital recently converted from traditional paper charts to CPOE. Is CPOE being used effectively? How has this change impacted medication safety?
4	Dabigatran	Dabigatran was recently added to hospital formulary. Is it being used safely?
5	Discharge Counseling	The hospital recently implemented a pharmacist-led discharge medication counseling program on general surgery units. Are patients and caregivers satisfied with this experience?
6	Enoxaparin	Enoxaparin is the preferred formulary agent for VTE prophylaxis. Is the medication being used appropriately in obese patients?
7	Fentanyl	Is transdermal fentanyl being ordered, dosed, administered, and disposed of in accordance with safety standards?
8	Lacosamide	The hospital recently added lacosamide to formulary. There is concern it is being used outside of studied indications. Is it used in appropriate patients at appropriate doses?
9	Medication Reconciliation	The hospital recently instituted a pharmacist-led admission medication reconciliation process for patients over age 70. Is this program effective?
10	Morphine PCA ^d	The hospital's PCA of choice is morphine. Are patients on morphine PCAs receiving appropriate dosing, administration, and monitoring?
11	Prasugrel	Prasugrel was recently added to hospital formulary. Is it being used safely?
12	Statins	The hospital recently implemented a program where all statins are held on hospital admission and restarted at discharge. Is this program safe, effective, and providing cost-savings?
13	Vitamin K	Is vitamin K being used safely and in accordance with clinical practice guidelines?
14	Warfarin	Is appropriate dosing and monitoring being used for patients started on warfarin for VTE ^e treatment?

^a MUE: Medication use evaluation.

^b BCMA: Bar-coded medication administration.

^c CPOE: Computerized provider order entry.

^d PCA: Patient-controlled analgesia.

^e VTE: Venous thromboembolism.

the scenario. Each team was assigned a mentor, either a course faculty member or pharmacist (clinical pharmacy generalist or postgraduate year 1 (PGY1) pharmacy resident) practicing at a local hospital, to provide guidance on the project. Ten of 14 teams had a non-faculty mentor. Teams were required to meet once with their mentor. The initial meeting was to be focused on discussing gathered background information and answering student-generated questions. Background questions were expected to focus on gaps in the description of either the scenario, the institution, or both, so students could practice interpreting project directions from a preceptor. If students posed questions related to general background information (eg, medications, disease states), they were instructed to use evidence-based references to answer their questions. Students were encouraged, but not required, to schedule a second meeting with their mentor in order to present their preliminary MUE design plan for review and formative feedback.

Teams had 4 weeks to complete the MUE team project; the primary deliverable was a PowerPoint or Prezi

presentation describing their MUE design that was to be recorded and uploaded using Desire2Learn (D2L Corporation, Kitchener, Canada), the course learning management system. The presentation was expected to be in the style of a professional proposal and to detail all major aspects of the teams' MUE design including background, assumptions, research question, study design (eg, cross-sectional, experimental), patients included and excluded, data to be collected, endpoints, resources needed, potential interprofessional collaborators, and potential impact of the MUE. Presentations were required to be 10 to 15 minutes in length.

A 2-part, longitudinal survey was administered immediately following the MUE lecture and prior to beginning the MUE project and also immediately following project completion. Both surveys were administered using course learning management system with 2 reminders provided. Students were informed they were not required to participate and could stop the assessment at any time. The project was granted exempt approval by the Manchester University institutional review board (IRB).

EVALUATION AND ASSESSMENT

Student performance was evaluated based on 3 activities. First, students (n=62) were assessed as a team (n=14) based on their performance in their required, initial mentor meeting on the basis of their preparation, teamwork, and professionalism. Assessment was provided by the mentor. Training and example assessment was provided to mentors to improve grading reliability. Mean score on this assessment was 13.9 +/- 0.7 points out of 15 points possible. Points were most commonly deducted for unprofessional communication with the mentor (43%), inadequate background information gathered prior to meeting (29%), or failure to provide evidence that all team members were involved in the project (29%). Any subsequent, optional meetings that took place were not assessed.

Secondly, students were assessed as a team based on the webinar-style presentation. A recorded presentation was selected instead of a live presentation because in-class time for presentations was limited. The rubric focused on whether the team met enabling objectives for the project described above and their presentation skills. Assessment was provided by both the mentor and an additional course faculty member to improve grading reliability. Discrepancies were resolved by consensus and

summative feedback from both individuals was provided to students. Training sessions and examples of completed rubrics were provided to all graders. Detailed results from this assessment are provided in Table 2. The mean score was 45.0 +/- 2.7 points out of 50 points possible.

Finally, each student was required to view and evaluate 2 other teams' projects and to complete a reflection describing what they learned from the other teams, aspects of the other teams' projects that could have improved their own, and opportunities for the other team to improve. This aspect of the project was included so students could practice providing feedback and learn about more than one MUE topic (since live presentations in front of the class were not part of the assignment). Assessment of student reflections was provided by the course coordinator. Points were deducted for failure to respond to reflection prompts. The median score on this assessment was 10 points out of 10 points possible (median score reported due to non-normal data distribution).

Students at Manchester University Pharmacy are required to complete course and instructor evaluations for each class and all instructors teaching for at least 4 hours during the class. Due to the several different novel components of this project (ie, MUE design as a primary

Table 2. Assessment 2:MUE Proposal Presentation – Team Performance (n=14)^a

Content	Poor (n [%]) 1 point	Fair (n [%]) 2 points	Good (n [%]) 3 points
Background	0 (0)	4 (29)	10 (71)
Assumptions	0 (0)	0 (0)	14 (100)
Research question(s)	0 (0)	6 (43)	8 (57)
Study design	0 (0)	3 (21)	11 (79)
Patients	0 (0)	3 (21)	11 (79)
Endpoints	1 (7)	7 (50)	6 (43)
Resources	0 (0)	5 (36)	9 (64)
Collaborators	0 (0)	0 (0)	14 (100)
Limitations	0 (0)	4 (29)	10 (71)
Impact	0 (0)	3 (21)	11 (79)
Presentation Style	Needs improvement (n [%]) 1 point	Satisfactory (n [%]) 2 points	
Objectives	5 (36)	9 (64)	
Visual aids	3 (21)	11 (79)	
Citations	4 (29)	10 (71)	
Organization	5 (36)	9 (64)	
Transitions	5 (36)	9 (64)	
Professional language	1 (7)	13 (93)	
Team involvement	1 (7)	13 (93)	
Knowledge level	4 (29)	10 (71)	
Comfort presenting	3 (21)	11 (79)	
Pacing	3 (21)	11 (79)	

^a Assessed as a team.

objective, use of pharmacy residents as mentors, webinar-style presentations), it was determined that an additional assessment specific to this project outside normal course assessment was essential to ensure students were meeting objectives and to incorporate student input into future iterations of the project. Moreover, because the main assessment focused on teams, it was important to instructors to identify individual student-perceived achievement of learning objectives.

On both the pre- and postsurvey, students were asked to rate their level of agreement with the following statements using a 5-point Likert scale: whether students believed they met the MUE lecture objectives, and whether students felt comfortable performing the MUE team project enabling objectives (Table 3). The postsurvey included additional questions about teamwork and presentation

skills (Table 4). It was hypothesized that student perception of competency would improve for lecture objective 3 (design an effective MUE given a clinical issue) but no other lecture objectives because they were not specifically addressed by the project (but were satisfactorily addressed during lecture). It was also hypothesized that student perceptions of competency would improve for all enabling objectives for the MUE team project. Ordinal data was described using median and interquartile range (IQR). Distribution of responses was compared between the 2 surveys for each item using the Wilcoxon signed rank test for paired data. Missing data from students who completed 1 survey but not the other were excluded when calculating inferential statistics. A conservative alpha value of 0.01 was used to determine statistical significance to reduce risk for type 1 error in this non-controlled study environment. SPSS

Table 3. Student Perceptions of Lecture Objectives and Project Enabling Objectives Pre- (n=35) and PostAssignment (n=34)

Indicate your agreement with the following statements: ^a	1 or 2 (SD or D) (n [%])		3 (N) (n [%])		4 or 5 (A or SA) (n [%])		Median (IQR ^c)		P value
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
I understand the role of medication use evaluation (MUE) for improving quality in health care institutions.	0 (0)	1 (3)	4 (11)	1 (3)	31 (87)	32 (94)	4 (4 – 4)	4 (4 – 5)	0.096
I can identify clinical issues that could be good candidates for a medication use evaluation.	0 (0)	0 (0)	8 (23)	2 (6)	27 (77)	32 (94)	4 (3.75 – 4)	4 (4 – 4)	0.058
Given a clinical issue, I can design a medication use evaluation.	2 (6)	0 (0)	20 (57)	4 (12)	13 (37)	30 (88)	3 (3 – 4)	4 (4 – 4)	0.003
Based on the results of a medication use evaluation, I can identify appropriate recommendations for change.	0 (0)	0 (0)	13 (37)	2 (6)	22 (63)	32 (95)	4 (3 – 4)	4 (4 – 4)	0.011
I can list strategies to avoid pitfalls encountered in medication use evaluation.	1 (3)	2 (6)	14 (40)	4 (12)	20 (57)	28 (83)	4 (3 – 4)	4 (4 – 4)	0.11
Indicate the degree to which you feel comfortable completing the following tasks in a medication use evaluation:^b									
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	P value
Developing a research question	4 (12)	3 (9)	13 (37)	6 (18)	18 (52)	25 (73)	4 (3 – 4)	4 (3 – 4)	0.070
Selecting a study design	6 (17)	3 (9)	19 (54)	6 (18)	10 (29)	25 (73)	3 (3 – 3.75)	4 (3 – 4)	0.026
Determining patients to include and exclude	2 (6)	1 (3)	16 (46)	4 (12)	17 (49)	29 (86)	3 (3 – 4)	4 (4 – 4)	0.005
Determining what data to collect	5 (14)	0 (0)	16 (46)	4 (12)	14 (40)	39 (88)	3 (3 – 4)	4 (4 – 4)	0.003
Identifying endpoints to measure	5 (14)	2 (6)	16 (46)	4 (12)	14 (40)	28 (82)	3 (3 – 4)	4 (4 – 4)	0.033
Determining potential collaborators from other disciplines	4 (11)	1 (3)	16 (46)	3 (9)	15 (43)	30 (88)	3 (3 – 4)	4 (4 – 4.5)	0.001
Identifying study limitations	2 (6)	2 (6)	21 (60)	6 (18)	12 (34)	26 (77)	3 (3 – 4)	4 (3.5 – 4)	0.002
Stating how the results will be used	3 (9)	1 (3)	17 (49)	5 (14)	15 (43)	28 (83)	3 (3 – 4)	4 (4 – 4)	0.009

^a SD: Strongly disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly agree.

^b 1: Very uncomfortable; 2: Uncomfortable; 3: Neutral; 4: Comfortable; 5: Very comfortable.

^c IQR: Interquartile range.

Table 4. Interplay of MUE Project, Teamwork, and Presentation Skills (n=34)

Indicate your agreement with the following statements regarding teamwork in the medication-use evaluation project:^a	1 or 2 (SD or D) (n [%])	3 (N) (n [%])	4 or 5 (A or SA) (n [%])	Median (IQR^b)
Working in teams for the MUE assignment was valuable for my professional development.	3 (9)	5 (15)	26 (76)	4 (3.5 – 5)
I understood my role in my team for the MUE assignment.	2 (6)	2 (6)	30 (88)	4 (4 – 5)
My team worked cohesively on the MUE assignment.	5 (15)	6 (18)	23 (67)	4 (3 – 5)
Our MUE presentation represented a true group effort.	3 (9)	8 (24)	23 (67)	4 (3 – 5)
I am confident working in teams in pharmacy school.	3 (9)	4 (12)	27 (79)	4 (4 – 5)
I will be confident working in teams after graduation.	0 (0)	4 (12)	30 (88)	4 (4 – 5)
I learned from peers within my team.	2 (6)	5 (15)	27 (79)	4 (4 – 5)
I learned from peers from other teams when viewing their projects.	0 (0)	7 (21)	27 (79)	4 (4 – 5)
Indicate your agreement with the following statements regarding presentation skills in the medication-use evaluation project. The project helped me improve in^a:				
Developing visual aids (ie, PowerPoint slides)	0 (0)	5 (15)	29 (76)	4 (4 – 4)
Providing appropriate citations	0 (0)	4 (12)	30 (89)	4 (4 – 4.5)
Organizing presentation content	0 (0)	3 (9)	31 (91)	4 (4 – 5)
Gaining self-confidence in verbal presentations	0 (0)	4 (12)	29 (85)	4 (4 – 5)
Pacing in verbal presentations	1 (3)	6 (18)	27 (80)	4 (4 – 4)
Presenting verbally as a team	0 (0)	5 (15)	29 (85)	4 (4 – 5)

^a SD: Strongly disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly agree.

^b IQR: Interquartile range.

Statistics version 21 (IBM Corp., Armonk, NY) was used to calculate inferential statistics.

In the second survey, students were also asked to use 5-point Likert scales to rate the use of teams in the project and the impact of the project on presentation skills. Individual items were developed based on similar published reports of pharmacy student team projects.¹⁹⁻²¹ It was of particular importance to gather data regarding presentation skills since the students would not have the experience of presenting the project in front of a live audience. Descriptive statistics were used to analyze results.

Thirty-five of 62 students completed the preassignment (response rate 56.5%) and 34 of 62 students completed the postassignment (response rate 54.8%) surveys, respectively. Results for items on both surveys are provided in Table 3. Students perceived improved ability to design an MUE as measured on the 5-point Likert scale from the preassignment survey to the postassignment survey (median 3 [IQR 3–4] vs. 4 [IQR 4–4]; $p=0.003$). Students also reported improved comfort from the

preassignment survey to the postassignment survey in the following skills: determining patients to include and exclude (median 3 [IQR 3–4] vs 4 [IQR 4–4]; $p=0.005$), determining data to collect (median 3 [IQR 3–4] vs 4 [IQR 4–4]; $p=0.003$), determining potential collaborators (median 3 [IQR 3–4] vs 4 [IQR 4–4.5]; $p=0.001$), identifying study limitations (median 3 [IQR 3–4] vs 4 [IQR 3.5–4]; $p=0.002$), and stating how results may be used (median 3 [IQR 3–4] vs 4 [IQR 4–4]; $p=0.009$) as measured on the 5-point Likert scale. Student perceptions of the interplay among the MUE team project, teamwork, and presentation skills are provided in Table 4. Median response to all items was 4, suggesting most students agreed that the teamwork and presentation aspects of the project were perceived to be beneficial.

DISCUSSION

Our results suggest that this team project and associated instruction allowed students to meet the objective of designing a MUE. Student perception of their ability to

design an MUE and comfort in performing specific enabling skills, for the most part, agree with this finding. Finally, it was identified that students found the teamwork aspect of the project beneficial and that the project helped them develop presentation skills. In addition to addressing the specific skill of MUE design with a CAPE subdomain of medication use management, this assignment represented an intersection of higher level subdomains such as innovation and professionalism.

Scores on the project were relatively high, with central measurements of about 14/15, 45/50, and 10/10 on the mentor meeting, presentation, and peer evaluation, respectively. There are likely many factors that contributed to high scores including the use of pharmacy residents for grading, especially for the mentor meeting as this component only had one grader, the use of teams secondarily balanced for GPA, and the high amount of mentorship provided to students for this activity. Training sessions, detailed rubrics, example assessments, and duplicate graders all likely improved grading reliability; however, there were anecdotal student comments that graders should have been better trained. There was some concern expressed by students that non-drug topics might be more open-ended and therefore more challenging than drug topics. We found scores were similar between drug and non-drug topics.

We hypothesized that students would be more likely to agree that they could successfully design an MUE after completing the team project, but that results for other lecture objectives would be unchanged because the project was not designed to give students practice in skills such as forming recommendations based on results or preventing common MUE pitfalls such as lack of ownership. Accordingly, students reported improved confidence only in MUE design and not other objectives. It was also hypothesized that students would improve in comfort performing all MUE enabling skills. Students reported perceiving improvement in most skills except developing a research question, selecting a study design, and determining appropriate endpoints. Improvement may not have been perceived in the first of these as that skill had already been practiced during lecture activities. Interestingly, determining appropriate study designs and endpoints was also an area of lower student performance according to item analysis of the presentation rubric. This was not surprising because students had not taken the required, 2-credit hour course in drug literature evaluation at this point in the curriculum.

This study probed the interplay of the MUE project, team work, and presentation skills. While the typical student appreciated the use of teams in this assignment, there was a minority who did not find this aspect of the project to be beneficial. Anecdotal student comments on course

evaluations underscored this theme. Considering that the project was only 4 weeks long, students may have not had enough time to fully develop into their particular role in the team. Team cohesiveness and fair distribution of work appeared to be somewhat problematic. Students appeared to find the project valuable for developing their presentation skills, and this was not surprising given that most groups received feedback regarding opportunities for improvement on at least 3 items on the presentation rubric.

Several approaches to teaching MUE have been described. Timpe, Motl, and Eichner suggested integrating MUE as part of a series of in-class activities intended to improve students' performance in drug information-related skills.¹⁶ Similar to our project, students were asked to complete the activity following a didactic lecture; however, this example differed from ours in that students were asked to collect and analyze data rather than participate in design. Gauthier and Morrison described conducting an MUE from start to finish as a required component of an elective clinical track.¹⁴ A similar track and MUE-related activity is being considered at Manchester University Pharmacy. Finally, Warholak described a similar team project where students worked with an experiential preceptor to conduct and present a quality assurance project.¹⁵ This project had similar goals and made use of community mentors; however, topics were more focused on medication error reduction and quality assurance from an operations standpoint. This project had the added benefit of providing students with the opportunity to work on a project directly benefiting a practice site. While our project lacked this admirable component, use of simulated problems will likely be easily sustainable and require less of a commitment from external partners.

There are some important limitations of this project. First, the project only addressed MUE design. Other significant aspects of MUE that could be incorporated into future projects include data collection, analysis, reporting, and dissemination.^{1,15} While our project allowed students to satisfy our local program outcome, these other skills may need to be considered in future iterations of the project. Secondly, while students found the recorded presentation to benefit their development, the carefully controlled environment of a prerecorded webinar may not have been analogous to the pressures and other variables involved in a live presentation. Finally, the assigned topics were variable in order to minimize duplication of work among teams, but this could have also contributed to variability in the rigor of the project.

With regard to the study itself, two primary limitations were the response rate and use of student perceptions data. While our response rate was approaching 60%, it

was disappointing that many students chose not to provide feedback at one or both opportunities. It is possible that the voluntary nature of the survey attracted only more engaged or opinionated individuals. Whether that would increase or decrease perceived project effectiveness was uncertain. Additionally, use of student perceptions data as a sole assessment endpoint could be problematic, but it became more useful paired with the more objective, rubric-based assessment provided by faculty.

In future years, several changes will be considered regarding this project. First, because significant time outside of class was needed to provide a full briefing on the goals and expectations of the project, the preproject MUE lecture will likely be expanded from 1 to 2 hours. This will also provide more in-class practice so students are better prepared for their first mentor meeting. Anecdotal comments suggest students would agree with this change. Additionally, greater focus will likely be placed on selecting a study design and appropriate endpoints based on project scores and student perceptions. While overall the use of teams appeared to be successful, the faculty will consider the addition of a peer assessment component of the project to better address student-perceived issues of cohesion and fairness of workload distribution. Models for achieving successful peer feedback are available in the pharmacy education literature.^{22,23} Formation of teams incorporating students with different strengths was expected to help reduce these issues; however, anecdotal feedback from students suggested that several teams struggled in these areas. The process for developing teams could also be reexamined.

SUMMARY

Our results suggest that this team project and associated instruction allowed students to meet the objective of designing a MUE. Student perception of their ability to design an MUE and comfort in performing specific enabling skills, for the most part, confirm this finding. Finally, it was identified that students found the teamwork aspect of the project beneficial and that the project helped them develop presentation skills. Several changes to the project will be considered including more emphasis on selecting a study design and endpoints and using peer feedback within teams.

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