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INSTRUCTIONAL DESIGN AND ASSESSMENT

Using Simulation to Improve First-Year Pharmacy Students' Ability to Identify Medication Errors Involving the Top 100 Prescription Medications

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Objective. To evaluate first-year pharmacy students' ability to identify medication errors involving the top 100 prescription medications.

Design. In the first quarter of a 3-quarter pharmacy self-care course, a didactic lecture on the most common prescribing and dispensing prescription errors was presented to first-year pharmacy students (P1) in preparation for a prescription review simulation done individually and as a group. In the following quarter, they were given a formal prescription review workshop before a second simulation involving individual and group review of a different set of prescriptions. Students were evaluated based on the number of correctly checked prescriptions and a self-assessment of their confidence in reviewing prescriptions.

Assessment. All 63 P1 students completed the prescription review simulations. The individual scores did not significantly change, but group scores improved from 79 (16.2%) in the fall quarter to 98.6 (4.7%) in the winter quarter. Students perceived improvement of their prescription checking skills, specifically in their ability to fill a prescription on their own, identify prescribing and dispensing errors, and perform pharmaceutical calculations.

Conclusion. A prescription review module consisting of a didactic lecture, workshop and simulation-based methods to teach prescription analysis was successful at improving first year pharmacy students' knowledge, confidence, and application of these skills.

Keywords: Simulation, Prescription Accuracy, Medication Errors, Pharmacy

INTRODUCTION

The Council on Credentialing in Pharmacy defines the mission of the pharmacy profession as the improvement of "public health through ensuring safe, effective, and appropriate use of medications."[1] Reviewing prescription accuracy is a fundamental pharmacist responsibility to achieve safe medication use that is recognized within the United States and internationally.[2,3] However, 2% of prescriptions result in medication errors,[4,5] and 28% of prescription errors can result in harm to the patient.[6] The most common error reported is medication selection[7] within the pharmacy.

The Accreditation Council for Pharmacy Education (ACPE) Standards and the Center for Advancement of Pharmacy Education (CAPE)[8,9] Educational Outcomes require that pharmacy school curricula provide education and ensure competency in the area of accurate medication prescription review and preparation. The ACPE Standards include education and training in the areas of mathematical skills for accurate preparation of prescriptions, "identification and prevention of medication errors," and "assurance of safety in the medication-use process."[8] In addition, ACPE states that education should involve active learning to help pharmacy students mature in their problem-solving skills.[8] The North American Pharmacist Licensure Examination (NAPLEX) also tests prospective pharmacists' ability to review medication prescriptions accurately "in a manner that promotes safe and effective use."[10]

St. Louis College of Pharmacy conducted a survey of both hospital and community pharmacists in which prescription interpretation and verification was identified as one of the most important skills.[11] Initial studies in the area of prescription review in pharmacy school curricula demonstrated that with the use of active-learning techniques such as role playing and simulations, students perform better when required to identify and correct the prescription error rather than identifying the error alone.[12,13] Furthermore, students' awareness of their role in preventing medication errors increased as a result of taking the medication safety laboratory sessions.[13] Computer-based modules[2,3,14] and "mock pharmacy"[12] techniques have also been identified as modes to further enhance active learning.

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At the University of California, San Diego (UCSD) Skaggs School of Pharmacy and Pharmaceutical Sciences (SSPPS), the first-year curriculum includes a Pharmacy Practice course that focuses on therapeutics of self-care diseases and introduces the top 100 prescription medications. Based on the ACPE Standards and CAPE Outcomes, the course co-chairs recognized a need to standardize curricula on prescription review using a combination of a didactic lecture, workshop, and individual and group simulation exercises.

DESIGN

The objective of this study was to determine the effect of a prescription review module on first year pharmacy students' ability to identify and correct prescribing and dispensing medication errors involving the top 100 medications (Figure 1). In the fall quarter, students completed a baseline knowledge and confidence survey, a didactic lecture, individual and group simulations on prescribing and dispensing medication errors involving the top 40 medications, and a postknowledge and confidence survey. In the winter quarter, students participated in a hands-on workshop, followed by individual and group simulations on prescribing and dispensing medication errors involving the top 80 medications (40 previous top medications plus 40 new medications), and another postconfidence survey. The top 100 medications were adapted from The Top 200 Prescriptions as published in *2012 Drug Topics*.[15]

The prescription review exercises were conducted in the first and second quarters of the required Pharmacy Practice course for first-year pharmacy students. This 3-quarter course focuses on self-care management, the top 100 drugs, pharmaceutical calculations, and patient communication and counseling through lectures, workshops, and conferences. The development of a prescription review component for the course stemmed from a need for more standardized instruction in the basics of community pharmacy practice before students start their introductory pharmacy practice experiences (IPPE) and internships. It was also viewed as an opportunity to cumulatively emphasize material such as pharmaceutical calculations, medication therapeutics, and pharmacy law.

In the fall quarter, students were asked to complete two ungraded questionnaires prior to the prescription exercise activities. The first questionnaire was intended to evaluate the students' baseline knowledge of prescription processing (Appendix 1). This knowledge-based questionnaire was comprised of seven multiple-choice questions that incorporated key concepts from the top 100 drugs, pharmacy law, and calculations, all of which the students had been exposed to in different areas of their curriculum. The second questionnaire was focused on the students' self-assessment of their baseline confidence regarding prescription review (Appendix 2). This self-assessment survey included 13 multiple-choice questions regarding the students' prior pharmacy experience, preferred learning format, and self-assessment of their baseline prescription review skills.

The students then attended a 90-minute lecture that covered the required components of prescriptions per California law, including controlled substances, common causes of prescribing and dispensing medication errors, and examples of poorly written prescriptions. During the lecture, students were asked to verbally identify missing or erroneous components of the example prescriptions. They were also reminded to review the top 40 medications for the prescription review simulation. Preparation beyond the lecture was left to the discretion of each student.

Four weeks after the prescription review lecture, students were asked to complete a simulation in which they checked five prescriptions based on the top 40 drugs, first individually and then as a group. Six sets of prescription stations were set up in separate video-monitored rooms within

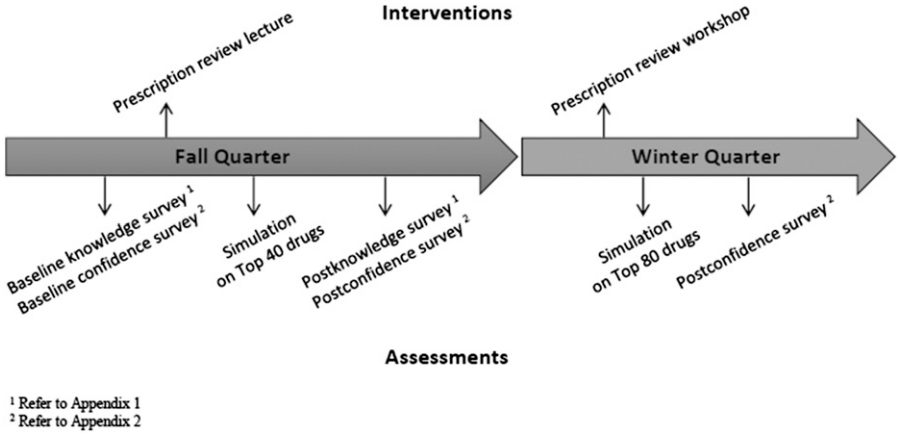

Figure 1. Prescription module timeline.

the school's simulation center. Students were randomly assigned into 18 groups, consisting of 3-4 students in each group. Six of the eighteen groups were rotated through the simulation at a time in 30-minute blocks, allowing for 63 students to complete the simulation within 90 minutes.

For the first 20 minutes of the simulation, students worked individually to review the five prescriptions. Each student was given a worksheet with one multiple-choice question for each prescription. Scantron (Scantron Corporation; Eagan, Minnesota) sheets were used to collect answers for the individual exercises. Students were assigned to start at a specific prescription station (#1-5) and given four minutes at each station to individually review a hardcopy of the prescription, stock bottle and labeled bottle for dispensing, and to answer a multiple-choice question identifying the source of the error(s), if any existed. One of the prescription stations also included a drug information reference that the students could use to calculate and check the correct dose for a given indication. The prescriptions included one or more errors related to the dispensing of the prescription: incorrect brand to generic conversion, incorrect stock bottle selection, different medication in the dispensed bottle vs the stock bottle, incorrect directions, or quantity, strength, or calculation errors. Errors related to prescribing medication included incorrect medication, incorrect indication, and incorrect number of refills. Students were directed to rotate to the next prescription station every four minutes until all five prescriptions were completed.

Following the individual simulation, students joined their assigned groups and were given 10 minutes to review the same set of prescriptions. Immediate Feedback-Assessment Technique (IF-AT)[16] cards were chosen for the group simulation so that the groups could see when the correct answer was chosen. The benefits of the IF-AT are that the system provides immediate affirmative feedback (if answer choice is correct) and/or corrective feedback (if answer choice is incorrect). We chose the IF-AT because we wanted to encourage the groups of students to continue answering a question until they discovered the correct answer and to discuss the correct answer in their group. After completion of the individual and group simulations, the entire class debriefed with the course chairs to review the identified errors and how to correct them.

The simulation was graded based on the students' individual (70%) and group performance (30%). Using the IF-AT scoring system, groups were given maximum credit if they chose the correct answer first, followed by decreasing degrees of partial credit depending on how many attempts it took them to identify the correct answer. The exercise was included as part of the total course grade to encourage participation, but given minimal weight since this was a pilot project. After the exercise, the students were asked to complete the same online knowledge and confidence questionnaires to compare their self-assessments before and after the prescription simulation. Additional questions regarding the impact of the prescription review module and student feedback were also included.

A second prescription exercise focusing on the top 80 drugs was conducted in the winter quarter of the Pharmacy Practice course. In keeping with a cumulative approach, students were tested on the top 80 drugs. Selected concepts from the fall quarter, such as pharmacy calculations and common prescription errors, were integrated into the questions to reinforce content. In addition, questions also reviewed pharmacy law related to the dispensing of controlled substances and introductory therapeutics knowledge of prescription medications students had been taught (eg, insulin). Based on the experience from the fall quarter, several changes were implemented.

In the winter quarter, a 60-minute workshop facilitated by four faculty members was provided instead of a didactic lecture. Community and hospital pharmacists were invited to the prescription review workshop to provide clinical pearls on their experience reviewing prescriptions and avoiding errors. The workshop focused on reviewing six prescription examples written in the same format as the upcoming simulation. Students were given worksheets with images of the hardcopy prescription, transcribed label, and a corresponding multiple-choice question to identify the error(s), if any existed. In addition to the transcribing and filling errors emphasized in the fall quarter, students were asked to recognize errors in the original written prescription, particularly for controlled substances. The types of errors highlighted in the workshop examples were similar to those tested in the final simulation. Students were given several minutes to review the prescription on their own before opening the discussion to the entire class. Preparation beyond the workshop was again left to the discretion of each student.

One week after the prescription review workshop, students completed a summative simulation in which they had to check six prescriptions based on the top 80 drugs. Similar to the fall quarter, students first answered a multiple-choice question for each prescription individually and then as a group. The format of the multiple-choice answers was revised so that the wording was consistent between questions. One of the six prescriptions was filled correctly. For the prescriptions that contained multiple errors, only one error was offered as an answer option (instead of K-Type questions with multiple options). Students were given additional time (30 minutes individually and 20 minutes as a group) to complete the simulation

because of the increasing complexity of the questions. Pictures of the prescriptions, labels, stock bottles, and medications were used instead of the actual products because the prescriptions included controlled substances and it was not feasible to fill these types of prescriptions. Use of pictures instead of actual medications allowed for more students to cycle through the simulation at one time and significantly reduced the cost of supplies overall. In addition, using the worksheet permitted students to budget their own time and work through the six prescriptions in any order. The student groups were also combined into a larger classroom that could accommodate about 30 students at a time, rather than six separate rooms. This allowed for one faculty member to facilitate the examination and provide consistent responses to questions.

After the exercise, the students completed the same ungraded, online confidence questionnaire to compare the self-assessments of their prescription review skills after each simulation in the fall and winter quarters. Additional questions regarding the workshop impact and student feedback were also included.

To assess the impact of the fall quarter didactic lecture and winter quarter hands-on workshop, individual and group student performance checking prescriptions in a simulation was compared to the conclusion of each quarter. An online self-assessment survey was used to elicit student perceptions of the prescription module and its effect on the students' performance. Prescription simulation scores and self-assessment survey responses were de-identified and analyzed. Descriptive statistics are reported. A student *t* test for paired data was used for continuous data. Categorical data was transformed to a numeric scale (−2 to +2...), strongly disagree to strongly agree, respectively). Wilcoxon signed rank test for paired data was applied to determine the impact of the workshop on prescription checking and self-assessment survey responses. The study was approved by our institutional review board.

EVALUATION AND ASSESSMENT

Demographic information on the students is summarized in Table 1. The first-year class consisted of 63 students who were 22.2 years of age and 38% were male. Eighty-three percent of students reported some exposure to the practice of pharmacy prior to entering pharmacy school. The majority of the experience occurred in the community (50%) or hospital pharmacy (22%) setting. Approximately 17% of students reported working as a pharmacy technician prior to entering pharmacy school. The average length of time of pharmacy experience was 3.7 (1.4) months.

The results of a multiple-choice questionnaire on basic prescription checking knowledge was 33.9 (19.4%) in the fall quarter prior to any formal training, and this increased to 49.3 (19.6%) after the didactic lecture about checking prescriptions (Table 2). Students scored well individually and in a groups in terms of checking prescriptions in each simulation. The individual scores were 84.1 (21.9%) in the fall quarter and 86.4 (13.9%) in winter quarter. However, this improvement was not significant ($p=0.53$) (Table 3). In contrast, the group scores significantly improved from fall to winter quarter [79.1 (16.2%) to 98.6 (4.7%), $p<0.001$] reflecting a possible learning curve in team roles and dynamics (Table 3).

When the students self-reflected on their prescription checking skills after completing the simulations in fall and winter quarter respectively, they reported improvements in their ability to fill a prescription (16.1% vs 28.6% strongly agreed), identify errors (12.9% vs 31.2% strongly agreed), apply a systematic approach to checking prescriptions (14.5% vs 22.6% strongly agreed), and correct errors (11.5% vs 25.4% strongly agreed) (Table 4). In terms of evaluating the prescription review module, students strongly agreed or agreed that the workshops and simulations integrated concepts in a way that facilitated

Table 1. Student Demographics

Characteristic	N (%)
Age, mean (SD)	22.2 (2.9)
Gender (male)	24 (38)
Pharmacy Experience	
Shadowing	15 (24)
Volunteer	20 (32)
Clerk	6 (10)
Technician	11 (17)
None	11 (17)
Pharmacy Experience Setting	
Community	32 (51)
Hospital	14 (22)
Clinic	2 (3)
Research	4 (6)
Other	11 (17)
Duration of Pharmacy Experience (months), mean (SD)	3.7 (1.4)

Table 2. Evaluation of Prescription Checking Knowledge Using Traditional Examination

Domain	Beginning of Fall Quarter Mean (SD)	End of Fall Quarter Mean (SD)	*p* value
Prescription checking knowledge survey			
Raw Score/7 points	2.4 (1.3)	3.5 (1.27)	<0.001
%	33.9 (19.4)	49.3 (19.6)	<0.001

Table 3. Evaluation of Prescription Checking Accuracy Using Simulation

Domain	Fall quarter Mean (SD)	Winter quarter Mean (SD)	*p* value
Prescription checking accuracy simulation			
Individual (%)	84.1 (21.9)	86.4 (13.9)	0.5
Group (%)	79.1 (16.2)	98.6 (4.7)	<0.001

retention of information from fall to winter quarter respectively (95% fall quarter vs 92% winter quarter), would improve their ability perform in the clinical settings (100% fall quarter vs 94% winter quarter), and they would recommend that more courses incorporate these types of simulation exercises (94% fall quarter vs 98% winter quarter). (Table 5).

DISCUSSION

This is the first study evaluating the effects of implementing a prescription review module comprised of a didactic lecture, workshop, and individual and group simulation exercises in a pharmacy school curriculum. Faculty members hypothesized that students' ability to identify and correctly prescribe and dispense medication errors involving the top 100 prescription medications and self-assessment of their prescription review skills would improve after completing the prescription module.

Students' individual prescription accuracy score was relatively high and consistent in the both quarters, which supports the use of simulation to assess the students' ability to identify and correct prescription errors. It also suggests that didactic lectures or hands-on workshops are similar in their effectiveness for teaching students how to check prescriptions; however, other factors should be considered. Despite an increased complexity in the winter quarter prescription simulation, students were able to maintain similar scores compared to the fall quarter. This may be attributed to a higher level of preparation gained from the workshop. In addition, students likely benefited from the knowledge gained during the fall quarter simulation experience. Immediate feedback was felt, by the course chairs, to be an important component of the prescription module to maximize knowledge gained by the students. Use of the IF-AT tool during the group simulation and faculty-led feedback with the entire class reemphasized the prescription errors and how to correct them.

An unexpected finding was that the prescription accuracy group score in the fall quarter was lower than the individual score. The group simulation component gave students the opportunity to improve their ability to work together when checking prescriptions. Once students learned how to work within a group, the benefit of a double-check system and team approach was observed. The group prescription accuracy scores improved significantly from fall to winter quarters, with group results at the end of the winter quarter surpassing individual scores. Although the goal is to develop pharmacy practitioners who can individually identify 100% of prescription errors and minimize harm to patients, mistakes still occur. These results highlight to students the value of working in a team environment and consulting with their colleagues when they are not confident in their work. Other studies evaluating pharmacy curriculum also showed team-based learning's positive impact on performance and scores.[17,18]

Based on the self-assessment knowledge questionnaire, students' general knowledge of law improved but remained less than optimal by the end of the fall quarter. In retrospect, some of the knowledge-based questions on the survey referred to information that was not reemphasized in the prescription review module. Although, the Law and Ethics course runs simultaneously with Pharmacy Practice in the fall quarter, students were not able to integrate and apply information received from two separate courses when asked about general concepts related to checking a prescription. Despite this, students were able to perform at a high level when presented with prescriptions for review in a simulated setting. This may support the role of simulation as a summative activity for prescription review vs conventional examinations. However, continual development of this skillset is more likely with longitudinal activities.[19] Curriculum assessment to identify and align course material to enable progressive development of general prescription review knowledge and skills would be ideal.

The students' self-assessment about their prescription review skills improved significantly in many areas. Students felt more comfortable with filling a prescription, identifying and correcting errors, and performing pharmaceutical calculations over the span of two quarters. Perhaps as students gained confidence in their knowledge and communication skills, this translated to their group performance and the improved prescription accuracy group scores seen in the winter quarter. The implementation of a prescription review module appears to be significant to the students' perception and confidence in their performance, and supports continued development within the curriculum.

We encountered several barriers while implementing the prescription review module within the first-year Pharmacy Practice self-care curriculum. There is a lack of validated prescription review assessments available to pharmacy faculty members. We developed prescription review simulations based on the most common medications involved in prescription errors[20] and the types of errors reported by community pharmacists.[21] Additionally, we used standardized testing guidelines for writing multiple-choice questions.[22] Ideally, we would like to

Table 4. Student Self-Evaluation Confidence Survey Results

Domain	Fall Quarter N (%)	Winter Quarter N (%)	*p* value
I can accurately fill a community prescription on my own.	N=62	N=63	
Mean (SD)	0.8 (0.8)	1.2 (0.6)	
(2) Strongly Agree	10 (16.1)	18 (28.6)	
(1) Agree	34 (54.8)	40 (63.4)	
(0) Neutral	12 (19.4)	4 (6.3)	
(-1) Disagree	6 (9.7)	1 (1.6)	
(-2) Strongly Disagree	0 (0)	0 (0)	<0.001
I can identify errors when reviewing a community prescription that has been filled for me to check.	N=62	N=63	
Mean (SD)	0.7 (0.9)	1.2 (0.6)	
(2) Strongly Agree	8 (12.9)	19 (31.2)	
(1) Agree	36 (58.1)	36 (57.1)	
(0) Neutral	10 (16.1)	8 (12.7)	
(-1) Disagree	8 (12.9)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	<0.001
I apply a systematic approach when checking community prescriptions to minimize medication errors.	N=62	N=62	
Mean (SD)	0.6 (0.9)	0.8 (0.8)	
(2) Strongly Agree	9 (14.5)	14 (22.6)	
(1) Agree	30 (48.4)	27 (43.5)	
(0) Neutral	15 (24.2)	18 (29)	
(-1) Disagree	8 (12.9)	3 (4.8)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.049
I know how to correct errors that I find when checking a community prescription.	N=61	N=63	
Mean (SD)	0.7 (0.8)	1.1 (0.6)	
(2) Strongly Agree	7 (11.5)	16 (25.4)	
(1) Agree	33 (54.9)	40 (63.5)	
(0) Neutral	15 (24.6)	17 (27)	
(-1) Disagree	6 (9.8)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	<0.001
I can accurately perform calculations needed to fill a community prescription.	N=61	N=63	
Mean (SD)	1.3 (0.6)	1.4 (0.7)	
(2) Strongly Agree	21 (34.4)	29 (46)	
(1) Agree	35 (57.4)	29 (46)	
(0) Neutral	5 (8.2)	4 (6.3)	
(-1) Disagree	0 (0)	1 (1.6)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.28
I feel that participating in hands-on activities like workshops and simulation exercises will better prepare me for my future pharmacy practice vs didactic lectures alone.	N=61	N=63	
Mean (SD)	1.7 (0.5)	1.6 (0.6)	
(2) Strongly Agree	41 (67.2)	41 (65.1)	
(1) Agree	19 (31.1)	19 (30.2)	
(0) Neutral	1 (1.6)	3 (4.8)	
(-1) Disagree	0 (0)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.56

validate the prescriptions used in the simulations in subsequent cohorts of students and develop a testing bank for random selection in the future.

An additional barrier was supplying the actual medications for the simulations. Our affiliated medical center was able to help us order noncontrolled medications for the

Table 5. Student Evaluation of the Simulation Exercises

Domain	Fall Quarter N(%)	Winter Quarter N(%)	*p* value
The prescription review exercise integrated previously learned concepts in a way that will help me remember.	N=62	N=63	
Mean (SD)	0.1 (0.6)	0.1 (0.6)	
(2) Strongly Agree	30 (48.4)	35 (55.6)	
(1) Agree	29 (46.8)	23 (36.5)	
(0) Neutral	2 (3.2)	5 (7.9)	
(-1) Disagree	1 (1.6)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.52
Participation in simulation exercises will better prepare me for my internships or practice experiences than didactic lectures alone.	N=62	N=61	
Mean (SD)	1.7 (0.5)	1.7 (0.5)	
(2) Strongly Agree	45 (72.6)	44 (72.1)	
(1) Agree	17 (27.4)	15 (24.6)	
(0) Neutral	0 (0)	2 (3.3)	
(-1) Disagree	0 (0)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.62
If given the choice, I would prefer more courses with simulation activities or exercises.	N=62	N=62	
Mean (SD)	1.5 (0.7)	1.4 (0.8)	
(2) Strongly Agree	39 (62.9)	34 (54.8)	
(1) Agree	19 (30.6)	20 (32.2)	
(0) Neutral	3 (4.8)	7 (11.3)	
(-1) Disagree	1 (1.6)	1 (1.6)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.07
I would recommend this type of simulation IPPE[a] to other pharmacy students.	N=62	N=63	
Mean (SD)	1.8 (0.5)	1.7 (0.5)	
(2) Strongly Agree	50 (80.6)	46 (73)	
(1) Agree	10 (16.1)	16 (25.4)	
(0) Neutral	2 (3.2)	1 (1.6)	
(-1) Disagree	0 (0)	0 (0)	
(-2) Strongly Disagree	0 (0)	0 (0)	0.34

[a]IPPE=introductory pharmacy practice experience

fall quarter simulation, but we could not provide controlled substance products for review in the winter quarter. Instead, we provided pictures of the tablets, prescriptions, labels, and bottles as an alternative for the controlled substances. This minimized supply expenses while still exposing students to a standardized experience checking controlled substance prescriptions, emphasizing the application of pharmacy law such as security prescription requirements and refill restrictions.

An additional consideration for other schools of pharmacy seeking to incorporate a prescription review module into the curriculum is that our class size is limited to approximately 60 students. In schools with larger classes, this curriculum may be more difficult to organize, but could be accommodated by having more prescription review stations. The logistical and financial burden of creating additional checking stations may be minimized with the use of product pictures or online programs.[2,14] Online programs could additionally be used to supplement scheduled curricular activities by providing extra practice exercises for students to complete on their own time.[2,3] We would not recommend increasing the group size or decreasing the prescription review time for the initial simulation. However, review time may be shortened if students are able to advance their skills through a longitudinal experience provided during their preclinical years.

In addition to the barriers of implementing our prescription review module, there were a few limitations to the study. First, we only assessed first-year pharmacy students from the beginning of the fall quarter to the end of the winter quarter. Because students have not participated in IPPEs at this point in their curriculum, the assessments used in this study should reflect the impact of the prescription module. However, students had varying degrees of baseline skills as a result of their prior experience and knowledge from working in different pharmacy settings before school. The timing of the

prescription review module minimized the impact of IPPE experiences on the students' scores, but it is possible that the results would have been more pronounced if the follow-up assessment occurred at the conclusion of the first year with a 3-quarter module.

A second limitation of this study is that students were not familiar with the simulation environment or group work, which may have impacted the initial prescription accuracy group scores observed in the fall quarter. Additionally, in the fall quarter, there were four weeks between lecture and simulation versus one week between intervention and simulation in the winter quarter. The time difference between intervention and assessment in the two quarters may have impacted the results. We also acknowledge that sequence bias may have impacted the difference in results between quarters. Repeated assessment of our process, evaluating the workshop and lecture intervention separately over time, or providing an introduction to the dynamics of group work may help to minimize this bias in the future.

As a result of this study, we have modified the didactic lecture to incorporate more information about developing a systematic approach to checking prescriptions and the application of pharmacy law. Based on the positive feedback from the students, we have not only continued this prescription review curriculum in the fall quarter, but are also actively developing workshops for all three quarters with expanded components such as reviewing a patient's profile and prescription history, evaluating drug-drug interactions, using drug information resources, and making prescriber interventions. Expanding this prescription review module to occur over the entire first year of pharmacy school will allow for longitudinal development of key skills for prescription review. Students can then apply this foundational knowledge to their IPPEs, which may enable them to apply their skills with greater depth.

SUMMARY

Implementing a module comprised of a didactic lecture, workshop, and simulations to teach and assess prescription review was successful at improving first-year pharmacy students' knowledge, confidence, and application of these skills. We hope to expand the prescription review module beyond the first-year curriculum to apply knowledge of pharmacy law and therapeutics to more advanced level of prescription review, including hospital-based orders. Expanded longitudinal exposure to prescription review and assessment throughout the preclinical years would support continued growth of this essential pharmacist skillset.

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Appendix 1. SPPS 201 Prescription Review Community pharmacy knowledge Pre/Post Questionnaire

Instructions: You will have 15 minutes to complete this 7-question, multiple-choice questionnaire. Please choose the single best answer for each question. Your answers will be scored to improve this exercise in the future and will NOT be part of your course grade. Thank you for your participation!

1. Which of the following statements about dispensing community prescriptions is CORRECT?
   a. The expiration date on the medication label should match the date on the stock bottle
   b. The indication or purpose for which the drug was prescribed must be included on the medication label
   c. If the strength on the original prescription is not in stock, the pharmacist can substitute a different form of the medication without calling the prescriber
   d. A prescription with "PRN refills" can be filled for up to one year from the original date it was written without contacting the prescriber
   e. If the prescription indicates that substitution is allowed, the pharmacist can substitute a generic product for the brand name without notifying the prescriber or patient
2. Mr. Patient comes to your pharmacy to fill a prescription for Coumadin 2.5 mg PO QD #30 with 1 refill for his wife, Mrs. Patient. The technician fills the prescription with the following label:
   "Warfarin (Coumadin) 2.5 mg tablets – Take 1 tablet once daily, quantity 30 with 1 refill."
   Which of the following statements regarding this prescription fill is CORRECT? (Note: assume that other elements of the prescription fill not specifically mentioned are done correctly)
   a. The pharmacist should confirm that generic substitution is allowed before dispensing the prescription
   b. To reduce cost, the pharmacist should dispense 5 mg tablets and advise the patient to cut them in half
   c. The pharmacist should make sure that the prescription bottle label is written for Mr. Public
   d. The pharmacist should check the stock bottle label to confirm that the correct drug and strength is dispensed
   e. The prescription is filled correctly and can be dispensed as is
3. Which of the following items is NOT required when filling a prescription?
   a. The dispensing pharmacist initials on the filled prescription
   b. The brand or manufacturer's name on the prescription label if dispensing a generic
   c. Name of the prescriber on the prescription label
   d. Duration of therapy on the prescription label
   e. Description of the medication on the prescription label
4. Which of the following statements regarding community pharmacy practice is CORRECT?
   a. The maximum amount of pseudoephedrine that can be purchased nonprescription in one transaction is 9 grams
   b. Pharmacists are required to provide patient counseling when dispensing prescriptions (new and refills)
   c. Oral medications should be dispensed in a child-resistant container unless the patient requests easy open caps (orally or written)
   d. Pharmacists who complete an immunization program can provide immunizations anywhere
   e. Pharmacists can adjust the prescription quantity to ensure a 1-month supply without contacting the prescriber
5. Which of the following consultation items listed below is NOT mandatory by law (eg, the pharmacist can use their discretion as to whether or not the patient needs to be consulted on that information)?
   a. Directions for use
   b. The importance of compliance with the directions
   c. Significant or common severe side effects
   d. Directions for storage
   e. What to do if a dose is missed

6. Which of the following medication pairs are CORRECTLY matched?
    a. Hydrocodone with APAP/schedule CII
    b. Esomeprazole/Histamine-2 (H2) blocker
    c. Levothyroxine/antidepressant
    d. Zestril/antihypertensive
    e. Desyrel/duloxetine
7. Which of the following unit conversions or abbreviation definitions is CORRECT?
    a. 1 tsp=15 mL
    b. 30 mL=1 ounce
    c. OD=left eye
    d. 10 lbs=2.2 kg
    e. AC and HS=with meals and at bedtime

Appendix 2. SPPS 201 Prescription Review Community Pharmacy Confidence Presurvey

Instructions: You will have 20 minutes to complete this 13-question survey. Please choose the single best answer for each question based on how you currently assess your own skills. Your answers will be recorded to improve this exercise in the future and will NOT be part of your course grade. Thank you for your honesty and participation!

1. Please describe your pharmacy experience prior to starting school (check all that apply)
    a. I shadowed a pharmacist(s)
    b. I volunteered in a pharmacy
    c. I worked as a pharmacy clerk
    d. I worked as a pharmacy technician
2. Please describe the setting in which your pharmacy experience took place (check all that apply)
    a. Community (retail or independent) pharmacy
    b. Ambulatory care (clinic) pharmacy
    c. Hospital (inpatient) pharmacy
    d. Research
    e. Other
3. Approximately how long did you actively volunteer or work in a community pharmacy prior to starting school?
    a. I did not volunteer or work in a community pharmacy
    b. <3 months
    c. 3-6 months
    d. 6-12 months
    e. >1 year
4. Which of the following learning formats do you prefer? You may select more than one option if applicable
    a. Didactic lectures
    b. Hands-on workshops or activities
    c. Simulation (interacting with standardized patients)
    d. Online teaching modules
    e. Self-study

For questions #5-13 below, please use the following scale for your responses: (a) strongly agree; (b) agree; (c) neutral; (d) disagree; (e) strongly disagree

5. I can accurately fill a community prescription on my own
6. I can identify errors when reviewing a community prescription that has been filled for me to check
7. I apply a systematic approach when checking community prescriptions to minimize medication errors
8. I know how to correct errors that I find when checking a community prescription
9. I can accurately perform calculations needed to fill a community prescription
10. I can effectively communicate with a patient to determine the chief complaint
11. I can develop an appropriate treatment plan for a patient with a self-care problem or issue
12. I am confident in my ability to effectively counsel a patient
13. I feel that participating in hands-on activities like workshops and simulation exercises will better prepare me for my future pharmacy practice vs didactic lectures alone

Appendix 3. SPPS 201 Prescription Review Community Pharmacy Confidence Postsurvey

Instructions: You will have 1 hour to complete this 14-question survey. Please choose the single best answer for each question based on how you currently assess your own skills. Your answers will be recorded to improve this exercise in the future and will NOT be part of your course grade. Thank you for your honesty and participation!

1. Which of the following learning formats do you prefer? You may select more than one option if applicable
    a. Didactic lectures
    b. Hands-on workshops or activities
    c. Simulation (interacting with standardized patients)
    d. Online teaching modules
    e. Self-study

For questions #2-14 below, please use the following scale for your responses: (a) strongly agree; (b) agree; (c) neutral; (d) disagree; (e) strongly disagree

2. I can accurately fill a community prescription on my own
3. I can identify errors when reviewing a community prescription that has been filled for me to check
4. I apply a systematic approach when checking community prescriptions to minimize medication errors
5. I know how to correct errors that I find when checking a community prescription
6. I can accurately perform calculations needed to fill a community prescription
7. I can effectively communicate with a patient to determine the chief complaint
8. I can develop an appropriate treatment plan for a patient with a self-care problem or issue
9. I am confident my ability to effectively counsel a patient
10. I learned things during the IPPE activities that will be useful in my practice
11. The prescription review exercise and standardized patient case integrated previously learned concepts in a way that will help me remember
12. Participation in simulation exercises will better prepare me for my internships or practice experiences than didactic lectures alone
13. If given the choice, I would prefer more courses with simulation activities or exercises
14. I would recommend this type of simulation IPPE to other pharmacy students