American Journal of Pharmaceutical Education **2013; 77 (2) Article 32.**

INSTRUCTIONAL DESIGN AND ASSESSMENT

A Prescription Analysis Exercise in a Pharmaceutical Care Laboratory Course

Jennifer A. Waitzman, PharmD, and Melissa M. Dinkins, PharmD*

UNC Eshelman School of Pharmacy, University of North Carolina, Chapel Hill, North Carolina

Submitted July 11, 2012; accepted September 26, 2012; published March 12, 2013.

Objective. To assess the impact of a new prescription analysis exercise in a second-year pharmaceutical care laboratory course.

Design. A new prescription analysis exercise was created and implemented that shifted the focus from strictly identifying errors and omissions to identifying and correcting them. Students used electronic label templates and mock prescription materials to correct various errors and omissions commonly seen in practice.

Assessment. Forty-one percent of students received full credit for the exercise using the new method compared to the previous method where 9.1% of students received full credit. Ninety-four percent of respondents preferred the new method versus the original method, with reasons given including the new method seemed more practical, applicable, and realistic.

Conclusion. The new prescription analysis exercise addressed many inconsistencies noted with the original method. Students performed better on graded assessments using the new method and preferred it over the old method of prescription analysis.

Keywords: pharmacy skills laboratory, prescription, active learning, medication safety, practice laboratory

INTRODUCTION

Medication errors are among the most common medical errors, harming at least 1.5 million people in the United States every year.[1] Medication error morbidity and mortality costs are estimated to be $77 billion per year, imposing a significant financial burden on patients and the health care system.[2] While most medication errors occur at the points of prescribing and administration,[1] pharmacists play an important role in preventing errors that occur at the point of dispensing. In the mid-1990s, there were errors with 24% of prescriptions dispensed in the community pharmacy setting.[3] Improvements in prescription dispensing systems and technology over the last 2 decades have significantly reduced dispensing errors, and a large-scale study in 2002 of both new and prescription refills dispensed in the community pharmacy setting found an error rate of just 1.7%.[4] While dispensing errors have declined drastically, with an annual prescription volume of 4 billion in the United States, pharmacists are still in a position to identify and correct 67.8 million prescription errors before they are dispensed to patients. Because pharmacists play a key role in preventing clinical and financial complications resulting from prescription errors, student pharmacists must be trained to identify and resolve medication-related problems at the points of prescribing and dispensing.

Approximately 57% of pharmacists in the United States work in community settings and 23% work in hospitals.[5] Medication dispensing is a part of the job requirement for most of these pharmacists. Furthermore, graduates who pursue an accredited residency will participate in dispensing services as a required component of their training.[6] Because prescription dispensing is a component of a majority of pharmacists' work expectations, and because it is an essential step in ensuring safe and appropriate medication use, it is important for student pharmacists to establish a process by which they can accurately and efficiently verify prescriptions. Additionally, states such as West Virginia, North Dakota, and Georgia require pharmacists to pass an errors and omissions practical as part of the licensure examination.[7-9]

Educational standards set forth by the Accreditation Council for Pharmacy Education (ACPE)[10] and the Center for the Advancement of Pharmaceutical Education (CAPE)[11] require colleges and schools of pharmacy to ensure student competencies in safe dispensing practices.

Corresponding Author: Melissa M. Dinkins, UNC Eshelman School of Pharmacy, 204 B Beard Hall, Campus Box #7574, Chapel Hill, NC 27599. Tel: 919-843-5119. Fax: 919-843-3861. E-mail: lisa_dinkins@unc.edu

*Affiliation at time of study. Dr. Waitzman's current affiliation is with Wingate University, North Carolina.

ACPE and CAPE developed competencies related to processing and dispensing prescriptions: identifying and prioritizing medication-related problems; preparing, dispensing, and administering medications to promote safe and effective medication use; and demonstrating professional accountability, responsibility, initiative, and leadership.

Pharmacy colleges and schools use a variety of approaches to achieve these goals. Several approaches have been used within the pharmaceutical care laboratory setting to train students in providing prescription-dispensing services. Purdue University School of Pharmacy implemented a laboratory session to improve first-year pharmacy students' knowledge and confidence concerning the prevention of medication errors.[12] The session focused on errors arising from incorrect or illegible prescriptions, missing information from the patient or caregiver, and incorrect filling of the prescription. The University of Toledo College of Pharmacy implemented a computer-based training module to teach students how to identify and correct prescribing errors.[13] Following completion of the module, students were better able to identify and correct such errors. Many colleges and schools purchase electronic software licenses, such as QS/1 (JM Smith Corporation, Spartanburg, SC) to simulate prescription processing and dispensing. Other colleges and schools create a "mock pharmacy," complete with shelves of medication stock bottles for students to use in prescription-filling simulations. Regardless of the teaching methods, according to a 2005 survey of practitioners associated with St. Louis College of Pharmacy, interpretation and verification of prescriptions is one of the most important skills in a successful pharmaceutical care laboratory curriculum.[14]

To prepare students at the UNC Eshelman School of Pharmacy to accurately and efficiently verify and dispense prescriptions, the Pharmaceutical Care Laboratory curriculum includes a series of hands-on learning activities in prescription analysis entitled Errors and Omissions. Errors and omissions is the process by which student pharmacists learn to verify or "check" prescription orders in the same manner as practicing pharmacists. This process involves the comparison of the final product to an original order to ensure accuracy and safety before the product reaches the patient. In spring 2012, the errors and omissions process was revised with the objectives of creating a more pragmatic simulation of prescription verification, as well as providing more timely feedback to students on their performance and increasing consistency in assessment. Following the spring 2012 semester, course coordinators compared student performance on errors and omissions to previous semesters and also conducted a questionnaire to gain student feedback on the revised process.

DESIGN

The 5-semester Pharmaceutical Care Laboratory course sequence prepares students for practice experiences and pharmacy practice, and its curriculum parallels and reinforces much of the content taught in the concurrent first-, second-, and third-year courses. The skills and content emphasized in the Pharmaceutical Care Laboratory course sequence are pertinent to providing quality patient care and prescription counseling and include compounding, prescription analysis, physical assessment, point-of-care devices, sterile technique, calculations, medical terminology, top 200 drug information, patient counseling, communication skills, and group/teamwork skills. The errors and omissions prevention/identification activities are introduced to student pharmacists during the fall semester of their first (P1) year, and they increase in difficulty as students matriculate through the curriculum.

Original Method for Errors and Omissions Prevention Training

The original errors and omissions activities (spring 2011 and fall 2011) were focused on assessing students' ability to identify the errors and omissions on a prescription product. Students were provided with a hardcopy prescription order, stock bottle or vial of product containing a picture of the product it contained, labeled bottle or vial to be dispensed with a picture of the product it contained, and an answer sheet with copies of the prescription labels and blank lines for documentation. Students were asked to write any error or omission they noted from comparing the stock bottle and labeled bottle to the original hardcopy prescription, in a specified time. Table 1 lists common errors and omissions that students were asked to identify. The number of prescriptions assessed varied from 4 to 5. As the student pharmacists became more experienced and progressed through the Pharmaceutical Care Laboratory curriculum, the allotted time for identification of errors and omissions was reduced from 3 minutes per prescription to 1.5 minutes.

During laboratory time (4-hour period), groups of 3 to 6 students rotated through the errors and omissions stations. To accommodate the large number of students in each laboratory section (approximately 50 students), 2 errors and omissions stations were prepared in separate areas of the laboratory to ensure all students had an opportunity to complete the activity during laboratory time. Teaching assistants were responsible for bringing their students to the errors and omissions stations at a time specified by the course coordinator. Each student was

Table 1. Common Errors and Omissions Found in Prescriptions

Incorrect prescriber on prescription label
Incorrect patient on prescription label
Incorrect medication name on prescription label
Incorrect strength of medication dispensed
Generic name not on prescription label
Incorrect directions on prescription label
Incorrect number of refills authorized
Incorrect quantity dispensed
Different medication in dispensed prescription bottle versus stock bottle (eg, tablets do not match)
Incorrect stock bottle used
Dispense as written for brand medication on prescription but generic dispensed in prescription bottle
Dispense as written for generic medication on prescription but brand dispensed in prescription bottle
Expired medication dispensed
Incorrect date written as compared to prescription hardcopy

provided an answer sheet and was given 1.5 to 3 minutes, depending on their level of experience in the Pharmaceutical Care Laboratory course, to list all errors and omissions on their answer sheet for the prescription product in front of them. At the end of the specified period, the teaching assistant instructed the students to rotate to the next prescription product station. Once students identified the errors and omissions for the product at each of the stations, they returned to their small laboratory group meeting space to review their answers and discuss questions with their teaching assistant.

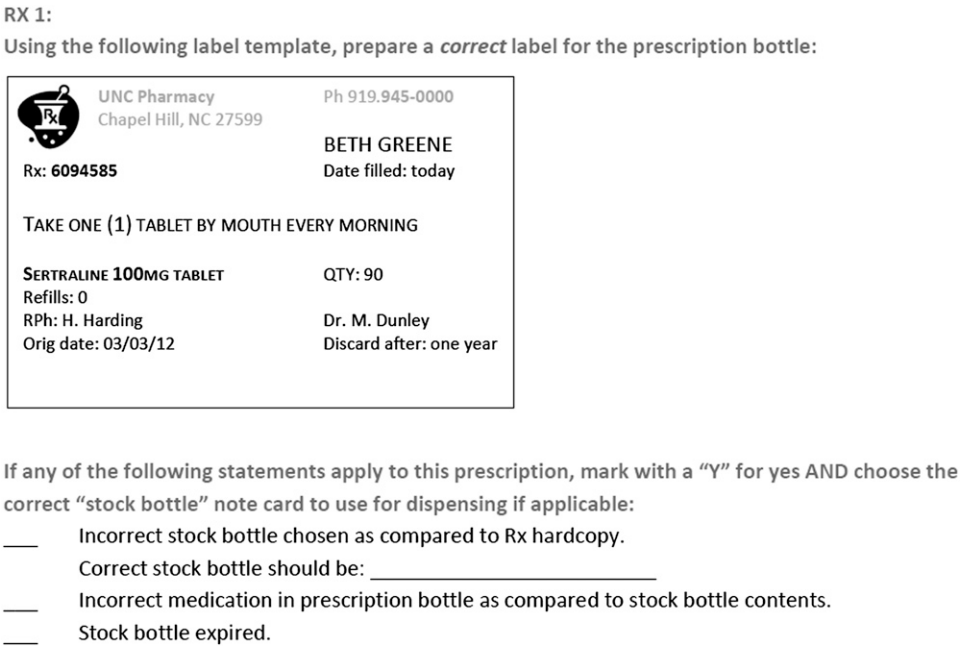
There were several insufficiencies noted with this original method of prescription analysis. Many students did not formulate efficient verification processes for checking prescriptions. Notable errors and omissions were not consistently identified, including: incorrect drug, incorrect patient, incorrect dose, and incorrect directions. There were discrepancies between students' and faculty members' wording of errors and omissions, ie, students documented the same errors but in a different way. This made grading difficult, time consuming, and inconsistent. Students received partial credit if there were multiple errors and omissions per prescription, which was not reflective of actual practice, where even 1 error can result in misinformation or harm to the patient. Feedback occurred after all students had completed the activity, and products were not available to review during this process. Additionally, students were only asked to identify errors and were not held accountable for correcting the errors. Some minor revisions were made to the original process, including providing students with a specified list of possible errors and omissions. However, the revisions did not adequately address the concerns of practicality, consistency, and efficiency that were identified with the original method.

New Method for Errors and Omissions Prevention Training

To optimize the errors and omissions activity, a revision was piloted in the fourth semester of the Pharmaceutical Care Laboratory course sequence in spring 2012. The new method shifted the focus from strictly identifying errors and omissions to identifying and correcting them. The same types of errors and omissions listed in Table 1 were assessed using the new method. This revision aimed to make the activity more representative of pharmacy practice, allowing students the opportunity to practice and develop an efficient, systematic verification process that would be graded consistently and provide real-time feedback on their performance.

In the new method, students were given a "pharmacy," which consisted of an index card box with labeled dividers separating numerous stock bottle cards. Each card had a photograph of a stock bottle on one side, a photograph of the actual contents on the other side (eg, tablets, capsules), and the product expiration date. The cards were organized alphabetically by the generic name of the drug pictured and collectively represented the stock for the entire "pharmacy." Students were provided baskets containing paper copies of the original prescription orders, stock bottle card, and labeled bottle to be dispensed with a picture of the drug inside it. Electronic answer sheets, in the form of a Microsoft Word document, were used to capture students' corrections to the prescription labels. The answer sheets contained a copy of the prescription label as well as some additional error and omission questions that could not be addressed on the label itself (Figure 1). The electronic answer sheets were displayed on desktop computers at the error and omission station.

Similar to the original method, teaching assistants brought groups of 5 students to the error and omission stations to complete the activity at a specified time during the laboratory session. Students were asked to sit in front of 1 of 5 computer terminals and were given 10 minutes to verify 3 prescriptions. Students did not rotate between prescription products. Instead, all 3 products were provided to students in a basket, and they could use the 10-minute period to check all 3 products in any order they chose. Using the electronic document, students corrected errors and omissions and prepared a final label for the product to be dispensed. Additionally, students were asked to check all stock bottle cards to ensure accuracy, and were instructed to pull the correct stock


RX 1:

Using the following label template, prepare a *correct* label for the prescription bottle:

UNC Pharmacy
Chapel Hill, NC 27599
Ph 919.945-0000

BETH GREENE
Rx: **6094585**
Date filled: today

TAKE ONE (1) TABLET BY MOUTH EVERY MORNING

SERTRALINE 100MG TABLET QTY: 90
Refills: 0
RPh: H. Harding Dr. M. Dunley
Orig date: 03/03/12 Discard after: one year

If any of the following statements apply to this prescription, mark with a "Y" for yes AND choose the correct "stock bottle" note card to use for dispensing if applicable:

___ Incorrect stock bottle chosen as compared to Rx hardcopy.
Correct stock bottle should be: _____
___ Incorrect medication in prescription bottle as compared to stock bottle contents.
___ Stock bottle expired.

Figure 1. Electronic student sheet for new prescription analysis method.

bottle card for any products that had been filled with the incorrect drug. After the 10-minute period, a faculty member graded each student's corrected labels, which required an additional 60 to 90 seconds per student. Each prescription was graded as correct (full credit) or incorrect (no credit). No partial credit was granted for correction of some, but not all, errors and omissions (eg, identified and corrected an incorrect patient name, but failed to correct incorrect label instructions). This "all or none" approach was used to emulate pharmacy practice, where any error or omission in a medication that is dispensed to a patient is considered a medication error.

The new approach was developed with several objectives in mind, including to address issues of inconsistency in understanding and assessment. Rather than requiring students to describe an error or omission on the prescription, the new method required them to assess a final product to be dispensed and focused on their ability to identify and correct the error or omission, which was the ultimate learning objective. The new method required a higher level of learning based on Bloom's Cognitive Taxonomy,[15] shifting the emphasis from understanding to application. The new method also provided students with a more pragmatic learning opportunity, as it permitted them to learn how to correct the error and omission, as they would similarly do in practice. Additionally, students were provided immediate feedback from faculty members and were able to ask questions with the products in front of them for reference.

EVALUATION AND ASSESSMENT

To assess the impact of the new method, the authors compared student performance on the errors and omissions section of practicum examinations before and after the new method was implemented, and elicited student perceptions of the new method through a 7-item questionnaire. Examination scores and questionnaire responses were de-identified and analyzed using descriptive statistics to determine the impact of the new method. The study was granted IRB approval under the UNC Eshelman School of Pharmacy Educational Research application.

A retrospective review of student pharmacists' grades on the error and omission section of the laboratory practicum examinations from 3 semesters was performed (Table 2). To compare performance between the 2 methods, the authors reevaluated practicum examinations from previous semesters using the "all or nothing" criteria used in the new method, ie, a student received no credit if any error or omission was missed on a prescription. The final grade for students in all 3 semesters was determined by calculating the percentage of prescriptions that were completely correct out of the total number of prescriptions the students assessed. Forty-one percent of students received full credit (3 out of 3 prescriptions correctly assessed using the new method on the spring 2012 laboratory practicum compared with 9% of students who received full credit (5 out of 5 prescriptions correctly assessed) on the spring 2011 practicum and 5% of students who received full credit (4 out of 4 prescriptions correct) in fall 2011. Only 7.2% of students using the new

Table 2. Pharmacy Students' Scores on an Errors and Omissions Practicum

E & O Method Used	Course	Notes	Number of Prescriptions Assessed	Number of Prescriptions Correct					
				5	4	3	2	1	0
New	PCL IV Spring 2012	Comparator group (n=139)	3	—	—	41.0	51.8	6.5	0.7
Original	PCL III Fall 2011	Same cohort, less experience (n=141)	5	—	5.0	31.2	44.7	16.3	2.8
Original	PCL IV Spring 2011	Different cohort, same level of experience (n=154)	4	9.1	31.8	39.0	14.3	5.8	0.0

Abbreviations: E & O = errors and omissions; PCL = Pharmaceutical Care Laboratory

method missed more than 1 prescription error or omission, compared to 59.1% and 63.8% of students using the original method in spring 2011 and fall 2011, respectively (Table 2). Student perceptions regarding the change in methods were evaluated using an online survey instrument administered at the conclusion of the semester following the final practicum. The 7-item questionnaire was distributed via e-mail using Qualtrics (Qualtrics Labs, Inc. Provo, Utah). The questionnaire asked students to respond to items regarding preference of method (ie, original or new), attitudes regarding fairer assessment of the learning objectives, and preparation for introductory and advanced pharmacy practice experiences. Each question also asked for justification for their choice. Completion of the survey instrument was optional; however, students were offered 5 points extra credit on their course grade as an incentive.

The response rate for the student perception survey instrument was 89.2% (n=124). Ninety-four percent of respondents preferred the new method vs the original method of identifying errors and omissions, stating that the new method seemed more practical, applicable, and realistic. Those that did not prefer the new method stated that they were not as comfortable with the new method, especially the "stock bottle" options. Eighty-six percent of respondents felt that the new method was a fairer assessment of abilities pertaining to error and omission exercises. In regard to preparing the students for practice experiences and future practice, all but 1 respondent felt that the new method best achieved this objective. In general, students commented repeatedly that the new method was more "realistic" or "practical" and that it seemed to be a "fairer assessment" of their actual ability.

DISCUSSION

The new method for assessing students' ability to identify errors and omissions in prescriptions was more effective at simulating a practical experience and assessing student competency than the original method. When examined under grading parameters similar to those used with the previous 2 methods, students performed better on the practicum using the new method, despite the higher level of learning it required. A higher percentage of students received full credit for identifying errors and omissions in all 3 prescriptions on the practicum using the new method, which is encouraging. The new method is effective in assessing student ability to both identify and correct errors and omissions. Student support, based on survey responses, was strong for the new errors and omissions method. In general, students preferred the new method, as they felt it was more hands-on and better emulated pharmacy practice.

Many of the insufficiencies noted with the original method of assessing students' skills in identifying errors and omissions were successfully corrected with the implementation of the new method. As indicated by their performance and comments, students were more successful at formulating efficient verification processes for "checking" prescriptions. On average, students were more consistent in correctly identifying errors and omissions. Many of the discrepancies between students and faculty members and issues in wording of errors and omissions were eliminated, leading to more efficient and consistent grading. Students appreciated the more immediate feedback on their performance in the new method.

There were some limitations to this study. The 3 practicums, included in the analysis, used different prescriptions to test students, which could have led to differences in performance, making comparison of scores across semesters problematic. Similarly, different errors and omissions were assessed on each practicum and not all possible errors and omissions were evaluated on each practicum. With respect to student performance, data from practicums in which the original method was used were available for 2 semesters, while data from practicums in which the new method was used were available for only 1 semester. Also, changes in student performance on the practicums between the fall and spring semester could have been impacted by differences in student maturity and experience. The students had used the original

method for 3.5 semesters before the new method was put into place. This could have impacted the level of comfort students had with the new method. Finally, under the new method, the specific errors and omissions missed by students were not tracked, so trends concerning the frequency with which students missed specific types of errors are not available to help identify specific areas of weakness. While the results of this initial data assessment were encouraging, it may be worthwhile to analyze the data again when data from additional practicums using the new method of errors and omissions are available.

After evaluating the results of this study, the Pharmaceutical Care Laboratory faculty members met to discuss future plans for training student pharmacists in identification of errors and omissions. As the laboratory sequence strives for consistency across the 5 semesters, all faculty members agreed to adopt the new method and to integrate it into the laboratory portion of every semester.

Faculty members felt that the new method was superior in achieving the objectives of the activity. Faculty members expect that as all students are trained in the new method, any confusing points for students will be resolved and students will feel comfortable completing the exercises. Additionally, faculty members are working with information technology specialists to develop a more robust electronic document that will house patient profiles, complete drug interaction checks, and provide students with more opportunities to assess the clinical implications of prescriptions with errors or omissions.

SUMMARY

The new method of assessing students' skills in identifying prescription errors and omissions implemented in a Pharmaceutical Care Laboratory course practicum addressed many of the inconsistencies and issues noted with the original prescription analysis method. Overall, students performed better on graded assessments using the new method, which was also the method they preferred. While there are some minor issues to address, faculty members plan to implement this new errors and omissions assessment method throughout the Pharmaceutical Care Laboratory curriculum.

REFERENCES

1. Institute of Medicine, Committee on Identifying and Preventing Medication Errors. *Preventing Medication Errors: Quality Chasm Series.* National Academies Press; 2007:124-125. http://www.nap.edu/catalog.php?record_id=11623. Accessed June 26, 2012.
2. Grissinger MC, Globus NJ, Fricker MP. The role of managed care pharmacy in reducing medication errors. *J Managed Care Pharm*. 2003;9(1):62-65. http://www.amcp.org/data/jmcp/contemporary%20subject-62-65.pdf. Accessed June 26, 2012.
3. Allan EL, Barker KN, Malloy MJ, et al. Dispensing errors and counseling in community practice. *Am Pharm.* 1995;NS35(12):25-33.
4. Flynn EA, Barker KN, Carnahan BJ. National observational study of prescription dispensing accuracy and safety in 50 pharmacies. *J Am Pharm Assoc.* 2003;43(2):191-200. http://japha.org/data/Journals/JAPhA/20398/10.1331_108658003321480731.pdf. Accessed June 26, 2012.
5. U.S. Bureau of Labor Statistics. Occupational Outlook Handbook, 2010. http://www.bls.gov/ooh/healthcare/pharmacists.htm. Accessed June 26, 2012.
6. American Society of Health System Pharmacists (ASHP). ASHP accreditation standard for post-graduate year one (PGY1) pharmacy residency programs. http://www.ashp.org/s_ashp/docs/files/RTP_PGY1AccredStandard.pdf. Accessed June 26, 2012.
7. West Virginia Board of Pharmacy. http://www.wvbop.com/index.php?option=com_content&view=article&id=52&Itemid=82. Accessed September 20, 2012.
8. Go Pharmacy Schools. http://www.gopharmacyschools.com/additional-state-exams.html. Accessed September 20, 2012.
9. Georgia Board of Pharmacy. http://sos.georgia.gov/plb/pharmacy/. Accessed September 20, 2012.
10. Accrediation Council for Pharmacy Education (ACPE). Revised PharmD standards. https://www.acpe-accredit.org/pharmacists/standards.asp. Accessed June 26, 2012.
11. American Association of Colleges of Pharmacy (AACP). CAPE educational outcomes. http://www.aacp.org/resources/education/cape/Pages/default.aspx. Accessed June 26, 2012.
12. Kiersma ME, Darbishire PL, Plake KS, et al. Laboratory session to improve first-year pharmacy students' knowledge and confidence concerning the prevention of medical errors. *Am J Pharm Educ.* 2009; 73(6):Article 9.
13. Peeters MJ, Kamm GL, Beltyukova SA. A computer-based module for prescribing error instruction. *Am J Pharm Educ.* 2009;73(6): Article 101.
14. Chereson RS, Bilger R, Mohr S, et al. Design of a pharmaceutical care laboratory: a survey of practitioners. *Am J Pharm Educ.* 2005;69(1): Article 3.
15. Anderson LW, Krathwohl DR. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman. 2001.