VIEWPOINTS

Performance Improvement in Pharmacy Education

Shelley L. Chambers, PhD

Department of Pharmaceutical Sciences, Washington State University

As our college has struggled to develop perspective about the monumental task of assessing our curriculum, a familiar mantra from my days as a hospital pharmacist emerged above the clatter: high risk, high cost, high volume. This adage reminded the hospital performance improvement team to focus its efforts on the aspects of health care that are high risk or high cost for the patient and institution, and those that are performed frequently. To apply this principle to the knowledge, skills, and values we impart to our graduates through pharmacy education, there would be no more high risk (or high cost) skill than compounding.

That our graduates can do serious harm by compounding poorly is well documented in the literature. A migraine patient developed atropine toxicity and remained comatose for 48 hours after administration of a compounded atropine sulfate 0.25 mg suppository that actually contained 25 mg of atropine sulfate.¹ In 2006, Civen et al described 11 cases of *Serratia marcescens* infection associated with improperly compounded betamethasone injection.² *Morbidity and Mortality Weekly Reports* describes several other outbreaks of infection resulting from poor compounding practices, and there have been numerous reports of the hazards of calcium phosphate precipitate in parenteral nutrition solutions.³⁻⁵

What is the evidence that pharmacy educators have trained our graduates well? In 2005, Kadi et al evaluated the compounding skills of pharmacy students by quantifying the concentrations of potassium permanganate and caffeine citrate compounded solutions. They found that approximately 54% of the P2 pharmacy students were able to prepare the 2 solutions within $\pm 10\%$ of the target concentrations on the first try.⁶ In a study of the retention of compounding skills, Eley and Birnie found that only 17% of pharmacy students demonstrated a competency level of 80% when asked to prepare metoprolol capsules a second time a year after learning the skill.⁷ A survey of compounded drug products by the FDA's Center for Drug Evaluation and Research revealed that 9 out of 29 samples collected failed the assay for potency (all were subpotent) and a tenth sample failed the assay for endotoxin.⁸

If we acknowledge then that we could improve our compounding educational process, how should this be done? Again, drawing from the performance improvement litera-

ture, we need to identify best practices, standardize our processes, and check the results. Standards of practice have become increasingly clear; USP 797, which set the standards for compounding sterile products, details the validation of sterile compounding skills at 3 levels: high risk, medium risk, and low risk. All graduates of an accredited school of pharmacy should have successfully validated their skills at the level of low risk sterile compounding. USP 795 and the Pharmacy Compounding Accreditation Board have articulated standards and compliance indicators for non-sterile compounding practice. All graduates should be familiar not only with these standards but be able to demonstrate that they can properly prepare selected compounded products within a specified standard.

While we can identify best practices in pharmacy practice, what are the academy's best practices? Which of these compounding skills should a new graduate possess, and what are the best ways to teach for a student to learn to compound and to retain an understanding of the significant principles of formulation, equipment selection and product preparation, and assessment to ensure patient safety? Should we count the number of lecture hours on parenteral products offered by each school of pharmacy, or ensure that the outcomes of the pharmaceuticals courses include the ability to weigh and measure within the standard $\pm 5\%$ error? I would submit to you that there is no substitute for quality laboratory education. The evidence we have so far suggests that we need to model the best practices identified by our practitioners in the laboratory, provide opportunities for students to practice their skills — practice, practice, practice — and finally require students to demonstrate competency in those key aspects of compounding that could put their future patients at risk.⁹⁻¹³ These are the obligations of pharmacy educators, and as we all strive to improve the quality of our educational programs, we have the opportunity to identify our own best practices and share them with the academy.

REFERENCES

1. Hazija BW, Shrewsbury RP. Atropine overdosage with a suppository formulation containing atropine sulfate. *Int J Pharm Comp.* 1997;1(1):271-273.
2. Civen R, Vugia DJ, Alexander R, et al. Outbreak of *Serratia marcescens* infection following injections of betamethasone

compounded at a community pharmacy. *Clin Infect Dis.* 2006;43(7):831-837.

3. Centers for Disease Control and Prevention. Exophiala infection from contaminated injectable steroids prepared by a compounding pharmacy. *MMWR Morb Mortal Wkly Rep.* 2002;51:1109-1112.

4. Centers for Disease Control and Prevention. Pseudomonas bloodstream infections associated with a heparin/saline flush—Missouri, New York, Texas, and Michigan, 2004–2005. *MMWR Morb Mortal Wkly Rep.* 2005;54:269-272.

5. Trissel LA. Compounding our problems. *Am J Hosp Pharm.* 1994;51(12):1534.

6. Kadi A, Francioni-Proffitt D, Hindle M, Soine W. Evaluation of basic compounding skills of pharmacy students. *Am J Pharm Educ.* 2005;69(4):Article 69.

7. Eley J, Birnie C. Retention of compounding skills among pharmacy students. *Am J Pharm Educ.* 2006;70(5):Article 132.

8. Subramaniam V, Sokol G, Zenger V, Anderson K, Scott G, Brown R, Hoffman R, Cantilena L. Survey of drug products compounded by

a group of community pharmacies: findings from a Food and Drug Administration study. US FDA, Center for Drug Evaluation and Research. <http://www.fda.gov/ohrms/dockets/dailys/03/Jan03/010303/8004604d.doc>. Accessed April 16, 2010.

9. Capehart K. A laboratory exercise in capsule making. *Am J Pharm Educ.* 2008;72(5):Article 119.

10. Brown MC, Conway J, Sorensen TD. Development and implementation of a scoring rubric for aseptic technique. *Am J Pharm Educ.* 2006;70(6):Article 133.

11. Hasting JK, West DS. Comparison of outcomes between two laboratory techniques in a pharmacy communications course. *Am J Pharm Educ.* 2003;67(4):Article 101.

12. Hadzija BW, Shrewsbury RP. Two basic pharmacy courses with strong experimental (laboratory) components. *J Pharm Teaching.* 1996;5(4):41-50.

13. Mrtek RG, Mrtek MD. Evaluation of student accuracy in the laboratory 1. Basic principles of pharmacy, 2. Analysis of complex dilutions. *Am J Pharm Educ.* 1970;34(2):214-218.