

*American Journal of Pharmaceutical Education* 2011; 75 (9) Article 181.

## INSTRUCTIONAL DESIGN AND ASSESSMENT

### Video Teleconferencing in the Compounding Laboratory Component of a Dual-Campus Doctor of Pharmacy Program

Jennifer L. Robertson, PharmD, and Robert P. Shrewsbury, PhD

Eshelman School of Pharmacy, University of North Carolina

Submitted May 20, 2011; accepted July 9, 2011; published November 10, 2011.

**Objectives.** To design, implement, and assess the effectiveness of using a live video teleconferencing system to connect the main campus and a satellite campus during laboratory compounding exercises in a doctor of pharmacy (PharmD) program.

**Design.** A new laboratory facility with identical equipment and supplies to the main campus was built at the satellite campus and teleconferencing equipment was set up. Students on both campuses prepared 20 compounded formulations over a 5-course pharmaceutical care laboratory sequence. Live video teleconferencing was used for students to ask questions and for the lead faculty instructor to observe the students' technique. Faculty and staff members and teaching assistants facilitated the laboratory sessions on both campuses.

**Assessment.** The performance of students on assayed products at the main campus was compared with that of students at the satellite campus to ensure program integrity with the compounding laboratory component. The use of video teleconferencing for teaching compounding was successful and no difference in overall student pass rates was seen. The few observed differences in student performance between the 2 campuses were believed to be a result of variations in instructor communication with distant students.

**Conclusion.** Video teleconferencing can be used successfully to deliver curriculum in laboratory compounding to pharmacy students.

**Keywords:** videoconference, distance education, compounding, teleconference

## INTRODUCTION

The University of North Carolina (UNC) Chapel Hill /Elizabeth City State University (ECSU) Doctor of Pharmacy Partnership Program enrolled its first cohort of doctor of pharmacy (PharmD) students in the fall 2005 semester in a joint curricular venture. This partnership uses synchronous video teleconferencing technology to deliver instruction simultaneously to pharmacy students at the Chapel Hill and Elizabeth City campuses.<sup>1</sup> The Pharmaceutical Care Laboratory and its integrated compounding component were elements of the PharmD curriculum that required careful consideration and planning. The compounding component of the Pharmaceutical Care Laboratory sequence was modified to use the same video teleconferencing as the rest of the program to facilitate simultaneous instruction on both campuses.

The UNC Eshelman School of Pharmacy incorporates pharmaceutical compounding instruction through

out its 5-semester Pharmaceutical Care Laboratory course sequence. Various methodologies are used by other colleges and schools of pharmacy and science programs to offer a laboratory component as part of their distant education programs to satellite locations. An Internet search that included PubMed revealed some programs that use a condensed summer laboratory curriculum, such as that located on the main campus of Creighton University in Omaha, NE; another at Oregon State University in Eugene teaches all chemistry and laboratory sections online; and others have developed a virtual laboratory environment for all distant students.<sup>2,3</sup> Although experts in the field agree that most aspects of compounding instruction require hands-on, face-to-face instruction,<sup>4</sup> a review of the available literature revealed few models.

Moore and colleagues described teaching a pharmacokinetics course to distance students of the Eshelman School of Pharmacy's external PharmD program, which was initiated in 1996 for practicing pharmacists with a bachelor of science in pharmacy degree.<sup>5</sup> The program was delivered using videotapes of recorded lectures, instructor site visits, and interactive videoconferences, but

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**Corresponding Author:** Jennifer L. Robertson, PharmD, Elizabeth City State University and UNC Eshelman School of Pharmacy, Elizabeth City, NC.

did not include a compounding laboratory. Georgiou and colleagues and Boje and colleagues described virtual laboratories for chemistry and pharmaceutical biotechnology. Both used software to immerse students in a virtual world where they could interact with their environment, conducting chemical procedures and product research for a company responsible for the drug discovery and Food and Drug Administration (FDA) approval processes.<sup>6,7</sup> Although innovative, these methods may not be adequate for developing pharmacists' compounding skills. At Nova Southeastern University, one of the required courses in the PharmD curriculum is unique in that half of the course lecture content originates from the main campus and the other half from their West Palm Beach, FL, satellite campus, ensuring all students have a similar classroom experience.<sup>8</sup>

A compounding laboratory was built on the West Palm Beach, FL, campus that featured onsite instructors, narrated audiovisual demonstrations of compounding techniques, and online forms for student to submit compounding records.<sup>9</sup> The University of Maryland uses asynchronous and synchronous technology to deliver instruction to their satellite campus.<sup>10</sup> Although many of the approaches used at other colleges and schools resemble the UNC program model, none documents using the same video technology for the compounding portion of their curriculum.

The UNC Eshelman School of Pharmacy has pioneered the delivery of compounding laboratory instruction between its main and satellite campuses by maintaining a live, 2-way video teleconferencing connection during compounding exercises. This approach enables a connection between the lead instructor of the compounding exercise and the students, despite a 200-mile distance between them. As with other satellite programs, the UNC Chapel Hill/ ECSU Doctor of Pharmacy Partnership Program has faculty members present on the satellite campus to instruct and facilitate as needed, working in collaboration with the lead instructors or course liaisons on the main campus.<sup>8</sup> This article describes the video teleconferencing and other key elements in the compounding laboratory course design and its implementation at the 2 UNC campuses over a 5-year period.

## **DESIGN**

The compounding portion of the laboratory curriculum focused on providing the pharmacy students opportunities to apply their pharmaceuticals knowledge to the formulation and analysis of a compounded preparation for a specific patient. Because students received the same instruction in other parts of the curriculum, the goal was for students on both campuses to receive the same labo-

ratory experiences and be held to the same expectations and grading standards. To this end, a new laboratory facility with identical equipment and supplies was built at the satellite campus (ECSU) and maintained by a pharmacist faculty member who served as the ECSU Pharmaceutical Care Laboratory Coordinator but was not an expert in compounding. This faculty member and a laboratory associate at that site were assigned to work with the compounding coordinator faculty member on the main campus (UNC) and to provide onsite faculty assistance, mentoring for each student cohort, and planning and implementation of all laboratory activities. These activities accounted for approximately 50 work hours per week during the academic year. The onsite laboratory support faculty and staff members were available to answer many student questions, operate and demonstrate the use of compounding equipment, and correct students' compounding technique. The lead compounding instructor on the main campus was also the author of the required compounding textbook, so some student questions were referred to that instructor.<sup>11</sup>

Because teaching assistants were not initially available on the satellite campus, laboratory sections during the first 2 years of the program (2005-2007) were attended by a combination of Elizabeth City and Chapel Hill-based students led by a teaching assistant located in Chapel Hill. Video teleconferencing equipment in small classrooms connected the students with each other and the teaching assistant. Beginning in 2007, third-year pharmacy (P3) students were available on the Elizabeth City campus and began to serve as teaching assistants for first-year pharmacy (P1) students. The following year, when area-based pharmacists were recruited to serve as teaching assistants for the second- and third-year pharmacy laboratory courses, the laboratory experience design was the same on both campuses.

A live video teleconferencing connection was maintained between the campuses during each laboratory session involving nonsterile pharmaceutical compounding. In Elizabeth City, a mobile audio visual cart (Peerless Industries, Inc., Aurora, IL) allowed all-in-one, interactive 2-way communications by using a camera unit (Tandberg, San Jose, CA) mounted on a 42-inch LCD plasma television screen and speakers with boundary microphone (Audio-Technica, Stow, OH). On the main campus, the equipment was eventually wall-mounted to conserve space in an already-crowded laboratory. The video teleconferencing technology allowed instructors on both campuses to communicate with one another and with the students to facilitate information sharing and asking and answering of questions regarding techniques or assignments. Problems related to video teleconferencing

were handled by designated instructional and technology personnel at each campus. When problems could not be resolved in a timely manner, instructors used a telephone with speaker as a backup method for connecting with students. Each weekly prelaboratory class session was recorded and made available to students as per policy and with instructor permission. Recording of the compounding laboratory connection was not possible with the equipment available.

The technology interface was sufficiently user friendly to be operated by laboratory faculty and staff members and teaching assistants with minimal training by instructional technologists and technology support staff members. Content was shared from a laptop computer, tablet computer, or digital microscope, and input could be displayed in place of video content. This technology is typically used to provide a broad view of each compounding laboratory's activities but can be used for "face-to-face" conversations when participants stand close to their respective cameras and microphones (Figure 1). Telephones were located within the laboratory areas for conversations that required privacy. Students, teaching assistants, or faculty members frequently initiated conversations for the purpose of asking a question or providing additional instructions or clarification that the entire group of students on the distant campus needed to hear. However, on occasion, one of the instructors would want to see an individual student's workspace in order to inspect product preparation or technique. Varying circumstances such as these were accommodated by controlling each camera's zoom from both campuses, which worked well for workstations with unobstructed camera views.

Nineteen compounded formulations were prepared by students on both campuses during fall 2008 and spring

2009 over the 5-course sequence of the Pharmaceutical Care Laboratory (Table 1). Each compounding exercise began with a clinical correlate, which included a patient scenario and prescription to be compounded. To guide the students in product preparation, a formulation record was provided to all students 1 or 2 weeks prior to the laboratory session to allow them time to watch the appropriate videos, generate questions for the faculty members, and prepare to complete the product preparation in the time allotted. To prepare for laboratory, students on both campuses attended a synchronous 1-hour prelaboratory lecture prior to their weekly laboratory session. Most of this class time prior to compounding exercises was allotted to the compounding faculty member, who described to students in great detail what to expect in the laboratory, particularly if the steps were intricate or if there was a history of students finding the steps confusing. A special video teleconferencing camera (FlexCam, Ken-A-Vision, Kansas City, MO) was available to instructors for the purpose of showing what products would look like during and after compounding and/or demonstrating preparation techniques. Demonstrations were supplemented by required reading from the compounding text, which described in further depth the theory of and correct technique for compounding.<sup>11</sup> Additionally, the Pharmaceutics and Compounding Laboratory Web site (<http://pharmlabs.unc.edu>) was created to house demonstration

Table 1. Compounded Products Prepared by Pharmacy Students Completing a Pharmaceutical Care Laboratory Course Sequence in Which Compounding Was Taught Both on Campus and via Teleconferencing

Course	Products Compounded
PHCY 401	diphenhydramine solution metronidazole solution sweet orange peel tincture lidocaine dental gel
PHCY 402	ibuprofen powder tri-estrogen capsules hydrocortisone sticks chocolate troches methylcellulose gel
PHCY 403	coal tar ointment cold cream progesterone suppositories urea / equipment demo lab
PHCY 404	metoprolol tablets DHE nasal spray enalapril flavoring demo lab
PHCY 405	ciprofloxacin otic solution stomatitis mouthwash valacyclovir oral suspension

Abbreviations: PHCY = Pharmacy.



Figure 1. Video teleconferencing from the course instructor in a compounding laboratory on the main campus to doctor of pharmacy students in a compounding laboratory at a satellite campus.

videos for students and instructors. As the program matured, new and revised procedure recordings began to replace lecture time during prelaboratory sessions. The videos could be viewed by students on all campuses, allowing the compounding prelaboratory to be used for question-and-answer sessions with the compounding faculty member and for active-learning exercises, some of which pertained to the compounding portion of the laboratory course.

Materials and students' compounded products are regularly shipped between the campuses using a commercial freight company and this process required advance planning. Communication between instructors on both campuses prior to and during each semester was crucial to successful laboratory exercises, student learning opportunities, and student and faculty satisfaction.

## **EVALUATION AND ASSESSMENT**

There were 4 different grading components and point values for each compounded product: product (formulation content, 15 points), product label for patient (5 points), compounding record (5 points), and counseling (15 points). The label and compounding record were graded according to a rubric.

Analyses of all students' completed products and patient labels were conducted on the main campus to promote uniformity in grading. Analyses of student products were carried out by the lead compounding instructor or by supervised graduate students using high performance liquid chromatography (HPLC) or spectrophotometric assay procedures. Grading for each compounded formulation was unique. Students were awarded the maximum 15 points for their product if its assay was within  $\pm 10\%$  of the labeled standard prepared by the instructor. Under most circumstances, if formulation assays were outside the accepted range, students received a grade of zero with an opportunity to remake the formulation on their own time if laboratory space was available. If the student preparation error was deemed potentially harmful to a patient, students received a grade of zero and were not permitted to remake it. Grading criteria for labels included correct drug name, clear and concise directions, beyond-use date, patient name, quantity, and prescriber. Once graded, the products were shipped back to the distant campus and returned to the students. Grading criteria and final grade results were made available to all students simultaneously using Blackboard learning management system (Blackboard, Inc., Washington, DC).

Compounding records were graded by the teaching assistants for P1 students and the lead compounding instructor for second- and third-year pharmacy (P2 and P3) students based on content and accuracy in recording of the ingredients and equipment and processes used to prepare

the products. After compounding, each student individually counseled their "patient" (the teaching assistant) on the proper use of the compounded product in accordance with The Omnibus Budget Reconciliation Act of 1990 (OBRA 90) guidelines. All teaching assistants evaluated the students' counseling technique using a grading rubric template available via Blackboard. Grades earned for the compounding and counseling portions were incorporated into the overall laboratory course grade.

For this assessment, student grades for one compound from each laboratory course in the 2008-2009 academic year were collected and compared to determine parity in the educational process for students on both campuses and to ensure program integrity. This study was determined to be exempt by the Institutional Review Board for Research with Human Subjects at the University of North Carolina at Chapel Hill.

Table 2 provides the compiled student performance data selected for comparison. The means and standard deviations for different formulations from the 2 student groups were compared to determine whether there were large differences in student performance between campuses. For the metronidazole, hydrocortisone, metoprolol, and ciprofloxacin preparations, student products were assayed to compare their prepared formulation content or concentration to the instructor-labeled standard. For the coal-tar ointment, a weight variation test was done for the same comparison. When comparing the mean and standard deviation, if the student performance on both campuses was similar, students were deemed to have performed equally on the technical aspects of pharmaceutical compounding within the laboratory program design. A 50% variation in student content or scores would mark an obvious difference in student performance and possibly indicate a problem with laboratory setup or instruction delivery. Based on the parameters measured, obvious differences in student performance were detected on the student product labels of the coal-tar ointment and ciprofloxacin otic solution.

## **DISCUSSION**

Overall, student performance of compounding skills was the same on both UNC Eshelman School of Pharmacy campuses. The obvious performance difference on the labels of 2 products compounded by students at the Elizabeth City campus may be explained by several factors. The fivefold or greater difference in student sample size between the campuses and its effect on calculated mean and SD should be considered when making comparisons. The difference in the ciprofloxacin otic solution label scores may be attributable to the difference in sample size or to students replicating the same mistakes. The mean coal-tar ointment label score for Elizabeth City students

Table 2. Comparison of Compounded Products Prepared by School of Pharmacy Students at a Main Campus and Students at a Distant Campus Who Completed the Laboratory Section Simultaneously via Video Conferencing

Comparison Items	Compounded Products (Standard Content)				
	Metronidazole Solution (1 g/100 ml)	Hydrocortisone Stick (2.5% w/w)	Coal tar Ointment (70 g)	Metoprolol Tablets (12.5 mg)	Ciprofloxacin Otic Solution (0.3% w/v)
Student product content, Mean (SD)					
Chapel Hill <sup>a</sup>	1.0 g (0.1)	2.9% w/w (0.8)	69.3g (2.0)	10.2 mg (2.0)	0.4% w/v (0.1)
Elizabeth City <sup>a</sup>	0.9 g (0.1)	2.5% w/w (1.1)	70.0g (2.3)	11.6 mg (0.5)	0.3% w/v (0.0)
Percent difference from labeled standard, Mean (SD)					
Chapel Hill	4.9% (4.8)	33.0% (16.2)	n/a	18.8% (15.9)	9.0% (6.0)
Elizabeth City	6.0% (5.1)	31.1% (28.3)	n/a	7.0% (3.8)	2.0% (0.8)
Compounding record score, Mean (SD)					
Chapel Hill	4.0 (1.2)	4.3 (1.1)	4.5 (0.7)	4.6 (0.7)	4.3 (0.9)
Elizabeth City	3.7 (1.0)	3.8 (1.6)	4.5 (0.9)	3.2 (0.4)	3.8 (1.0)
Product label score, Mean (SD)					
Chapel Hill	5.0	5.0	4.8 <sup>b</sup> (1.0)	4.8 (1.1)	4.4 <sup>b</sup> (1.7)
Elizabeth City	5.0	5.0	0 <sup>b</sup>	5.0	2.0 <sup>b</sup> (2.6)

<sup>a</sup> Number of students completing each part of the laboratory section varied on each campus: Chapel Hill (main campus), N = 44-50; Elizabeth City (distant campus), N = 10-11.

<sup>b</sup> Obvious difference in student performance (defined as 50% variation).

was 0 out of 5, suggesting that either important information was not available to students on both campuses or incorrect information or advice was provided to Elizabeth City students by their local instructor or classmates.

This analysis revealed important issues that otherwise might not have been considered and are being used to improve the teaching and coordination processes. To minimize variations in future student performance, the compounding faculty members have implemented monthly meetings to review the data throughout each semester to refine the communication and grading process. The development of grading keys for each compound, label, and compounding record also has assisted instructors in providing similar student guidance and information dissemination to students on both campuses. Faculty members, clinical instructors, and support staff members continue to use telephone, e-mail, the Blackboard learning management system, and video conferencing to improve communication and cohesion between the campuses.

Ongoing student performance comparisons between campuses yielded obvious content variations for 2 formulations during the fall 2010 semester. In both cases, analysis of the products produced by students at the satellite campus revealed a deficiency in concentration of the active ingredient. Across-the-board deviations from the formulation

records such as this are typically not expected. After careful consideration of all variables, the instructors determined that variable temperature or moisture conditions during shipping was the most likely explanation. Despite any reported variances in student grades, overall course pass rates were not affected. Future program modifications under consideration include obtaining equipment to conduct compounded product analysis on both campuses to control for this variable as well as to reduce shipping expenses.

Increasing integration of the Pharmaceutical Care Laboratory coordinator faculty members and laboratory associate into the combined Pharmaceutical Care Laboratory team has resulted in improved communication and streamlined processes. The Pharmaceutical Care Laboratory faculty team meets weekly throughout the summer and academic year to plan and make laboratory curriculum decisions. The gradual transition from video conferencing teaching assistants located on the main campus to onsite teaching assistants on the satellite campus also has contributed to the cohesiveness of the program and the consistency of the students' learning experience. Course teaching assistants from both campuses meet with course coordinators and compounding faculty members on a weekly basis to discuss implementation of laboratory activities and grading. The progression over the years toward adding onsite

teaching assistants at the ECSU campus is thought to have equalized the student experience, minimized the lack of direct student mentoring and oversight, and improved dissemination of instructor expectations to the students.

Although our model program has an onsite faculty member present during compounding sessions to answer student questions, advise on the process or technique, and provide reassurance, the video teleconferencing element in the compounding portion of the curriculum was important because it facilitated contact between the lead faculty instructor and all students, ensuring that delivery of the curriculum was consistent between the 2 campuses. The video teleconferencing connection during the compounding portion provides more than an extension of the lead instructor's reach. It allows students on both campuses to feel connected to one another as well as to provide support for the students, teaching assistants, and laboratory faculty and staff members, who all take advantage of the opportunity to ask questions of the lead instructor. An additional value is the ability of students on the distant campus to expand their peer group and benchmark the time they spend on laboratory activities with that of students on the main campus. It is unknown whether student contact with the instructor on the main campus via video teleconferencing is reduced by the presence of the onsite faculty member, the lack of the lead instructor's visual presence on screen at all times, or student apprehension to appear onscreen and visible to peers on both campuses while asking a question. Future survey tools will address these topics with the goal of validating this anecdotal evidence.

Measuring student satisfaction was beyond the scope of this article, which describes compounding-specific application of overall curricular design in a pharmacy program with students on 2 campuses. However, because students on both campuses have access to face-to-face and distant instructors, student satisfaction with the compounding laboratory portion is expected to be similar to overall satisfaction with the program. Future course evaluations will be modified to include compounding-specific questions for assessing student satisfaction on the distant campus and to make program modifications.

## SUMMARY

The UNC Eshelman School of Pharmacy has achieved the same success in applying video teleconferencing principles in its laboratory compounding curriculum as it has

with the rest of its doctor of pharmacy program. Evidence of differences in student learning was not found in the first 6 years of the program and 3 graduating classes of students. Previous evaluation of student outcomes within the program showed little difference in student performance between the campuses, and this difference has been attributed to preadmission student characteristics.<sup>12</sup> Evaluation of student performance will continue and further modifications will be made, as needed. This model is expected to help guide future expansion of the program to other campuses as well as other institutions' decisions about incorporating video teleconferencing in their laboratory compounding curriculum.

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