Integration of Pharmacy Practice
and Pharmaceutical Sciences
in Developing an Elective Course
in Contemporary Compounding

Archana Desai
Arunya Usayapant
Karen MacKinnon
Mary-Beth Stanaszek

ABSTRACT. A 3-quarter-hour elective course in compounding is
offered to third-year pharmacy students. The objective for this
course, which involves a lecture component and extensive laborato-
ry experience, is to strengthen students' proficiency in prescription
compounding. Dosage forms compounded include troches, lip-
balms, suspensions, gels, ointments, suppositories, ophthalmics, and
IV admixtures. Topics discussed target the need for compounding,
compounding versus manufacturing, and legal aspects involved.
Each student is given an independent formulation project. Students
utilize library resources to prepare a written report, order required
supplies, and compound the product. Approximately 92% of the
students surveyed after taking the course felt more competent in their
compounding skills and knowledge after taking this course. Students
agreed that a combination of lectures, laboratories, and project

Archana Desai, Ph.D., is Assistant Professor in the Department of Pharmaceu-
tical Sciences, Arunya Usayapant, Ph.D., is Assistant Professor in the Department
of Pharmaceutical Sciences, Karen MacKinnon, R.Ph., is Assistant Professor in
the Department of Pharmacy Practice, all at Chicago College of Pharmacy, Mid-
western University, Downers Grove, IL 60515-1235. Mary-Beth Stanaszek,
Pharm.D., is a resident at the VA Medical Center, Denver, CO 80220-3873.
Portions of this work were presented as a poster at the annual meeting of the

Journal of Pharmacy Teaching, Vol. 6(4) 1998
© 1998 by The Haworth Press, Inc. All rights reserved.
INTRODUCTION

The Chicago College of Pharmacy (CCP) was founded in 1991 and is a college of Midwestern University, a private, health-professions institution located in the western suburbs of Chicago, Illinois. CCP offers both a three-year Bachelor of Science in Pharmacy degree and a four-year Doctor of Pharmacy degree.

The objectives of the CCP curriculum include the following:

- to provide a comprehensive background in the basic pharmaceutical sciences as a foundation for practice,
- to provide experiential instruction in the art and science of pharmacy,
- to sensitize students to the high ethical standards of a pharmacist as a member of a health-care team,
- to provide the students with an appreciation of the need for life-long learning to maintain professional competence, and
- to provide students with elective opportunities that strengthens preparation for practice in the varied environments.

Extemporaneous prescription compounding has historically been considered as a cornerstone in the professional practice of pharmacy, as pharmacists have been compounding prescriptions for centuries. The mortar and pestle are universally recognized as a symbol of the pharmacy profession. Compounding patient-specific and commercially unavailable dosage forms allows the pharmacist to provide optimal patient care and improve compliance. Pharmacists acquire these unique skills through extensive training and education obtained in pharmacy school regarding pharmaceutical dosage forms, chemical structures of drugs, drug stability and interactions, incompatibility information, and storage.

At CCP, pharmacy students take courses in their first and second professional year in which they acquire basic skills in pharmaceutical compounding; course outlines for these courses are included in Appendix A. The courses include:

Pharmacy 360 (Pharmaceutical Calculations), Pharmacy 361 (Pharmaceutics I), and Pharmacy 362 (Pharmaceutics II): The students take these courses in their first professional year. The students in the two
pharmaceutics courses take a total of ten 4-hour formulation design and compounding wet labs.

*Pharmacy 482 and 483 (Applied Pharmaceutical Care)*: The students take these courses in their second professional year. The students participate in four 2-hour compounding wet labs preparing nonsterile dosage forms and five 2-hour wet labs preparing sterile dosage forms.

Due to the recognized importance of pharmaceutical compounding in the professional practice of pharmacy and to meet the stated objectives of the CCP curriculum, an elective course entitled “Contemporary Compounding” (Pharmacy 564) was developed. During the fall quarter of their third professional year, students are offered this ten-week, 3-quarter-hour elective course which is taught jointly by the faculty in the departments of pharmacy practice and pharmaceutical sciences.

**COURSE DESCRIPTION**

Contemporary compounding was designed for students who wish to develop an expertise in the field of extemporaneous compounding. The course’s stated objectives include strengthening the students’ proficiency in prescription compounding by utilizing hands-on experience, stimulation of critical-thinking by the student, and development of problem-solving skills. The course includes a one-hour weekly lecture discussing topics and issues in pharmaceutical compounding and four hours of wet lab per week.

*Classroom Discussion*: Topics of current interest in pharmaceutical compounding and other topics that help develop student confidence in compounding are discussed with the students in a lecture *cum* dialog format. The topics include:

- the need and importance of pharmaceutical compounding
- legal aspects related to pharmaceutical compounding
- compounding versus manufacturing
- formulation and procedural development
- general guidelines for compounding nonsterile and sterile dosage forms
- chemical incompatibilities
- stability and expiration dating for compounded prescriptions
- review of pharmaceutical calculations

During the one-hour lecture the students receive the prescriptions which are to be compounded in the following week in the laboratory. The
students are required to complete all calculations and determine the optimum compounding procedure, labeling instructions, and expiration date prior to coming to the laboratory. The objective of this approach was to give the student autonomy and practice in retrieving pharmaceutical compounding information from suggested reference books.

Laboratory Exercises: Laboratory exercises included the preparation of topical products, oral solutions, suspensions, capsules, troches, suppositories, ophthalmic drops, IV medications, and cosmetics such as antidan-duff shampoo and fluoride toothpaste gel. The products along with the write-ups were to be submitted at the end of each lab period for evaluation of calculations, compounding procedure, product quality, and accuracy of the label. If there was a significant error in either the product or label, the student was required to fill out an Incident Report Form explaining the error (Appendix B). In order to give the student practice in documentation, the student is required to keep an extensive compounding log book and record information such as prescription number, the date of making the product, initials of the compounder, expiration date of the product, as well as the name and amount chemicals used, the manufacturer or the source of the chemical, and its expiration date. Appendix C includes an outline of the various laboratory topics covered in the course.

Assessment of Student Performance: Student performance is assessed based on laboratory assignments, a laboratory practical, workshops, class assignments, and a midterm and a final examination. Laboratory work and projects constituted approximately 66% of the grade. The midterm and final examinations as well as other assignments were given to students as take-home exercises.

Practice Assignments/Workshops: The purpose of the assignments/workshops was to improve the students' problem-solving skills and expose the students to questions on a variety of topics in compounding, compatibility issues, and calculations which are considered important in practice. These assignments would also aid the students in studying for the state board licensing examination. One of the workshops given to the students was intended to give students experience in identifying legal or documentation errors and omissions on prescriptions. Another workshop dealt with IV incompatibilities and was designed to give the student practice in retrieving IV compatibility information from reference books. Students were responsible for identifying and correcting the incompatibility in the prescriptions and compounding the final product after incorporating the necessary changes after checking with the prescriber (instructor).

Laboratory Practical: During the third week of the course, students were given an independent project and assigned a prescription for their
laboratory practical. The student was responsible for researching and developing a compounding procedure, ordering all the necessary supplies needed to formulate, compounding and dispensing the product, and developing a pricing strategy to charge for the final product. This was done in order to allow the students to develop critical thinking and problem-solving skills. This product would be compounded as the final laboratory exam exercise during the tenth week of the course.

**STUDENT EVALUATION OF THE COURSE**

Contemporary compounding has been offered as an elective course since the fall of 1994. At the end of the quarter, the students were asked to evaluate the course through written comments and rating scales to determine the usefulness of the course and the ability to meet its stated objectives. The course was found to be very enjoyable and interesting by over 90 percent of the students.

*Question:* Why did you decide to take this elective course?

*Responses:*

- To improve skills in the area of extemporaneous compounding
- To increase confidence in the area of extemporaneous compounding
- To broaden the knowledge base and learn how to prepare different types of dosage forms
- To review pharmaceutical calculations
- To prepare for the NAPLEX examination

*Question:* What were some of the strengths of this course?

*Responses:*

The course:

- Enhanced skills and techniques in the area of compounding
- Increased confidence in this area
- Provided experience with a wide range of prescriptions
- Provided good preparation for professional practice and the NAPLEX examination
- Provided good practice with calculations
- Had convenient and appropriately scheduled laboratories and lectures and adequate amount of time was given to complete the laboratory exercises
Question: What were some of the areas that needed more emphasis?

Responses:

- Documentation skills
- Literature searching
- Selection of preservatives and excipients
- Incompatibilities
- General compounding procedures
- End-of-laboratory discussion and conclusion

Student responses to other selected questions is presented in Tables 1-3.

**TABLE 1. Evaluation of Course Content.**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Percentage of Responses</th>
<th>SA*</th>
<th>A*</th>
<th>N*</th>
<th>D*</th>
<th>SD*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the course provide practice with relevant clinical examples?</td>
<td></td>
<td>36</td>
<td>54</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Did the course stimulate critical thinking?</td>
<td></td>
<td>46</td>
<td>46</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Was the course intellectually challenging?</td>
<td></td>
<td>49</td>
<td>43</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

*SA
Strongly Agree
A Agree
N Neutral
D Disagree
SD Strongly Disagree

**TABLE 2. Evaluation of Learning Objectives.**

<table>
<thead>
<tr>
<th>After taking this course...</th>
<th>Percentage of Responses</th>
<th>SA*</th>
<th>A*</th>
<th>N*</th>
<th>D*</th>
<th>SD*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel more sure of my compounding skills.</td>
<td></td>
<td>26</td>
<td>68</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I feel more confident in calculations.</td>
<td></td>
<td>34</td>
<td>60</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I feel better prepared to take the licensure exam.</td>
<td></td>
<td>23</td>
<td>57</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I have a better understanding of the legal requirements.</td>
<td></td>
<td>11</td>
<td>49</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I know how to approach a compounding prescription.</td>
<td></td>
<td>14</td>
<td>77</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*SA
Strongly Agree
A Agree
N Neutral
D Disagree
SD Strongly Disagree
TABLE 3. Evaluation of Time Dedicated to Specific Compounding Topics.

<table>
<thead>
<tr>
<th>Topics</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NE*</td>
</tr>
<tr>
<td>Oral Liquids</td>
<td>3</td>
</tr>
<tr>
<td>Ointments</td>
<td>8</td>
</tr>
<tr>
<td>Suppositories</td>
<td>6</td>
</tr>
<tr>
<td>Aseptic Technique</td>
<td>14</td>
</tr>
<tr>
<td>Lip Balms/Troches</td>
<td>3</td>
</tr>
<tr>
<td>Expiration Dating</td>
<td>25</td>
</tr>
<tr>
<td>Excipients</td>
<td>44</td>
</tr>
</tbody>
</table>

*NE = Not Enough, S = Sufficient, TM = Too Much

CONCLUSION

"Contemporary Compounding" (Pharmacy 564) was received well by the students and met its stated objectives. This elective course is being offered every year to the third-year students who wish to fine-tune their compounding skills.

REFERENCE MATERIAL USED FOR COURSE DEVELOPMENT


APPENDIX A

COURSE OUTLINES

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
<th>Laboratory/Workshop Topics</th>
</tr>
</thead>
</table>
| 1    | 1. Introduction  
3. Chapter 2: “Interpretation of the Prescription,” Appendix A: “Common Systems and Intersystem Conversion” | 1. Workshop, Chapter 1  
2. Workshop, Chapter 2 and Appendix A |
| 2    | 1. Chapter 4: “Calculation of Doses”  
2. Chapter 5: “Reducing and Enlarging Formulas”  
3. Chapter 7: “Percentage and Ratio Strength Calculations” | 1. Workshop, Chapter 4 and Chapter 5  
2. Workshop, Chapter 7 |
| 3    | 1. Chapter 7: “Percentage and Ratio Strength Calculations”  
2. Chapter 6: “Density and Specific Gravity”  
3. Chapter 8: “Dilution and Concentration” | 1. Workshop, Chapter 7  
2. Workshop, Chapter 6 |
| 4    | 1. Chapter 8: “Dilution and Concentration”  
2. Dosage Form Development and GMP  
3. Dosage Form Design | Workshop, Chapter 8 |
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
<th>Laboratory/Workshop Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Stability Kinetics</td>
<td>Laboratory, Analytical Techniques</td>
</tr>
<tr>
<td>10</td>
<td>Introduction to Statistics in the Medical Sciences</td>
<td>Workshop, Acid/Base Chemistry and Stability Kinetics</td>
</tr>
<tr>
<td>Week</td>
<td>Lecture Topics</td>
<td>Laboratory Topics</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
| 1    | 1. Course Introduction and Lab Introduction  
      2. Prescription Standards  
                                        Hydralazine Oral Powder |
| 2    | 1. Solid Dosage Forms/Oral Products  
      2. Solid Dosage Forms/Dissolution Testing  
      3. Liquid Dosage Forms/Single Phase System | Theophylline and Ephedrine Sulfate Oral Capsules  
                                                  Capsule Filling by Machine (Video Demonstration) |
| 3    | 1. Liquid Dosage Forms/Interfacial Phenomena  
      2. Liquid Dosage Forms/Multiple Phase System  
      3. Liquid Dosage Forms/Rheology | Potassium Chloride Oral Syrup  
                                    Hydrochlorothiazide Oral Suspension |
| 4    | 1. Liquid Dosage Forms/Suspensions  
      2. Liquid Dosage Forms/Emulsions | Castor Oil Oral Emulsion  
                                         Mineral Oil Oral Emulsion |
| 5    | 1. Semisolid Dosage Forms  
      2. Rectal/Vaginal/Urethral Products | Hydrophilic Petrolatum USP  
                                         Hydrophilic Ointment USP |
| 6    | 1. Nasal/Aural Products  
      2. Sterile Dosage Forms/Parenteral | Sulfur in Hydrophilic Ointment USP  
                                              ZnO/Calamine in White Petrolatum  
                                              Urea in Hydrophilic Petrolatum USP |
| 7    | 1. Sterile Dosage Forms/Parenteral  
      2. Sterile Dosage Forms/Ophthalmic | Progesterone/PEG Suppositories  
                                                Aspirin/Cocoa Butter Suppositories  
                                                Sterile Product Demonstration |
| 8    | 1. Oral Sustained Release Dosage Forms  
      2. Transdermal Products  
      3. Ocular Insert/Implants/IOD | Epinephrine Eye Drops  
                                         Novel DDS Product Demonstration |
| 9    | 1. Nanoparticles/Liposomes  
      2. Biotechnology Products | Cold Cream  
                                         Gel |
<p>| 10   | Radiopharmaceuticals | Compounding Laboratory Practical |</p>
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
<th>Laboratory Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Introduction</td>
<td>Rx Errors and Omissions</td>
</tr>
<tr>
<td></td>
<td>2. Pharmacy Ethics</td>
<td>Patient Assessment: Pharmacy Ethics</td>
</tr>
<tr>
<td></td>
<td>2. Geriatric Counseling</td>
<td>Patient Profile Review</td>
</tr>
<tr>
<td>3</td>
<td>1. Top 200 Quiz/Computer</td>
<td>Compounding: Capsule Rx, Patient Profile #13, Computer</td>
</tr>
<tr>
<td></td>
<td>2. Lab Review (Capsules, Emulsions, and Expiration Dating)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1. Patient Assessment</td>
<td>Patient Assessment: Allergy/Vital Signs</td>
</tr>
<tr>
<td></td>
<td>2. Pediatric Overview</td>
<td>Compounding: Emulsion Rx</td>
</tr>
<tr>
<td>5</td>
<td>1. EENT</td>
<td>Patient Assessment: Pediatric/EENT</td>
</tr>
<tr>
<td></td>
<td>2. The Fatal Swallow</td>
<td>Compounding: Lozenges Rx</td>
</tr>
<tr>
<td>6</td>
<td>1. Top 200 Quiz/Lab Review</td>
<td>Compounding: Ophthalmic Rx, Patient Profile #16 with Phone Rx</td>
</tr>
<tr>
<td></td>
<td>2. Preservatives and Excipients</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hypertension</td>
<td>Patient Assessment: Hypertension</td>
</tr>
<tr>
<td></td>
<td>2. Lab Practical review</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1. Compounding Laboratory Practical</td>
<td>Blood Pressure Evaluations Patient Profile #13 with Phone Rx</td>
</tr>
<tr>
<td></td>
<td>2. Top 200 Quiz</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1. Rx Jeopardy</td>
<td>Patient Assessment: Physical Assessment Exam</td>
</tr>
<tr>
<td></td>
<td>2. Course Review</td>
<td></td>
</tr>
<tr>
<td>Week</td>
<td>Lecture Topics</td>
<td>Laboratory Topics</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>1. Overview</td>
<td>Home Health Care</td>
</tr>
<tr>
<td></td>
<td>2. Reference Review</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>IV Incompatibility</td>
<td>IV Incompatibility</td>
</tr>
<tr>
<td>3</td>
<td>Aseptic Technique</td>
<td>Aseptic Preparation</td>
</tr>
<tr>
<td>4</td>
<td>1. Reference Review</td>
<td>1. Patient Assessment: Asthma Case</td>
</tr>
<tr>
<td></td>
<td>2. Top 200 Quiz</td>
<td>2. Asthma Equipment and Technique</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Medication Profile Review</td>
</tr>
<tr>
<td>5</td>
<td>Nutrition</td>
<td>Patient Assessment: Nutrition/TPN</td>
</tr>
<tr>
<td>6</td>
<td>1. TPN Preparation</td>
<td>TPN and IV Preparation</td>
</tr>
<tr>
<td></td>
<td>2. Top 200 Quiz</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Patient Assessment: MI</td>
<td>1. Patient Assessment: Diabetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Equipment and Technique</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Medication Profile Review</td>
</tr>
<tr>
<td>8</td>
<td>Infectious Disease</td>
<td>1. Patient Assessment: ID/Pharmacokinetics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Medication Profile Review</td>
</tr>
<tr>
<td>9</td>
<td>1. Neoplastics</td>
<td>Chemo Preparation</td>
</tr>
<tr>
<td></td>
<td>2.Chemotherapy Preparation</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1. Rx Jeopardy</td>
<td>1. Evaluation of IV Preparations</td>
</tr>
<tr>
<td></td>
<td>2. Course Review</td>
<td>2. Hospital Pharmacy Stations and Compatibility Stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Top 200 Quiz</td>
</tr>
</tbody>
</table>
APPENDIX B

PRESCRIPTION INCIDENT REPORT

1. PHARMACIST, STORE NAME, AND ADDRESS: ______________________

2. PATIENT'S NAME: ________________________________
   
   Approximate Age: _____ Sex: _____ Phone No. (_____ ) ________
   
   If patient is a minor child, provide names of both mother and father: ________________
   
   ___________________________________________________________________
   
   Address: City, State, and Zip Code: _________________________________
   
   What was patient told by pharmacist or pharmacy personnel? ________________
   
   ___________________________________________________________________

3. PRESCRIPTION NO. __________________ Date Filled: ____________
   
   Prescription called for: ___________________________________________________________________________
   
   (NOTE: medication, strength, regimen)
   
   Did patient take any of the medication? ________________
   
   If so, how much? ____________________________
   
   Patient's attitude/comments: ______________________________________________________________________

4. PHYSICIAN'S NAME: __________________ Phone No. ____________
   
   Was the Physician (Instructor) contacted? ________________
   
   Physician's comments: _________________________________________________________________________

5. DESCRIBE THE INCIDENT: ________________________________
   
   __________________________________________________________________________
   
   What action has been taken to prevent a recurrence of this incident? ________________
   
   __________________________________________________________________________
   
   __________________________________________________________________________
## APPENDIX C

### COURSE OUTLINE

**Pharmacy 564 (Contemporary Compounding)**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
<th>Laboratory Topics</th>
</tr>
</thead>
</table>
| 1    | Introduction to the Course and to Laboratory Exercises | Topical Products/Applicator Sticks  
* Lip Balms  
* Medisticks |
| 2    | Need for Compounding Legal Requirements             | Topical Products  
* Carbopol Gels  
* Lotions |
| 3    | Topical Products                                    | What is wrong with these Rxs? Identify and correct errors in some of the prescriptions and modify them. Compound these modified Rxs. |
| 4    | Oral Products                                        | Oral Suspensions using tablets, capsules, solutions as the source of the active ingredient |
| 5    | Workshop: Identify Legal Errors                     | Troches and Lozenges (containing PEG or gelatin)                                  |
| 6    | Rectal and Vaginal Products                          | Suppositories                                                                     |
| 7    | Ophthalmic Drops                                     | Ophthalmic Drops: Aseptic Technique                                               |
| 8    | Aseptic Technique/Compatibility Issues               | IV Preparations  
Detect the incompatibility (if any), correct the Rx and prepare it.               |
| 9    | Cosmetics                                            | Shampoos and Toothpastes  
Working with chemicals that may be hazardous                                     |
| 10   | Compounding vs. Manufacturing                        | Lab Project and Practical                                                          |