Innovations in Teaching

Utilization of an Integrated Interactive Virtual Patient Database in a Web-Based Environment for Teaching Continuity of Care

L. Clifton Fuhrman Jr., Wayne E. Buff, Michael Eaddy and Michael Dollar

College of Pharmacy, University of South Carolina, Columbia SC 29208

The project’s purpose was to develop students’ understanding of pharmaceutical care concepts while enhancing their abilities to utilize information technology. Pharmacy students entering their first year fall semester are assigned a virtual family that is accessed via an Internet server web page. The families, consisting of an adult male, an adult female, a child, and a geriatric patient, were designed by clinical pharmacy practitioners. Problem scenarios, based on each patient’s specific disease state, integrate didactic concepts taught during each semester. Each patient has three scenarios a semester for four semesters over a two-year period. Students receive one problem each week at random. The problem must be answered via the web page within 24 hours. Students are given a response to their answer by day’s end. Students have been able to access and retrieve information via various computer sources to successfully answer patient problems (97 percent rate correct). Students have also established responsibility in answering questions in a timely manner (99.8 percent answer rate, 97.3 percent on time rate). A seven item five-point Likert questionnaire indicated that students’ perceptions of the project were favorable. The project has developed a positive learning experience for the students as they begin to answer patient questions concerning pharmacy care. The students also have become adept with utilizing Internet and computer software information sources.

INTRODUCTION

Educating health professionals for the new century is a challenging endeavor. The constant change in the health care arena imposes demands upon the faculty of health professional institutions. The faculties of these colleges must adapt paradigms that give students not only the knowledge and skills required to provide medical care but also the ability to furnish quality, efficient, and cost-effective care. Health care professionals must also have an explicit understanding of continuity of care and the enormous responsibility to the patients involved in providing this care. The purpose of developing this teaching method was to integrate subject matter from the various pharmacy disciplines and provide an interactive environment for our students to learn, locate information, and develop practice skills, dependability, responsibility and self-confidence. This course sequence provides experience and training to assist students in developing the following academic and professional characteristics required to provide quality patient care. The objectives of this teaching strategy are:

1. to develop students’ understanding of continuity of patient care through a weekly problem scenario sequence over a two-year period;
2. to reinforce didactic material taught each semester through integration of topics and concepts that maintain a direct relationship to patient care;
3. to develop students’ evaluative and cognitive learning skills through problem scenarios, which build on patient background data, weekly problem scenarios, and didactic course work over a two-year period;
4. to develop students’ ability to work and research in an information technological environment utilizing various health professions software packages and the worldwide web;
5. to develop students’ oral, written, and computer communication skills through answering patient problem scenarios via a web based environment; and
6. to develop students’ professionalism by having them assume responsibility through evaluating patients and answering problem scenarios in a timely manner over a two-year period.

DESCRIPTION OF TEACHING METHOD

The Integrated Pharmacy Laboratory and Recitation (IPLR) is a two-year, four-semester course that provides students with pharmacy practice and clinical skills in the areas of community and institutional pharmacy settings. As part of this course students are assigned a “Virtual Family” at the beginning of the fall semester of their first year. The family consists of an adult male, an adult female, a pediatric, and a geriatric patient. Each patient has a specific disease state that corresponds to topics discussed in the clinical therapeutics courses during the third year of the pharmacy curriculum. Disease states include: Type I and Type II diabetes, hypertension, angina, anemia, oncology, osteoarthritis, asthma (pediatric and adult), epilepsy, congestive heart failure, and, Parkinson’s disease, as well as pregnancy, childhood immunizations, and acute illnesses. Patient scenarios are based upon the primary disease state and potential

---

secondary ailments or conditions related to the primary condition. Students are responsible for taking care of their patients' over four semesters (two years). The course while emphasizing dispensing and clinical skills also integrates didactic material covered in the pharmaceutical sciences, pharmacy administration, and therapeutic courses. Students' ability to utilize and integrated information technology and didactic learning to provide continuity of care is evaluated by this teaching modality.

Students experience continuity of care for patients using a unique innovative teaching technique. Utilizing a computer networked patient profile data system, accessible via the college's web page; students have an interactive patient-pharmacist relationship. The course takes the student and their “Virtual Patients” from community pharmacy practice (semester one) to institutional (semester two) then advanced institutional/clinical (semester three) and finishes with advanced community pharmacy (semester four). Assigning each student to their own “Virtual Patients” developed by clinical faculty and preceptors provide students with real world problems in an information technology environment.

Students are responsible for evaluating their “Virtual Patient” members on a daily basis. Sixteen students each day (Monday through Thursday) receive a problem scenario on one of their patients. Students check their patients by logging, into the Virtual Patient Database page located on the college’s web site at www.pharm.sc.edu. Each morning the web server downloads a designated set of patient problem scenarios automatically. Students then check to determine if one of their patients has a problem by entering the “Check the Pharmacy” site (Figure 1). If one of their family members’ names is located at that site, that member of the family has a problem. The student can then enter the family page by clicking on the family name and entering their password. The question appears at the top of the screen with a text box for entering their answer (Figure 2). Students have constant access of the patients' history to enable them to answer patient problems (Figure 3). Students have until 9AM the next day to submit their answer. Students have access to computer networked healthcare references as well as an Internet link to various health professional sites for answering their patient scenarios. Students are also provided with an e-mail system connected directly to the instructors for feedback on questions and answers.

The instructors in the course evaluate and critique student’s answers on a daily basis. At least one instructor is readily available to students either in the computer lab or via e-mail to assist students with technical (computer) or patient care problems. The instructors also provide the students with additional information and reference sources appropriate for answering their questions. At least once a week an instructor will debrief the class on patient scenario problems and ask for student input concerning the functioning of the informational technology interface.

PERFORMANCE DATA
Students were graded on their response with regards to, accuracy, thoroughness and timelines of their answer. Learning where to find information, interpretation of the problem, and taking responsibility to answer in a timely manner is stressed as paramount. In this regard the students (n=58) had a 90 percent answer accuracy rate, a 99 percent answer rate on all questions, and a 97 percent timeliness rate.

A quiz consisting of seven multiple choice questions and one short answer question (Appendix A) was designed to test the students ability with regards to basic knowledge of information integrated from didactic courses that was utilized for
virtual patient questioning throughout the semester. For this exam only, students were timed to assess their proficiency for working within an information technological environment. Students taking part in the study group were compared, based on score and length of time to complete the test, to a cohort group (second year class) that had not been exposed to the “Virtual Families” teaching method.

The pair-wise comparison of means was conducted using a two-tailed, paired t-test after adjusting the significance $P$ value of 0.05. Data collection was conducted on a total of 48 cohort and 58 test group students. The results of the performance data are reported in Table I and II. The data reported in Table I indicated no significant difference ($P>$0.05) with regards to mean number of questions answered correctly or mean time to complete the exam. Data reported in Table II for the second semester exam indicated a significant difference ($P<$0.05) for the mean number of answers correct comparing the test group to the cohort group. No significant difference was exhibited with respect to mean time to complete the second semester exam.

EVALUATIVE DATA

After the first semester, a survey was created to evaluate the students’ perceptions of the “Virtual Patient” program (Appendix B). The survey was designed to assess the students’ overall feelings concerning their experience; the degree of problems encountered; the ability to effectively use the Internet to answer clinical questions; and the ability of the scenarios case to aid the student in understanding the specific disease states of the their patients. Each participant was given a survey consisting of seven items, graded on a five point Likert-like scale. All responses were assigned values ranging from -2 (strongly disagree) to +2 (strongly agree) with values of 0 representing neutral responses. The responses to the item that assessed the students’ overall feelings concerning their experience ranged from an extremely poor experience (-2) to an excellent experience (+2) with values of 0 representing an average experience.

Of the 58 students who participated in the project during the first semester, 57 completed the survey. All students agreed that the cases helped them understand the disease state of their “Virtual Patient” (mean = 1.57 SD =0.50) and that the knowledge acquired while participating in the project would be beneficial in the future (mean = 1.68 SD =0.47). The majority of students (97.9 percent) used the Internet to answer problems, however only 28.3 percent of the students used Internet links provided to them as references to address specific problems. Only 8.5 percent of the students had difficulty accessing a computer to answer their problem. When asked where they gained access to their virtual families, 78.7 percent of the students reported using the Pharmacy Computer Lab, computers within the Integrated Pharmacy Practice Lab, or their home computers. Overall 66 percent of the students rated their experience as excellent, while 31.9 percent rated their experience as good and 2.1 percent rated their experience as average.

**DISCUSSION**

Learning requires a proactive approach by both the teacher and the students. Developing new tools for teaching enables the instructor to provide students with new avenues to learn. The utilization of new technology and sophisticated techniques allow the students to not only develop their knowledge of information and concepts but also afford them the ability to immerse themselves within the technology itself.

The use of computer technology is not new to pharmacy education. Courses designed around computer simulations in pharmacokinetics, dispensing, calculations, and clinical therapeutics are well described in the literature(1-4). Thompson’s database project was used in a laboratory setting for students to dispense and evaluate drug utilization review as well as patient counseling(3). Chisolm et. al. utilized a computer-assisted instructional (CAI) program to teach case based pharmacotherapy(4). The use of computers in teaching has for the most part been course specific with no longitudinal component or emphasis on continuity of care.

**PERSONAL REFLECTION AND CONCLUSIONS**

The “Virtual Patient” project is a more comprehensive attempt to develop students’ professional and practice skills at a higher level. This project is innovative to other documented computer assisted teaching methods in several ways. There is a specific emphasis on continuity of care. Integration of didactic concepts from all areas of pharmacy are used in developing patient disease state scenarios. Students begin the project immediately during their first semester of the professional program. The longitudinal aspect of students following, their patients for two years are unique. Incorporation of information and computer technology in a server active web page environment is used for student interaction. Developing students’ professionalism by having them assume responsibility for their patients for an extended period of time is innovative.

Pharmaceutical care has been a paradigm for many years in pharmacy education. The design and implementation of a new Doctor of Pharmacy curriculum emphasizes complete pharmacotherapeutic care of the patient. Continuity of care has been considered an important concept in pharmacy care, however a method for implementing the teaching of this concept has been difficult. Many students believe they will either work in a retail or an institutional setting, however it is assumed that since they will work in one they do not need to know about the other. The patient sees pharmacists as playing a key role in the community as well as the institutional setting. This teaching method was developed out of years of frustration in trying to get students to realize that patients understand the concept of continuity of care but students seem to be unaware. The virtual patient project gives our students an understanding of complete patient care by emphasizing continuity of care as patients move between retail and hospital setting. Based on the results of the student survey and the accuracy and timelines results of their answers the teaching method has been successful. The significance of the method as a learning tool is still being eval-

---

**Table I. Results for “Virtual Patient” exam - Semester 1**

<table>
<thead>
<tr>
<th>Group</th>
<th># of students</th>
<th>Mean # correct</th>
<th>Mean time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort</td>
<td>48</td>
<td>3.7+/-.1.4</td>
<td>42.4+/-.8.9</td>
</tr>
<tr>
<td>Study</td>
<td>58</td>
<td>3.9+/-.1.5</td>
<td>41.1+/-.6.4</td>
</tr>
</tbody>
</table>

**Table II. Results for “Virtual Patient” exam - Semester 2**

<table>
<thead>
<tr>
<th>Group</th>
<th># of students</th>
<th>Mean # correct</th>
<th>Mean time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort</td>
<td>48</td>
<td>3.7+/-.1.5</td>
<td>51.0+/-.6.0</td>
</tr>
<tr>
<td>Study</td>
<td>58</td>
<td>4.6+/-.1.7*</td>
<td>54.0+/-.7.4</td>
</tr>
</tbody>
</table>
uated. Students have been very receptive and have become proactive in suggesting new ideas for database presentation of patients to potential disease states and problem scenarios. It has quickly become commonplace to see our first-year students working in the computer lab at all hours of the day. They have also developed camaraderie as they try to assist each other on information sources and using the Internet. At the beginning there was hesitancy on their part, since this was a new teaching method and other students had not been required to do this work in the past. However, through constant debriefing and timely response to their questions the project began running smoothly after the second week. Students in other classes have indicated a willingness to take part in the family project. We have now embarked on the second semester and the students seem delighted to continue the project this semester.

Some questions are considered more difficult than others, however the emphasis is not on the grade but on timeliness and effort that is placed in the answer. Learning is the bottom line because for every question, there can be more than one right answer and sometimes no correct answer at all.

Acknowledgement. Work was funded by the Proctor and Gamble Curriculum Development Fund.

References

APPENDIX A. SURVEY QUIZ. FIRST SEMESTER: FALL COHORT

Please use the following provided profile and any computer application you wish to employ to answer the following questions. Place all answers on the answer sheet provided. Please fill in your social security number and check it for accuracy. Enter the time (start time) you started the survey appropriately on the answer form. When you have finished the questions please enter the time (finish time) on the answer sheet. Please try and answer as many questions as possible. You can and use any computer resource you have available. Please do not discuss these questions with any other member of your class. Thank you for your time and effort.

Your patient is Jenny Talbert

PHARMACIST’S PATIENT DATA BASE

Demographic Information
Name Jenny Talbert
DOB 02/09/91 Race Caucasian
Height 4’0” Weight 58 lb
Gender F Religion non-denom
Occupation: NA
Allergies: Sulfur

History of Present Illness (HPI)
Symptoms occurred 3 days ago. Sore throat, nausea, cough, general malaise
Temp. 99.9F, BP 100/65, R 68, P 75

Mother has treated with Robitussin cough syrup, Tylenol, and rest.

Past Medical History (PMH)
Patient has had childhood diseases; chicken pox, whooping cough
Suffered from chronic Otitis media-tubes inserted in 1993
Immunological shot record is current
No underlying medical or disease state
Last wellness check-up in 1997

Family and Social History (F&SH)
Father has diabetes mellitus, mother has family history of heart disease.

Lifestyle
Mrs. Talbert, Jenny’s mom, enters your pharmacy. She has just taken Jenny to Dr. Harley’s office she has two prescriptions.

UNIVERSITY OF SOUTH CAROLINA
Medical Offices
COLUMBIA SOUTH CAROLINA 29208

NAME: Jenny Talbert AGE: 7
ADDRESS: 14 Rush Dr DATE: today

Rx
Augmentin 400mg/5ml
100ml
Take 1 tsp q12h till all taken

Dr Harley
DISPENSE AS WRITTEN SUBSTITUTION PERMITTED
REFILL NR 12 3 4 5 PRN DEA NO AH1234563

UNIVERSITY OF SOUTH CAROLINA
Medical Offices
COLUMBIA, SOUTH CAROLINA 29208

NAME: Jenny Talbert AGE: 7
ADDRESS: 14 Rush Dr DATE: today

Rx
Benadryl/Hycodan 1:1
120ml
Take 1 tsp every 4 to 6 hours prn cough
Refill as needed
Dr Harley
DISPENSE AS WRITTEN SUBSTITUTION PERMITTED
REFILL NR 12 3 4 5 PRN DEA NO AH1234563

Question 1. How many mg/kg/day of Augmentin is Jenny receiving?
Question 2. What is the appropriate mg/kg/day dose for Augmentin for Jenny?

Mrs. Talbert tells you that the nurse at the doctor’s office did a culture swab of Jenny’s throat and the doctor is determining if Jenny has strep throat.

Use the following to answer questions 3, 4, and 5
A if 1 only is correct
B if 3 only is correct
C if 1 and 3 are correct
D if 2 and 3 are correct
Question 3. Which of the following characterizes Streptococcus bacteria:
1. Gram positive cocci
2. Gram negative cocci
3. Streptococcus pyrogens are the causative agent for sore throat infections.

Question 4. Which of the following medications would also be appropriate for Jenny to take for a strep throat infection?
1. Cipro
2. Bactrim DS
3. Keflex

Question 5. You counsel Mrs Talbert concerning Jenny’s prescriptions as follows
1. Shake the Augmentin well and keep in the refrigerator
2. The Augmentin has no refills and you may refill the cough syrup as needed
3. The cough syrup may cause drowsiness

Question 6: Two days later Mrs. Talbert contacts you concerning Jenny’s medication. She explains that Jenny’s fever has gotten worse and the doctor advised her to use ibuprofen suspension instead of the Tylenol elixir. She gave her daughter two tablespoonfuls instead of two teaspoonfuls of ibuprofen by mistake about an hour ago. The doctor’s office is closed and she is calling you for advice. You tell her:
A if I only is correct
B if 2 only is correct
C if I and 3 are correct
D if III only is correct

1. Tell her to give the child ipecac and explain the proper procedures to Mrs. Talbert
2. Tell her the dose is not enough to cause a problem, just give Jenny water to dilute the dose
3. Tell her this is also an overdose and take Jenny to the nearest ER

After the ten day course of therapy Jenny is still no better. She now has been diagnosed with strep throat. She still has a slight fever, a productive cough, and general malaise. She has just come from the doctor’s office and asks you about the doctor information on Jenny’s visit record.

Question 7. The doctor had a bilateral chest x-ray done on Jenny. Mrs. Talbert explains that the doctor talked about Jenny possibly having pneumonia based on an infiltrate in the middle lobe. You explain to Mrs. Talbert that the pneumonia would be present in:
A. The right lung
B. The left lung
C. Both lungs

Question 8. The doctor visit record also states that the doctor observed hemoptysis.

You explain hemoptysis means: _______________________

APPENDIX B. VIRTUAL PATIENT SURVEY 2001

Please circle your response to each question.

1) The problems my virtual patients encountered were answerable with the resources available to me.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

2) The problems my virtual patients encountered helped me understand the disease state of my virtual patient.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

3) I often used the Internet to answer problems encountered by my virtual patient.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

4) When using the Internet to answer problems encountered by my virtual patient, I often performed an Internet search on the problem rather than use the websites present in the reference section for the virtual patients.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

5) Although the computer lab was available to me, I often had difficulty accessing a computer to answer the problems associated with my virtual patient.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

6) I feel that the information I learned while answering the problems encountered by my virtual patient will be beneficial to me in the future.

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>

7) Overall, I would rate my virtual patient experience as:

<table>
<thead>
<tr>
<th align="left">Strongly Disagree</th>
<th align="left">Disagree</th>
<th align="left">Neutral</th>
<th align="left">Agree</th>
<th align="left">Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">-2</td>
<td align="left">-1</td>
<td align="left">0</td>
<td align="left">+1</td>
<td align="left">+2</td>
</tr>
</tbody>
</table>