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INSTRUCTIONAL DESIGN AND ASSESSMENT

An Online Course in Veterinary Therapeutics for Pharmacy Students

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Objective. To determine the effectiveness of an online course in veterinary therapeutics for pharmacy student learning.

Methods. Quantitative and qualitative survey methods were used to assess the effectiveness of the course. A one-group, pretest-posttest, quasi-experimental design was used to evaluate the students' confidence level and application of skills related to veterinary therapeutics. Reflective commentary was also collected.

Results. Cognitive postcourse scores improved significantly over the precourse scores on all survey questions.

Conclusion. This online course was an effective method of educating pharmacy students on topics specific to veterinary pharmacy. Students' confidence in their knowledge about veterinary therapeutics increased.

Keywords: distance education, educational outcomes, online course, veterinary therapeutics, veterinary pharmacy

INTRODUCTION

Most pharmacists practicing in a community setting have been presented with prescriptions for animal patients at some time during the course of their career. Veterinary drugs approved by the Food and Drug Administration (FDA) are not available to treat every condition for every species, so treatment with human-labeled drugs are a viable alternative. However, prescriptions for veterinary use sometimes challenge pharmacists' knowledge of veterinary drugs, indications, dosages, disease states, and therapeutic monitoring parameters.

The lack of veterinary/animal health education in the pharmacy curriculum must be recognized. The inclusion of curricular offerings or course content focusing on veterinary therapeutics and veterinary pharmacy is not a standard offering in most schools and colleges of pharmacy. However, a few pharmacy programs have didactic offerings on veterinary pharmacy topics.[1-8]

Pharmacists may be unsure of their ability to offer insightful and accurate counseling to the owner of an animal. Most state statutes pertaining to the practice of pharmacy require that pharmacists make a verbal offer to counsel patients on new prescriptions. In most states, the regulatory bodies that govern the practice of pharmacy do not separate the legal requirements for verbal prescription counseling for human patients from those for animal patients. Consequently practitioners may feel ill equipped to handle veterinary patient care scenarios. Veterinary information resources can assist pharmacists in confidently meeting the legal requirements of providing prescription counseling to animal owners. However, these resources are not typically included in didactic drug information courses.

Another area that is not familiar to pharmacists or students is legal and regulatory issues governing veterinary pharmacy. Regulations that govern human pharmacy differ from those that govern veterinary medicine and veterinary compounding, but this type of information is usually not included in pharmacy jurisprudence courses. Students need to be aware of guidelines and laws that direct the practice of veterinary pharmacy for companion animals and food-producing animals.[9,10]

How can academia introduce pharmacy students to the unique differences between human and veterinary pharmaceuticals, their indications, species dosing, and the legal applications of filling veterinary prescriptions for animal patients? One possibility is to disseminate information using distance-based technology to deliver an online course in veterinary therapeutics to any interested pharmacy student in the nation. Pharmacy academia has a history of employing electronic technologies and distance-based learning for entry-level and nontraditional doctor of pharmacy degree pathways. Offering instruction on veterinary pharmacy topics in an online,

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distance-based format gives any student the opportunity to gain new skills and knowledge in veterinary therapeutics regardless of their geographic location.

Funding from a 2002 District Five, National Associations of Boards of Pharmacy and American Associations of Colleges of Pharmacy (NABP/AACP) Individual Study Grant provided the resources to develop and offer a 2-credit hour elective course in veterinary therapeutics to provide any interested pharmacy student with an opportunity to develop new skills and a knowledge base in veterinary therapeutics.

OBJECTIVES

The purpose of this article is to describe the veterinary therapeutics curriculum and to assess the effectiveness of the curriculum by measuring the cognitive knowledge of the pharmacy students. Cognitive knowledge was measured by the student's confidence level in explaining common animal disease states, summarizing veterinary pharmacotherapy options, and explaining important regulatory documents that influence the practice of veterinary pharmacy. It was hypothesized that the student's confidence level in their knowledge of the subject would increase from the precourse survey compared with the postcourse survey by virtue of completing the curriculum. Reflective comments solicited from the students at the completion of the course on how they will use their new veterinary therapeutic knowledge base will provide insight into how students will practically apply new knowledge and skills to their practice.

This online course in veterinary therapeutics for pharmacy students was developed during the 2002 calendar year and made available in January 2003. The course was specifically designed as an educational opportunity for pharmacy students who may be considering practicing in the growing area of veterinary pharmacy.

DESIGN

Course Description

All course materials were placed in the *Blackboard* electronic learning environment to facilitate easy access for the students to the course documents, self-assessment quizzes, examinations, and surveys. Technical and instructional design assistance was obtained from the Office of Information Technology and Learning Resources housed within the School of Pharmacy and Health Professionals.

Interested students could access an informational Web site that listed the course objectives, hours of elective credit, registration information, dates of course offering, course requirements, contact information, and syllabus at http://pharmacy.creighton.edu/pha380. Interested students complete a registration application that is sent to the admissions department within the School of Pharmacy and Health Professions. Students who are enrolled in the University for PHA380 only are not considered matriculating students and are termed "visiting" students.

After enrolling, students receive a welcome packet mailed by the School of Pharmacy and Health Professions. One week before the start of class, students are provided with a course syllabus, course schedule, and instructions for completing the expectations of the course. The grading criteria are explained in the syllabus. Students are expected to read the course materials, read and respond to weekly e-mails, respond to questions/cases generated by the instructor, and stay current with the course schedule. E-mail serves as the primary form of communication, although the instructor also used telephone and fax communications. Students are also expected to post their responses to specific reflective questions at the beginning, mid-term, and end of the semester using an online discussion board. At the completion of the semester, visiting students can transfer the 2 hours of elective credit successfully earned to their home school or college of pharmacy.

Course Content

The course content focuses on 3 main areas: veterinary disease states and supporting informatics, legal and regulatory issues, and veterinary pharmaceutical classes. The information on veterinary disease states provides an introduction to veterinary therapeutics by detailing the pathology, signs and symptoms, diagnosis, pharmacotherapeutics, and prognosis for the 15 most common disease states affecting companion animals (dogs, cats, and horses). Examples of the disease states covered are diabetes mellitus in canines and felines, thyroid disorders in canines and felines, osteoarthritis, and separation anxiety. The veterinary- and human-labeled pharmaceuticals that are used to treat these disease states are listed and common dosages are indicated. Graphics that illustrate a specific disease presentation are incorporated in the text of each disease state. Graphics of veterinary pharmaceuticals used to treat the diseases are also presented. Additionally, print and internet-based references that can assist pharmacists in their practice of veterinary pharmacy are listed and described. URL's for each Internet reference are provided for the student to enter into a web browser and search for further drug information or animal disease state information.

There is heavy emphasis on the legal and regulatory documents influencing veterinary pharmacy. The Compliance Policy Guide (Section 608.400), "Compounding of Drugs for Use in Animals,"[10] and the Animal Medicinal Drug Use Clarification Act of 1994[9] (AMDUCA, 21 CFR Part 50) are presented and their importance explained. These items give students valuable guidance and direction with regard to veterinary pharmacy and compounding. These regulatory documents are particularly useful in giving direction to future pharmacists regarding compounding for companion animals (non-food animals) vs food animals. The compliance policy guideline delineates acts that will cause the FDA to seriously consider enforcement action. Pharmacists who practice any type of veterinary pharmacy need to have a complete understanding of these documents and be able to practically apply concepts from these documents to their practice environments. Additionally, the Drug Compounding Position Statement[11] adopted by the American Veterinary Medical Association is included to inform students of the issues identified in veterinary compounding brought forth by the membership of this veterinary organization.

Current topics from veterinary medicine and veterinary pharmacy are presented to supplement the readings on regulatory issues and document the need for a clear understanding of guidance documents and acts that directly affect the practice of veterinary pharmacy. Current articles and publications that focus on veterinary compounding and internet/mail order pharmacies are included to highlight the many contemporary issues facing veterinary medicine and veterinary pharmacy.

The third area of content focuses on broad pharmaceutical classes and their uses. Introductory information on heartworm preventatives is presented along with a discussion of the disease state. The dispensing of heartworm preventatives is a service ideally provided by the prescribing veterinarian as a component of best patient care. However, there are numerous Internet veterinary pharmacies that supply these medications. The purpose of presenting this topic is to encourage students to promote awareness of preventative pharmaceutical care for their veterinary patients. Interestingly, the most popular brands of heartworm preventatives can be purchased through traditionally human drug wholesalers such as McKesson.[12] A section on antineoplastic use is included in the course materials. Common cancers affecting companion animals are presented and the use of chemotherapeutic agents in this population is discussed. Drug therapy protocols used to treat these specific cancers are included for informational purposes. Additionally, a section on anesthetic and analgesic use listing the drug names, indications, and dosages is included. To round out the comprehensive therapeutic education, a section on the human/animal bond and its positive effects upon human health is presented and discussed. The human/animal bond topic is relevant to pharmacy education based upon preliminary research findings that document the use of animal models and interactions in a veterinary therapeutics course to teach caring attitudes and behaviors.[13]

Assessment of Effectiveness

Both quantitative and qualitative methods were used to assess the effectiveness of the course curriculum. In the spring of 2003, 17 (n = 17) students from 9 different schools and colleges of pharmacy enrolled in PHA380. A one-group pre-post quasi-experimental design was used to evaluate the confidence level for knowledge in veterinary therapeutics and application skills of the students. The online curriculum served as the intervention. All students were required to complete a 25-question precourse survey instrument to measure their confidence levels on veterinary disease states, pharmacotherapeutics, and legal and regulatory issues. All students were also required to complete an identical 25-question postsurvey instrument to measure their knowledge or confidence level on the same topics after completing the curriculum. The surveys designed for this assessment used a 5-point Likert scale (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree). Course-related self-confidence surveys consisted of questions designed to get an approximate measure of the students' self-confidence in relation to a specific skill or ability. These types of instruments help faculty members assess their students' level of confidence in their ability to learn the relevant skills and material.[14] When faculty members can measure the student's level of confidence, and what affects that confidence, they can structure course materials in a way to build confidence and enhance learning.[14]

Students posted responses to discussion board questions 3 times during the semester. The first question posed to the students at the beginning of the semester was, "What are your reasons for taking this course?" It was intended to solicit insights on the student's motivations for enrolling in the online course. Midterm questions, "How has this course applied concepts gained in previous pharmacy courses to the subject of veterinary therapeutics?" and "List three things that you have learned so far," were intended to solicit students' thoughts on specific new knowledge they had gained from the course. The end-of-semester reflective questions were, "What is the

Table 1. Examination Scores* of Pharmacy Students Enrolled in an Online Veterinary Therapeutics Course, Mean (SD)

Examination	Creighton University Students, n=55	Visiting Students, n=17
Midterm	36.8 (0.6)	36.5 (0.7)
Final	36.7 (0.5)	36.7 (0.7)

*Each examination was worth 40 points.

connection between this course and your role as a pharmacist?" "What was different about this course compared to other courses that you have had in the pharmacy program?" and "Describe what effect (if any) your experiences with animal disease states had on your professional attitude towards being a caring health care provider." The questions were intended to prompt students to describe their thoughts about the relationship between the course content and their perceptions of how they will use this new knowledge in future practice environments. A final question appearing on the postcourse survey instrument, "Do you have any comments about this course?" was intended to obtain feedback about the course that could be used for overall improvement.

RESULTS

The course statistics tool in the *Blackboard* platform provided information about the student's use of the course Web site. There were over 6,300 visits to the main content areas of the Web site and 1,743 visits to the discussion board area of the course. Over 90% of access to the site occurred between the hours of 10 AM and 11 PM. The highest access per day of the week was on Wednesday, which corresponded with the time weekly e-mails were sent by the instructor.

Table 1 lists the formative results of the 2 examination scores (each examination was worth 40 points) of the visiting students (n = 17) and Creighton University students (n = 55) also enrolled in PHA 380. Student performance was consistent between the 2 groups.

Table 2 lists the precourse and postcourse survey questions with their calculated median scores. During the 2003 spring offering, 17 students enrolled in the course and completed the precourse survey instrument (100%) and 17 students completed all course requirements including the postcourse survey (100%).

Cognitive postcourse scores significantly improved over the precourse scores on all 25 items. Scores on survey questions assessing the student's confidence in their ability to explain a veterinary disease state consistently increased by a ranking of 2 to 2.5 indicators on the postcourse questions above the same precourse questions. Survey questions measuring the student's confidence in their ability to summarize veterinary pharmacotherapy options for a disease state also consistently increased by a ranking of 2 to 3 indicators on the postcourse survey questions compared with the precourse survey questions. Questions pertaining to the application of legal and regulatory documents to assist the student in determining the appropriateness of a compounded product for an animal patient increased by a ranking of 2 on the postcourse question analysis. Students reported the most confidence on both precourse and postcourse questions in their ability to use veterinary informatics to locate dosages or disease state information.

Table 2 also lists the results of the Wilcoxon signed rank test for each question. The analysis for each question resulted in statistically significant increases, thereby indicating that the increase in the cognitive measure as reported by the student was not due to error. The null hypotheses of no increase in cognitive knowledge and skills between the precourse survey and postcourse survey questions can be rejected. Because the *Blackboard* course platform cannot keep a record of specific student responses to each question, the analysis was performed on each question individually instead of on matched pairs.

Theme Analysis of Reflective Commentary

The most frequent reason given by students for taking the course was a strong interest in animals. Many students referred to current work experience in a community or compounding pharmacy where veterinary pharmacy knowledge could be applied to the practice environment. Students also reported a desire for a knowledge base in animal disease states and veterinary pharmaceuticals.

The responses for the question, "How has the course applied concepts gained in previous pharmacy courses to the subject of veterinary therapeutics?" and the question "List three new items learned from this course" followed similar themes. Students were able to apply enduring knowledge from core didactic pharmacy classes such as dosage forms, pharmacokinetics, and human therapeutics to veterinary medicine and to animal patients. Students reported being unfamiliar with legal and regulatory issues that applied to veterinary medicine and veterinary pharmacy. There were strong themes on the benefit their new knowledge in legal and regulatory issues would bring to the practice of veterinary pharmacy. Overall, students felt that the knowledge base gained would positively influence future veterinary pharmacy experiences such as experiential rotations and counseling of animal owners. Students also expressed how their new knowledge of veterinary informatics would enhance

Table 2. Precourse and Postcourse Questionnaire Responses of Pharmacy Students Enrolled in an Online Veterinary Therapeutics Course*

Survey Question	Median Precourse Response†	Median Postcourse Response†
1. I feel confident in my ability to explain diabetes in canines	2	4
2. I feel confident in my ability to explain diabetes in felines	2	4.5
3. I feel confident in my ability to explain hypothyroidism in canines	2	4.5
4. I feel confident in my ability to explain hyperthyroidism in felines	2	4.5
5. I feel confident in my ability to explain equine protozoal myeloencephalitis	2	4
6. I feel confident in my ability to explain keratoconjunctivitis sicca	2	4
7. I feel confident in my ability to explain separation anxiety in canines and felines	2	5
8. I feel confident in my ability to explain urinary incontinence in canines	2	5
9. I feel confident in my ability to explain idiopathic epilepsy in canines	2	5
10. I feel confident in my ability to summarize pharmacotherapy options for diabetes in canines	2	4.5
11. I feel confident in my ability to summarize pharmacotherapy options for diabetes in felines	2	4.5
12. I feel confident in my ability to summarize pharmacotherapy options for hypothyroidism for canines	2	4.5
13. I feel confident in my ability to summarize pharmacotherapy options for hyperthyroidism in felines	2	4.5
14. I feel confident in my ability to summarize pharmacotherapy options for equine protozoal myeloencephalitis	2	4
15. I feel confident in my ability to summarize pharmacotherapy options for keratoconjunctivitis sicca	2	4
16. I feel confident in my ability to summarize pharmacotherapy options for separation anxiety	2	5
17. I feel confident in my ability to summarize pharmacotherapy options for urinary incontinence in canines	2	4.5
18. I feel confident in my ability to summarize pharmacotherapy options for epilepsy in canines	2	4.5
19. I feel confident in my ability to summarize pharmacotherapy options for cancer in canines and felines	2	4
20. I feel confident in my ability to summarize pharmacotherapy options for nutrition therapy in canines and felines	2	4
21. I feel confident in my ability to summarize pharmacotherapy options for anesthetic and analgesic agents	2	4
22. I feel confident in my ability to determine if a compounded medication would be appropriate for use in companion animals utilizing CPG 608.400 and AMDUCA	2	4
23. I feel confident in my ability to determine if a compounded Medications would be appropriate for use in food animals utilizing CPG 608.400 and AMDUCA	3	5
24. I feel confident in my ability to utilize a text or internet reference to find a dosage for an animal patient	3.5	5
25. I feel confident in my ability to utilize a text or internet reference to locate disease state information	2	5

*The differences between precourse and postcourse responses were significant for all 25 items in the questionnaire ($P<0.001$), as determined using Wilcoxon signed rank test.

†Respondents ranked each item using a 5-point Likert scale with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree

their ability to problem-solve issues relating to veterinary disease states and pharmacotherapy.

End of semester reflective questions focused on how students would apply their new knowledge, comparing and contrasting this course to other pharmacy courses, and changes in their professional attitudes as a result of the learning experiences with animal patients and animal disease states. A recurring theme of increased self-confidence was evident from the feedback to the question, "What is the connection between this course and your

role as a pharmacist?" Students reported they now had a knowledge base and foundation from which they could provide care to animal patients through counseling and insightful communication with veterinary professionals. Students also spoke about a new appreciation for the human-animal bond and how caring and disease treatment are not limited to humans.

Responses to the question, "What was different about this course compared to others that you have taken?" related to the course being an online, distance-based course. The responses were overwhelmingly positive for the format, teaching skills, course materials, Web site organization, and emphasis on student learning. Some students reported being apprehensive about taking an online course, but their anxiety faded as they became familiar with the structure of the online learning environment.

Themes of caring, compassion, empathy, and a desire to care for and assist animal patients were clearly evident in responses to the question, "Describe what effect your experiences with animal disease states had on your professional attitude towards being a caring health care provider." This finding triangulates previous work reporting the use of animal models and scenarios used in the teaching of caring behaviors and attitudes for pharmacy students.[13]

Responses to the question, "Do you have any comments about this course?" revealed that students were satisfied with the learning experience of this online course. A postcourse survey question asking, "Would you recommend this course on veterinary therapeutics to a friend?" also reflects the positive learning experience reported by the students. One hundred percent of students reported that they would recommend this course to a friend.

DISCUSSION

Instructor Reflections

The online course fills a need for educational offerings on the subject of veterinary pharmacy. Interest in this practice area has grown tremendously and this is the first online veterinary pharmacy course offered by an accredited school of pharmacy. This course is the first to offer the opportunity for education to all interested students regardless of geographical barriers. Additionally, there is benefit to the profession as a whole in making the course available to all interested students. The positive feedback received from students who have completed the course has made the teaching experience rewarding and enjoyable.

The positive comments from students regarding the structure of the course, ease of navigation, and logical presentation of course materials are thought to be a direct result of the guidance and direction received from instructional designers in the Office of Information Technology and Learning Resources. Clearly, the input and advice given to the instructor on successful teaching strategies and best practices in electronic-based distance education was beneficial to the instructor and well received by students.

The *Blackboard* course platform has proven to be an exceptional tool for the delivery of this course. Administrative issues such as ease of student enrollment and the quick ability to generate access codes for enrolled students are definite benefits to this particular platform. This platform also has a demonstrated history of ease of use and negligible technical problems associated with user access.

While the *Blackboard* platform is an effective tool for the delivery of course materials to this particular population, it is limited in its ability to collect individual data on the precourse and postcourse surveys instruments. The platform can collect and present questionnaire results as a group, but it lacks the capability to collect and report on individual responses to each question, which in turn, limits the type of statistical test that can be used to analyze the educational outcome data.

Other limitations to this evaluation are that the one group, pretest and posttest design of the research is not particularly strong scientifically. Issues of internal and external validity are present. The presentation of identical survey questions in a test/retest scenario may have accounted for the improvement seen in the posttest medians. Another limitation to this outcome analysis is that all respondents to the surveys were self-selected as evidenced by their desire to enroll in the online course.

The educational outcomes of this course in veterinary therapeutics have been positive. The results show that an online curriculum in veterinary therapeutics for pharmacy students can be used to increase the confidence level in the student's cognitive knowledge after completion. Table 2 shows consistent increases in the postcourse survey question medians indicative of short-term, and perhaps long-term cognitive knowledge in veterinary therapeutics.

Survey results indicated that students' confidence improved in all areas relating to the global course objectives. The online offering of this course appears to be an effective method of educating pharmacy students on topics specific to veterinary pharmacy.

The growth in veterinary pharmacy has allowed pharmacists to apply their drug knowledge resources to veterinary situations. This is accomplished by providing drug information and therapeutic recommendations to veterinarians, animal owner consultation and education, and compounding dosage forms. Pharmacists can advise veterinar-

ians of new developments in human pharmaceuticals and discuss the therapeutic advantages or disadvantages of extra-label usage with veterinarians. Many pharmacists have easy access to text or internet-based informatics that can be used to supply pertinent drug information to veterinarians. Pharmacists, by being one of the most accessible health care professionals, can provide owner consultation and education on dispensed pharmaceuticals or on animal disease states that have similar monitoring parameters to human disease states such as diabetes. Currently, there are few curricular offerings via an accredited school of pharmacy for students to gain comprehensive education on concepts critical to the practice of veterinary pharmacy. This online course is not exclusive and students who desire more education on the subject of veterinary pharmacy can take this course in addition to any didactic or experiential course at their home school.

The educational curriculum and the profession of pharmacy as a whole has historically focused on the human species as the center of disease state and drug therapy management. The profession has undergone dynamic revisions in order to prepare practitioners to provide pharmaceutical care. Courses focusing on animal patients are not a part of the standard offerings of schools and colleges of pharmacy. One practical approach to filling this educational void is to provide the needed information to all interested students via distance education courses. A compliment to this course for pharmacy students has been the offering of an online continuing education (CE) course in veterinary therapeutics for practicing pharmacists. This course is available to any interested pharmacist. The educational outcomes of this CE course have been measured and report similar results.[15] While educational offerings in veterinary pharmacy are trailing the explosive growth in this area, the need has been recognized and this course is now available to pharmacists and pharmacy students alike.

Implications

Upon completing this course, students will have knowledge and skills that can positively impact educational, veterinary, and economic outcomes when veterinary situations arise in their practice. Education of future pharmacists on veterinary medicine acts and guidelines has the potential to positively impact the practice of veterinary pharmacy by assisting pharmacists in being compliant with state and federal laws that affect this practice specialty. There is a need for education of pharmacists who desire to offer products and services to veterinarians, as well as education for veterinarians who seek to use these products and services.

A potential long-term implication of this type of educational offering is that pharmacist-driven education that uses thoughtful adaptation and application of human pharmacy practices to animal situations could provide economic and strategic advantages for progressive pharmaceutical organizations. The comprehensive drug knowledge and unique perspectives of pharmacists trained in veterinary therapeutics can be a valuable resource to veterinary medicine to the ultimate benefit of animal patients.

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