

INSTRUCTIONAL DESIGN AND ASSESSMENT

An Innovative Elective Course in Anticoagulation Management

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Objective. To develop and implement an elective pharmacy course in anticoagulation management and assess student learning.

Design. Students participated in active-learning activities including evaluating a patient receiving outpatient or inpatient anticoagulation therapy, participating in a team project and presentation, and completing a “living with anticoagulation” assignment that included modeling both the health care provider’s and the patient’s role.

Assessment. A precourse and postcourse standardized examination on anticoagulation along with a short answer midterm and final examination were administered. Performance between precourse and postcourse examination improved by approximately 25%, and 90% of students scored $\geq 90\%$ on the final examination. Reflective narratives provided support that students found the “living with anticoagulation” assignment a valuable learning experience which developed empathy towards patients.

Conclusion. An elective course in anticoagulation management that included multiple active-learning assignments was successful in increasing both students’ knowledge and empathy.

Keywords: anticoagulation, patient modeling, active learning, patient simulation

INTRODUCTION

In 2002 the American Association of Colleges of Pharmacy (AACP)/Accreditation Council for Pharmacy Education (ACPE) Task Force on Assessment and Accreditation created graduating student, faculty member, and alumni survey instruments to collect and evaluate data on doctor of pharmacy (PharmD) programs.¹ After the release of the ACPE Standards 2007, these survey instruments were revised and made available to assist colleges and schools of pharmacy in continuous quality improvement. The PharmD program of the Eugene Applebaum College of Pharmacy and Health Sciences at Wayne State University participated in these surveys in 2007. Results of the graduating student survey identified the lack of elective courses as a major concern (32% of students disagreed or strongly disagreed with being satisfied with elective course availability). The PharmD program at Wayne State University allows for 4-credit hours of electives to be completed prior to the beginning of the fourth year. The PharmD curriculum committee was charged with increasing the number of electives offered. Faculty members were asked to consider develop-

ing an elective course proposal in their area of interest and expertise. As a result, a new 2-credit-hour elective course entitled Contemporary Issues in Anticoagulation Management was developed for third-year PharmD students. This paper describes the rationale for this course, provides a summary of course development, and presents outcomes from the first offering of the course.

The traditional role of the pharmacist in anticoagulation therapy management in the inpatient and outpatient setting is well established. When compared to conventional physician care, pharmacist-managed anticoagulation has resulted in improved anticoagulation control, improved patient outcomes, and a reduction in health care costs.^{2,3} As health systems increase their focus on medication safety, the pharmacist’s role in anticoagulation management is expected to expand.⁴ Numerous quality, regulatory, and reimbursement organizations have brought attention to the appropriate preventative and therapeutic use of antithrombotic therapy in the health care setting. The goal of reducing harm with anticoagulant medications was recently added to the list of Joint Commission National Patient Safety Goals.⁵ The Institute for Safe Medication Practice, the Joint Commission, National Quality Forum, and the Agency for Health Care Research and Quality support the establishment of comprehensive anticoagulation management services.⁵⁻⁹ Such services should encompass inpatient and outpatient care

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and the transition between these care environments. In the future, pharmacists will manage and monitor patients with a broad range of thrombotic disorders who are on a variety of antithrombotic medications.⁴ Pharmacy education will play a central role in equipping pharmacy graduates with an appropriate foundation for future practice in this setting.

As an undergraduate anatomy and physiology course is a program prerequisite, students are expected to enter the PharmD program with baseline knowledge of the coagulation system. In the first year, students complete Pathophysiology I and II, which provide approximately 4 lecture hours on abnormalities in coagulation. In the second year, students complete the cardiology module, which provides 9 hours of lecture on the pathophysiology of thrombosis, pharmacology, and chemistry of antithrombotic agents, and the therapy of thrombosis. Students have the opportunity to evaluate patient cases and partic-

ipate in class discussions of these cases. The goal in constructing the anticoagulation elective in the third year was to expand on the knowledge and patient management skills already developed, and to ensure that students developed an understanding of the patient's perspective on anticoagulation therapy.

DESIGN

Development of this course included 4 components: (1) Alignment of course objectives to/with Bloom's and Fink's taxonomies of learning; (2) identification of the desired pedagogy; (3) development of course assignments to meet each objective; and (4) determination of assignment and course assessment plans. An overview of components 1 through 3 is shown in Table 1. Each aspect of course development is described in detail below. The course was designed to be offered to a small number of students.

Table 1. Objectives, Pedagogy, and Course Assignments in a Course on Contemporary Issues in Anticoagulation Management

Course Objective	Bloom's/Fink's Taxonomy	Pedagogy and Linked Course Assignments
(1) Apply evidence-based recommendations to a patient case scenario involving anticoagulant therapy surrounding prevention and treatment of thromboembolic conditions	Bloom's: Level III, Application Fink's: Application, Integration, learning how to learn	<ul style="list-style-type: none"> ● In-class small group discussion - questions from assigned reading on anticoagulation guidelines^a ● Experiential site visit - case presentation ● Patient and health care provider modeling exercise - living with anticoagulation assignment
(2) Assess subjective and objective factors involved with managing a patient on warfarin or parenteral anticoagulants	Bloom's: Level IV, Analysis Fink's: Integration, foundational knowledge, application	<ul style="list-style-type: none"> ● In-class small group discussion - questions from assigned reading on anticoagulation guidelines^a ● Experiential site visit - case presentation ● Patient and health care provider modeling exercise - living with anticoagulation assignment
(3) For patients on anticoagulant therapy, identify potential drug-related problems and develop a comprehensive anticoagulation management plan.	Bloom's: Level V, Synthesis Fink's: Application, integration, foundational knowledge, learning how to learn	<ul style="list-style-type: none"> ● In-class small group discussion - questions from assigned reading on anticoagulation guidelines^a ● Experiential site visit - case presentation ● Patient and health care provider modeling exercise - living with anticoagulation assignment
(4) Analyze and disseminate current information related to issues or controversies in anticoagulation management.	Bloom's: Level IV, Analysis Fink's: Foundational knowledge, application, integration, learning how to learn	<ul style="list-style-type: none"> ● Team project – anticoagulation topic presentation
(5) Judge the day-to-day challenges associated with taking anticoagulation therapy to develop an understanding and empathy for the patient.	Bloom's: Level VI, Evaluation Fink's: Human dimension, caring	<ul style="list-style-type: none"> ● Patient and health care modeling exercise - living with anticoagulation assignment

^a from the *American College of Chest Physicians Evidence-based Clinical Practice Guidelines on Antithrombotic and Thrombolytic Therapy 2008*. See references 12-17.

The course instructors discussed their vision for the course and came to a consensus on the overall course objectives. Once identified, objectives were mapped to both Bloom's and Fink's taxonomies of learning. Bloom's taxonomy involves the cognitive, affective, and psychomotor domain.¹⁰ Fink's taxonomy, on the other hand, is not hierarchical but integrated in its approach to higher learning.¹¹ The instructors sought to teach the course using a variety of student-directed, active-teaching, and learning strategies; traditional lectures were not included. A list of possible active-learning strategies were identified and included in the course: student-directed learning through completion of work prior to class; small group and class discussion; an experiential learning component; a team project with a presentation; and a "living with anticoagulation" exercise, which required the student to model the role of the health care provider and that of an anticoagulation patient. After devising this list of active-learning strategies, the instructors created class assignments to meet course objectives, and then matched assignments to a specific teaching and learning technique (Table 1).

To accomplish objectives 1 through 3, students needed to be familiar with and apply the guidelines presented in the *American College of Chest Physicians Evidenced-based Clinical Practice Guidelines on Antithrombotic and Thrombolytic Therapy*. The instructors identified 5 key chapters/articles within the *Guidelines*¹²⁻¹⁷ and assigned students to read specific chapters and complete 15 to 20 discussion and case-based questions prior to class. During these 5 weeks of the course (Table 2), students spent the first 30 minutes of class in small group discussion (3 or 4 students), followed by discussion involving the entire class. At the semester midpoint, students were given a grade for their class participation, along with subjective comments from the instructors.

Case presentation assignment. Each student was assigned to an experiential training site for a single visit to evaluate an outpatient or inpatient case on anticoagulation therapy. After gathering data and interviewing their patient, students developed a case presentation that identified all pharmacy issues and drug-related problems and included literature-based plans for resolution. They also prepared a class handout with the most pertinent information about their case. This assignment accomplished objectives 1 through 3, and encompassed 4 weeks of class: 2 weeks for completion of site visits and 2 weeks for the student case presentations and classroom discussion.

Team project with topic presentation. Students were assigned randomly to work in groups of 2 to develop a presentation on an emerging topic in the area of anticoagulation. Topics identified by the instructors were

Table 2. Contemporary Issues in Anticoagulation Management Course Schedule

Week 1: Syllabus Review/Assign groups for team topic presentation/Draw topics
Week 2: Case-based discussion on parenteral anticoagulants
Week 3: Case-based discussion on vitamin K antagonists
Week 4: Case-based discussion on venous thromboembolism treatments
Week 5: Site visit to work up anticoagulation patient
Week 6: Site visit to work up anticoagulation patient
Week 7: Students present outpatient site visit presentation
Week 8: Students present inpatient site visit presentations
Week 9: Examination
Week 10: Case-based discussion on bridging
Week 11: Receive <i>living with anticoagulation</i> patient assignment
Week 12: Case-based discussion on venous thromboembolism prevention
Week 13: Thanksgiving break
Week 14: Students present team topic presentation / Report on <i>living with anticoagulation</i> assignment
Week 15: Final Examination

assigned randomly and included: genetic polymorphisms with warfarin; antiphospholipid syndrome; post thrombotic syndrome; controversies with low molecular weight heparin (LMWH) and unfractionated heparin (UFH) as therapy for pregnant patients with mechanical heart valve replacement; and new antithrombotics. A 15-minute oral presentation and a 1-page written summary were required. This assignment accomplished objective 4, and required 2 weeks of class time.

Living With Anticoagulation assignment. The "living with anticoagulation" assignment was a newly developed, innovative teaching strategy that met 4 course objectives (1, 2, 3, and 5). In constructing this assignment, 3 student goals were considered: (1) to identify and empathize with the daily challenges associated with taking and adhering to anticoagulation therapy (including diet, self monitoring, and administration of therapy); (2) to identify individualized therapeutic targets (including international normalized ratio [INR] range and duration of therapy); and (3) to communicate a pharmacotherapeutic plan for an anticoagulation patient using a SOAP (subjective, objective, assessment, and plan) note. A first-year pharmacy resident completing an academic rotation developed 12 different anticoagulation cases (an example is provided in Appendix 1).

This assignment allowed the student to play a dual role, that of both patient and pharmacist, following the patient's anticoagulation management. Each student was assigned a patient case that contained the diagnosis,

comorbid conditions, pertinent history related to anticoagulation, medication list, current INR value, and warfarin dose. Students were given instructions on how to create a dosing calendar, maintain a daily dietary log of vitamin K intake, monitor stool and urine for blood, and monitor medication intake and changes, including non-prescription medications, vitamins, and herbal products. After reading the initial case history, students first acted in the role of the caregiver and responded to their most recent clinic visit data (ie, medication changes, INR data, upcoming surgery, etc) by creating a pharmacotherapy management plan for themselves for the next week. After creating this plan, students followed the plan and reported back to the clinic for follow up. Each student was given the necessary props to play the role of the patient. Props included placebo pills, pill box, anticoagulant dosing calendar, saline syringes, warfarin education booklet, compression stockings, stool occult blood cards, dietary log, and a cane (for a patient with difficulty ambulating). Students were required to keep a dietary log and calculate their daily intake of vitamin K. For the second part of the assignment (week 2), students were provided with a follow-up scenario that included a new INR and any information regarding bleeding or thrombotic events in the past week. From this, the students created a pharmacotherapy management plan for the second week.

After completion of this assignment, students were required to write a SOAP note (in the role of the pharmacist) about him/herself (the patient) for the first week. An example of a completed SOAP note from an anticoagulation clinic was provided to students along with the assessment checklist that instructors used to evaluate the SOAP note. Students also had to submit a written reflection upon completion of the experience. Universal to all student reflections was a required discussion on the challenge of monitoring daily vitamin K intake and medication adherence. Additional content in each student's case scenario differed depending on their patient's comorbid condition(s), complications from venous thrombosis, need for bridging, or need for stool guaiac monitoring built into the case.

EVALUATION AND ASSESSMENT

Class participation, the team presentation, and the case presentation were graded using rubrics. Students' grades represented the average of the scores given by the 2 course instructors. The newly developed "living with anticoagulation" assignment was assessed using 3 methods: review of the student's written SOAP note; review of the student's self-reflection; and completion of an 8-question online assessment of the experience after the course was completed. All students received a score

$\geq 80\%$ (mean 90%) on their written SOAP note using a standardized grading template. Comments from student self-reflections supported that they understood, recognized, and empathized with the challenges of daily living that patients faced while on anticoagulant therapy.

The online assessment provided evidence that this assignment met the goals identified *a priori*. On 7 of the 8 questions, 100% of the students either agreed or strongly agreed with their development in the area queried (Table 3). Questions 1, 3, 6, and 7 supported the development of student understanding and empathy, questions 2 and 4 supported their ability to recognize therapeutic targets for anticoagulant medications, and question 5 demonstrated that students were prepared to write anticoagulant SOAP notes.

Two short-answer examinations (a midterm and final) were administered. Examinations required students to explain therapeutic principles, identify anticoagulant drug-related problems, and create appropriate management and monitoring plans. Ten percent of the material on the final examination was cumulative. The final course grade was determined as follows: class participation (20%), midterm examination (20%), case presentation (10%), team topic presentation (20%), SOAP note/self reflection (10%), and final examination (20%).

To quantify the overall learning accomplished through this course, an anticoagulation pretest was administered to students at the beginning of the first session. This assessment included 20 questions from a local area health system anticoagulation competency test for pharmacists. The same assessment was administered to students after the completion of the last class, and precourse scores were compared to postcourse scores. Four questions on material which was not covered during the class were eliminated from this comparison prior to the analysis. Questions included in the final assessment focused on those concepts that all students had the opportunity to learn, and excluded specific learning points that may have arisen from the experiential site visit. The mean score on the 16-question anticoagulation pretest was 58.6% and the posttest was 83.1%. All students received a score $\geq 75\%$ on the posttest.

DISCUSSION

This paper describes the successful first offering of a new P3 elective course, Contemporary Issues in Anticoagulation Management. This course was designed for a small number of students to allow the entire course to be delivered through a combination of active-learning strategies. Improved knowledge and patient management skills were demonstrated through a number of different assessments. The mean score from the anticoagulation

Table 3. Online Assessment of “Living With Anticoagulation” Assignment (N = 10)

Question ^a	Somewhat Agree (%)	Agree (%)	Strongly Agree (%)
After completing this assignment I have a better understanding of the challenges of maintaining a consistent weekly intake of vitamin K.	-	30	70
I feel adequately prepared to monitor a patient’s anticoagulation therapy with confidence.	-	70	30
I found the experience of self-injection a valuable insight into the challenge this may pose for patients. ^b	-	20	10
I am able to identify individualized therapeutic goals for an anticoagulation patient.	-	60	40
I am able to write a SOAP note for a patient in an anticoagulation clinic on my P4 rotations.	-	60	40
I found the experience of adhering to my anticoagulant dosing calendar provided insight into the challenges of chronic medication adherence with anticoagulant therapy.	-	50	50
This experience has increased my sensitivity and empathy for patients on anticoagulation therapy.	-	50	50
I suggest the “Living with Anticoagulation” assignment continue to be part of this elective.	10	20	70

^a Scale: 1 – 5: 1 = strongly agree; 2 = agree; 3 = somewhat agree; 4 = neutral; 5 = somewhat disagree; 6 = disagree; 7 = strongly disagree; NA

^b only 3 students responded to this question as these students were assigned a case involving parenteral anticoagulant therapy
SOAP= subjective, objective, assessment, and plan

pretest to the posttest increased by approximately 25%, with all students scoring above 75%. Student performance on a short-answer, case-based cumulative final examination was excellent, with 90% of the students receiving a score $\geq 90\%$.

After course completion, the instructors evaluated each assignment to reflect on the learning that occurred and to identify opportunities for improvement. Initially, 5 weeks of course time focused on applying therapeutic principles from recent guidelines on antithrombotic therapy (parenteral anticoagulants, vitamin K antagonists, treatment of venous thromboembolism, prevention of venous thromboembolism, and perioperative anticoagulation management).¹²⁻¹⁷ Although some student assignments (experiential site visit and team topic presentation) required an understanding of anticoagulation issues in valvular heart disease and atrial fibrillation, these topics were not included due to time constraints, the desire to keep the course workload manageable, and the goal to maximize other active-learning techniques. These topics will be added to the next course offering. Course time for these topics will be gained by having students attend class on 1 of the 2 weeks previously scheduled out of class for completion of the experiential site visit.

The experiential site visit assignment was well received by students. For subsequent classes, instructors will provide a template of an inpatient anticoagulation case presentation to assist students in organizing their information. Additionally, the class time allotted for

presenting these cases will be increased to allow more interactive discussion. In the future, additional instruction will be given about the topic presentation and the expected roles and contributions of each team member.

The patient modeling exercise, “living with anticoagulation” was a newly developed innovative instructional strategy. The experience emphasized the pharmacist’s role in managing a patient’s anticoagulant therapy. Each case was designed around the need to consider patient-specific factors when outlining a pharmacotherapy plan. Results from the post-course assessment of this exercise supported student learning with regard to anticoagulation therapy management. All students either agreed or strongly agreed with the following statements: “I feel adequately prepared to monitor a patient’s anticoagulation therapy with confidence;” “I am able to identify individualized therapeutic goals for an anticoagulation patient;” and “I am able to write a SOAP note for a patient in an anticoagulation clinic on my P4 rotations.” This assignment also promoted student learning in the areas of empathy and patient understanding related to anticoagulation therapy. All students either agreed or strongly agreed with the following statements: “I have a better understanding of the challenges of maintaining a consistent weekly intake of vitamin K;” “Adhering to my anticoagulant dosing calendar provided insight into the challenges of chronic medication adherence with anticoagulant therapy;” and “This experience increased my sensitivity and empathy for patients on anticoagulation

therapy.” The assignment also raised some interesting cultural considerations as 2 students, one who ate a Lebanese diet and the other an Indian diet, found it difficult to determine the vitamin K content of some of their foods.

Three anticoagulation cases involved managing post-thrombotic syndrome with graduated compression stockings. Students were fitted for and received a pair of graduated compression stockings. All 3 students reported the challenges associated with using the stockings, but also recognized the benefit for the patient. One student reflected, “I liked wearing the compressions stockings at first, but by the end of the day, they were so constrictive that I wanted to take them off. The stockings were also hard to put on. I can only imagine how hard they are to maneuver for an older person.” Another student was required to monitor her stool using stool guaiac cards. She was able to appreciate the complexity of such monitoring in her statement, “Testing my stool with guaiac cards was hard work and required commitment. I will forever be empathetic to patients who have to use these stool testers.”

Having students play dual roles in this modeling exercise contributed to learning. One student, playing the role of a patient at low risk for thrombosis with a subtherapeutic INR, created an initial plan to use twice daily low molecular weight heparin bridge therapy. After leaving class he reflected on his management plan and realized the evidence did not require bridging, and now he, as the patient, would have to follow the plan he had created. His reflection indicated, “This exercise was very eye opening. I never took a look at the patient’s perspective when taking medications.” Outside of class, he then reevaluated and changed his anticoagulation plan after considering the patient’s point of view on twice daily injections in a low-risk situation.

The concept of patient modeling exercises, with students assuming the lifestyle attributes of their patients, has been described and implemented in other teaching settings.¹⁸⁻²⁰ Chen and colleagues used this teaching model with pharmacy students in an advanced pharmacy practice experience in caring for an underserved patient population.¹⁸ In their patient modeling exercise, the students simulated the life of a patient who had multiple chronic diseases and was coping with an economic, cultural, or communication barrier to optimal health care. This pedagogy improved pharmacy student empathy toward the psychosocial situation of the underserved population. Another patient modeling exercise described an addiction recovery course with pharmacy students undergoing a guided abstinence experience through a 6-week process of giving up a problematic habit.¹⁹ Assuming the patient’s role not only helped students understand the

concept of the addiction and recovery procedure, but also improved their perceived ability to assist addicted patients and colleagues.

Previous descriptions of patient modeling exercises outline examples where students dealt with the challenges of being a patient with psychosocial issues and health care barriers. To our knowledge, the “living with anticoagulation” exercise implemented in our course is the first description of a dual role pedagogy where students had to make clinical decisions as a pharmacist, and live as a patient with the consequences of those decisions. The authors believe the “living with anticoagulation” assignment could be translated easily to other types of chronic illness addressed in other pharmacy courses.

CONCLUSION

An elective course on anticoagulation management for P3 students was developed. The construct of this course enabled the use of unique teaching strategies that took learning beyond the classroom setting. Outcome data provided evidence of improved knowledge, patient management skills, and patient empathy. Giving students an opportunity to “walk a mile” in their patients’ “shoes” by incorporating learning through a modeling exercise taught students important knowledge, skills, and attitudes required of a pharmacist. The “living with anticoagulation” assignment not only increased students’ empathy for their patients, but also improved their clinical skills and confidence when acting as the pharmacist providing care in the assignment. The authors anticipate that this learning experience will leave an indelible impression on the students that translates into quality patient-centered care for the anticoagulation patient.

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Appendix I. "Living With Anticoagulation" Patient Case

Living With Anticoagulation - Patient Case 1 - Week 1

Anticoagulation related history:

You are a 30 year old with a deep vein thrombosis, diagnosed 1 month ago. You have been taking warfarin since your diagnosis. You have been fully educated on your anticoagulation therapy. You currently have residual pain and swelling in your left leg (where you had the DVT). Your doctor has diagnosed you with post thrombotic syndrome (PTS). You are instructed to wear compression stockings for PTS.

Past medical history:

Positive Factor V Leiden

No other significant medical history

Medications:

Warfarin (dosed by the anticoagulation clinic)

Centrum multivitamin

Vicodin 1-2 tablets Q 4-6 hours prn for leg pain

Ibuprofen 800 mg TID prn for leg pain

Warfarin dose prior to today:

5 mg daily except 7.5 mg on Monday and Friday (40 mg/week)

INR today: 2.2

Instructions:

Before the end of class today, you must determine your INR goal, and your warfarin dose for the week based on the above information.

You must fill out the warfarin dosing calendar and present it to the class instructor. During the next week, you must take your "warfarin" as designated on your calendar, keeping track of any errors in dosing or missed doses. You must monitor yourself daily for signs and symptoms of bleeding, checking your stool and urine, bruising, bleeding gums, or bloody noses. Make note of any such problems. You must keep a diet log of all foods eaten during the week, and attempt consistency with vitamin K intake. Write down any actual prescription medications, over-the-counter medications, herbal medications, or vitamins that you are taking (in addition to the medications listed above). Note any warfarin interactions that may be present with any of these therapies.

Props:

Pill bottle with "warfarin" 5 mg tablets

Pill box

Warfarin dosing calendar

Diet log

Compression stockings

Warfarin education book

Patient Case 1 - Week 2

You return to the clinic today. Note pertinent anticoagulation related information below.

Current warfarin dose:

Missed doses or deviation from schedule:

Number of servings of vitamin K-containing foods:

Other dietary interactions with warfarin:

Signs or symptoms of bleeding noted:

Warfarin-drug interactions:

INR today: 3.2

Instructions:

Before the end of class today, you must determine your INR goal, and your warfarin dose for the week based on the above information.

You must fill out the warfarin dosing calendar and present it to the class instructor. During the next week, you must take your "warfarin" as designated on your calendar, keeping track of any errors in dosing or missed doses. You must monitor yourself daily for signs and symptoms of bleeding, checking your stool and urine, bruising, bleeding gums, or bloody noses. Make note of any such problems. You must keep a diet log of all foods eaten during the week, and attempt consistency with vitamin K intake. Write down any actual prescription medications, over-the-counter medications, herbal medications, or vitamins that you are taking (in addition to the medications listed above). Note any warfarin interactions that may be present with any of these therapies. You must continue to wear your compression stockings for PTS.

Props:

Warfarin dosing calendar

Diet log

Warfarin pill refills (if needed)

Abbreviations: DVT = deep vein thrombosis; INR= international normalized ratio