

## INSTRUCTIONAL DESIGN AND ASSESSMENT

### A Critical Care Hybrid Online Elective Course for Third-Year Pharmacy Students

Matthew A. Wanat, PharmD, Anne M. Tucker, PharmD, Elizabeth A. Coyle, PharmD

University of Houston College of Pharmacy, Houston, Texas

Submitted August 25, 2015; accepted October 31, 2015; published November 25, 2016.

**Objective.** To assess the impact of a four-week hybrid online elective course in critical care on student learning attitudes and outcomes compared to that achieved when the same course was taught using a traditional lecture-based approach.

**Design.** A hybrid online elective course was created that featured video-recorded lectures and in-class skills laboratories. Course evaluations were used to assess student perceptions of learning methods, and examination scores were used to assess learning outcomes.

**Assessment.** One hundred five students enrolled in the critical care elective course from 2011-2014. Fifty-four students completed the traditional lecture course, and 51 completed the hybrid online elective course. The examination scores of students who completed the hybrid course were significantly higher than those of students who completed the traditional lecture course. The majority of students enrolled in the hybrid online elective course stated they preferred that format over a traditional course format and would recommend the elective course to a peer.

**Conclusion.** Students preferred the format used for an online hybrid elective course in critical care over a traditional course format, and performed better on examinations than did students who had completed the course when it was offered in a traditional lecture format.

**Keywords:** critical care, pharmacy, elective course, hybrid course, curriculum

## INTRODUCTION

Critical care medicine is the multidisciplinary health-care specialty that cares for patients with acute, life-threatening illness or injury. Over the past several decades patients' health conditions have become more complex and critical care medicine has expanded with increased lengths of stay in the intensive care unit (ICU), higher occupancy rates and higher costs to the healthcare system.<sup>1</sup> More than 5 million people are admitted to the (ICU) each year in the United States, accounting for 13.4% of hospital costs and over 81 billion healthcare dollars each year.<sup>2</sup> Care of the critically ill patient is multifaceted and requires a host of interdisciplinary team members with sufficient education and training, including a pharmacist, to provide safe and effective care.

The complexity of critical care pharmacotherapy requires specialized education and training for the pharmacist to maximize patient outcomes. In 2011, 83% (44/53) of colleges of pharmacy responding to a survey indicated that their therapeutics curriculum included critical care

content.<sup>3</sup> Critical care topics are traditionally difficult to master for students based on the intricacy of the disease states involved. With a crowded curriculum at most colleges of pharmacy, critical care lectures often only touch the surface of learning. Supplemental courses introducing specialty topics such as critical care, or advanced elective courses can help improve students' understanding of these difficult topics, and spark an interest in this field of clinical pharmacy prior to students beginning their advanced experiential education.

In a 2010 survey, 50.9% (27/53) of pharmacy schools indicated they offered a critical care elective course for students interested in a deeper understanding of care for critically ill patients.<sup>3</sup> Additionally, the pharmacy profession has met the increased need for specialty residency training in critical care pharmacy by establishing 108 postgraduate year 2 critical care residency programs and 144 residency positions as of 2014.<sup>4</sup> However, with a disproportionate need for clinical pharmacists in the ICU compared to the number of critical care residencies available, many ICU pharmacists never receive specialty training in intensive care beyond that in the standard pharmacy school curriculum.<sup>5</sup> This further emphasizes the importance of an effective critical care education in pharmacy school.

---

**Corresponding Author:** Matthew Wanat, 1441 Moursund St., Houston, Texas 77030. Tel: 834-842-8367. Fax: 832-842-8383. E-mail: MAWanat@uh.edu

At the University of Houston College of Pharmacy, all third-year professional students receive critical care pharmacotherapy instruction during mandatory advanced therapeutics courses. Students transitioning from their second- to third-professional year are required to earn six credits in elective courses during the summer, with Critical Care Therapeutics being one of the many elective options. Critical Care Therapeutics has been offered as an elective course to students since 2005. With the current placement of elective courses in the summer before the third professional year, the critical care elective course primarily builds upon Domain 1 (Foundational Knowledge) of the American Association of Colleges of Pharmacy Center for the Advancement of Pharmacy Education (CAPE) outcomes. Students enrolled in the course gain foundational knowledge that is necessary in maximizing pharmacotherapy to critically ill patients. The skills laboratory assignments/sessions that students are required to complete as part of the course teach problem solving and fulfill CAPE outcome 3.1, but only at an introductory level. Further foundational knowledge, problem-solving skills, and patient-centered care skills (Domain 2.1) are taught later in the therapeutics portion of the core curriculum.

With a current initiative of college leadership being to increase innovative teaching methods to improve student learning, and the need for flexible class schedules during the summer session for students completing their introductory pharmacy practice experiences (IPPEs), a hybrid online/in-class elective course was created and initially offered during the summer of 2013. To our knowledge, this is the first study that compares learning outcomes from a hybrid elective course with those from a traditional elective course, when the course is taught over a condensed four-week time period.

## DESIGN

Critical Care Therapeutics is a 2-credit-hour elective course offered during the summer semester for pharmacy students transitioning into their third professional year. Prerequisites included successful completion of Therapeutics I, which covers chronic disease states such as hypertension, diabetes, hyperlipidemia, asthma/chronic obstructive pulmonary disease and thyroid disorders, and Pharmacy Practice IV, which teaches the contemporary practices of community and hospital pharmacy.

With the current placement of electives prior to Therapeutics II and III being taught in the third professional year, elective courses at the University of Houston serve as introductory learning experiences rather than enhanced study of topics. The critical care elective course provides an introduction to topics that will be

taught in the required Therapeutics II and III modules, in addition to several specialized topics not taught elsewhere in the curriculum (Table 1). The elective course is team taught, co-coordinated by two clinical faculty members at the University of Houston College of Pharmacy and other critical care faculty members. Guest lecturers include critical care clinical pharmacy specialists and residents from local institutions in the Texas Medical Center.

Prior to offering the hybrid version of the course in summer 2013, the critical care elective course was presented as a traditional classroom lecture-based course over a four-week period in the summer semester. The class met four days each week for two hours per day and attendance was required. Course requirements included attending 12 live lectures, watching an ICU ethics video, and writing a follow-up essay. Students also had to attend two skills laboratory sessions in which they applied lecture material to patient cases. A question and answer period and examination review were conducted at the end of each laboratory session. All guest lecturers were invited to attend the skills laboratory sessions to serve as cofacilitators. The course grade was based on scores on two noncumulative examinations (40% each), participation in skills laboratory sessions (10%), and score on the ethics writing assignment (10%). Recommended textbooks for the course included *Pharmacotherapy: A Pathophysiology Approach* (DiPiro et al) and *Critical Care Pharmacotherapeutics* (Johnson).<sup>6,7</sup> The learning objectives for the course are provided in Table 2.

Starting in the summer of 2013 semester, the critical care elective was redesigned as an online hybrid course that used the same course proficiencies as the traditional course. On the first day of class, faculty members met with students to discuss the course design, introduce the online content, and answer student questions. The college uses the Blackboard Learn (Blackboard Inc., Washington, DC) learning management system to post course information. All lecture topics were created with PowerPoint and voice recorded using Camtasia Software (TechSmith Corporation, Okemos MI) or Mediasite (Sonic Foundry, Madison, WI). The narrated presentations were uploaded and given a private link so only students enrolled in the course had access to them.

Each lecture topic had its own content folder that contained a link to the presentation, a pdf version of the presentation for student printing and note taking, and supplemental material (eg, relevant primary literature, clinical practice guidelines, and additional video content). The final grade for the new hybrid course was based on scores on two examinations (40% each), scores on online quizzes administered after each lecture

Table 1. Critical Care Topics Covered in the Elective and Advanced Therapeutics Courses

<b>Topics only covered in Critical Care Therapeutics Elective Course</b>	<b>Topic covered in both courses</b>	<b>Topics only covered in Advanced Therapeutics (required course)</b>
Hematological disorders in the ICU	Hemodynamics and hypovolemic shock (covered in physical assessment course)	Fluid and electrolyte disorders
Ethics in the ICU	Mechanical ventilation/Acute respiratory distress syndrome	Neuromuscular blocking agents
Pharmacokinetic/dynamic considerations in ICU patients	Advanced cardiovascular life support (ACLS)	Status epilepticus
Neurotrauma	Decompensated heart failure	Alcohol withdrawal (added to elective in 2015)
	Stress ulcer & deep vein thrombosis prophylaxis	Hypertensive emergencies
	Sepsis	Hemodialysis and Peritoneal Dialysis
	Sedation and analgesia	
	Delirium	
	Acid/base disorders	

(10%), and participation in skills laboratory sessions (10%). New in 2013, students were required to attend a mechanical ventilator demonstration conducted at the Department of Respiratory Care at Houston Methodist Hospital, in Houston, TX. The demonstration was given by the Director of Respiratory Care Services and introduced students to the functions of and settings for a ventilator.

Each Monday morning, three to five lectures were made available to students. The students had until Sunday evening to learn the content presented in the lectures and complete an online recall assessment for each. The online quiz consisted of five questions and was designed to assess student knowledge of key concepts after viewing the lecture. Students were encouraged to use an online discussion board on Blackboard Learn to ask questions regarding difficult concepts, with faculty serving as discussion board moderators. Students attended in-class skills laboratory sessions during weeks 2 and 4 where they completed patient cases that were related to lecture topics. The skills were taught in the same format previously used

in the traditional lecture course. Faculty used the in-class skills laboratory sessions and recall quizzes to assess student comprehension of key concepts, and answer student questions in an examination review format. In 2014, examination review Q&A sessions were separated from skills laboratory sessions, based on student feedback, to allow students the opportunity to ask new questions that arose after the previous day's skills laboratory but prior to the upcoming examination.

The in-class time required for students and faculty members was reduced to 13 hours compared to 30 hours with the traditional course design. A sample class schedule is included (Appendix 1). The class was taught by two faculty coordinators, a teaching assistant, and several guest lecturers. The course coordinators were responsible for posting content, coordinating video recordings, and facilitating content on the discussion board, in addition to providing lectures. The teaching assistant helped with the technical aspects of lecture recording. Several local Critical Care Clinical Pharmacy Specialists provided guest lectures on topics they specialized in, and were

Table 2. Critical Care Therapeutics Learning Objectives

Discuss the pathogenesis and pathophysiology of specific disease states related to critical care (shock, pulmonary, cardiovascular, renal, neurological, gastrointestinal, hepatic, infectious diseases, analgesia, nutrition, ethics/end of life)
Analyze and solve complex problems for patients who are critically-ill
Collect patient specific information needed to resolve drug therapy problems
Develop a patient specific problem list
Identify individualized treatment goals and optimal therapeutic regimens
Establish an appropriate individualized monitoring plan
Recommend alterations in therapy based on monitoring
Apply principles of advanced cardiac life support and emergency care to patient care situations.

invited to participate in skills laboratory sessions. This research has been approved by the University of Houston IRB.

## EVALUATION AND ASSESSMENT

One hundred five students enrolled in the critical care course from 2011 to 2014, with 54 students taking the course via the traditional lecture format in 2011 and 2012, and 51 via the hybrid online format in 2013 and 2014. Students were assessed using two paper-based examinations during the course, both of which consisted of 42 multiple-choice questions with four possible responses for each question. The first examination covered content taught during the first half of the course, and the second examination covered content taught during the second half of the course and was not cumulative. All test items were written by the lecturer who had presented the material addressed in the question. Only topics that were taught and evaluated in both the traditional (2011 to 2012) and hybrid online course (2013 to 2014) were included in this study. An unpaired *t* test was used to compare the group's average examination scores. All *p*-values were 2-sided and statistical significance was defined as an alpha less than .05. All data were analyzed using GraphPad Software (GraphPad Software, Inc., La Jolla, CA). The presentation of results from our curricular redesign were approved by the University of Houston Institutional Review Board.

Students enrolled in the hybrid online critical care elective course had higher mean examination scores than students taking the traditional course ( $87.7\% \pm 3.7$  vs  $82.6\% \pm 6.3$ ,  $p < .001$ ). Students who took the hybrid course also performed better on specific topics covered by the examination such as acute decompensated heart failure, hemodynamics and hypovolemic shock, and nutrition support (Table 3).

A special survey was distributed to students enrolled in the first offering of the hybrid online course in 2013 to gain additional feedback regarding course delivery. Twelve of the 21 students taking the course in 2013 responded, for a 57% response rate. Eleven students (92%) said they would recommend taking an online elective course using this format to their classmates. Eight students (67%) indicated they preferred the online hybrid format over a traditional course format, compared to three (25%) who said they had no preference. The majority of students stated that both the online assessment quizzes (75%) and in-class case-based discussions (83%) were beneficial to learning. Based on course format and not the overall subject matter, 50% of students stated they spent more time learning in the hybrid online course compared to time spent learning in their other elective courses, while

50% said they spent about the same amount of time. The in-class hours were reduced from 30 hours for the traditional format elective course to 13 hours with the hybrid online course.

In their responses to open-ended survey questions, students listed the ability to choose their own schedule and listen at their own pace as positive aspects of the course. Students also appreciated being able to stop and look up information when new concepts were presented without missing anything. When asked what area of the course needed improvement, students indicated that the recording quality of the lectures need to be improved so there was less background noise. Students stated a negative aspect of the course was the lost networking opportunity with local clinical pharmacy specialists when they could not serve as co-facilitators for the skills laboratory content they had lectured on. Although students were encouraged to use a new online discussion board feature in 2013 and 2014, less than 10 total posts were made online each year. Students indicated they preferred to use their Facebook group forums because they could post about any class in this forum.

## DISCUSSION

Even with the impressive number of programs offering an elective course in critical care, there are no published reports on a critical care online hybrid course and related learning outcomes. Several studies have described critical care elective courses at colleges of pharmacy throughout the United States.<sup>8,9</sup> A study with fourth year medical students given an online hybrid curriculum during fourth-year clerkships in the ICU demonstrated improved knowledge compared to pre-clerkship evaluations.<sup>10</sup> There are several descriptions of curricular innovation in pharmacy education using hybrid courses which have shown positive effects on learning outcomes that are similar to our strategy.<sup>11-13</sup> Zapantis and colleagues used a hybrid online elective course to teach internal medicine topics. Very similar to our course but in internal medicine, they utilized online recordings, assessments, and in class activities and assignments. The assessment tool used in their curricular innovation was student survey feedback, which demonstrated the course was recommended by students and helped prepare them for APPEs.

This study did not provide any objective examination performance data to show the effectiveness of course delivery. Most similar to our course design was the work by Seybert and colleagues describing a hybrid online acute care elective course focused primarily on critical care and cardiovascular pharmacotherapy. Students watched weekly video presentations (45 minutes per week) and

Table 3. Comparison of Examination Performance by Pharmacy Students Enrolled in a Critical Care Elective Course

	Hybrid Online Course N=51 students	Traditional Course N=54 students	p-value
Overall Examination Scores	87.7 (3.7)	82.6 (6.3)	<0.0001
Year 1 Hybrid Course - 2013	86.7 (3.7)		N/A
Year 2 Hybrid Course - 2014	88.6 (3.4)		N/A
Traditional Course - 2011		80.0 (6.5)	N/A
Traditional Course - 2012		85.4 (4.7)	N/A
Comparison of Exam Scores (mean +/- standard deviation) on Selected Topics			
Acute Decompensated Heart Failure	87.7 (10.9)	73 (16.3)	<.001
Advanced Cardiovascular Life Support	86.3 (13.8)	89.2 (13)	.28
Hemodynamics and Hypovolemic Shock	94.6 (9.3)	77.4 (13.7)	<.001
Nutrition Support	83.8 (11.9)	76.2 (16.1)	.007
Sepsis	91.3 (9)	93.1 (10.9)	.36

then participated in a skills laboratory in which they assessed and treated simulated patients. Students improved their performance on nine out of 10 weekly post-tests in the course (compared to pretest scores) and were satisfied overall with the learning approach. While very similar to our course design, the major difference was content provided per week. Their course was spread out over 10 weeks with less than one hour of content per week, while our course delivered four to six lecture hours of content per week over a four week condensed period. Our student performance data indicate that critical care topics can be taught in a hybrid format in a four-week time period, which may be the timeframe many college of pharmacy have built into their curriculum to deliver electives within. Our curricular redesign and educational strategy aimed to build off currently available data and provide information regarding taking a relatively common elective course and teaching it in a hybrid online format in a condensed four-week period.

Students' performance on examinations did not decrease when the course format was changed from a traditional lecture format to a hybrid online learning format. Because the examinations for the years compared in this study did not contain identical questions, only similar examination topics were included in the analysis and compared against each other. There may be several reasons why students' performance improved with the online hybrid course format. First, students were able to learn at their own pace instead of during a defined period of time. The new format may have appealed to students who were visual learners (slides and video recording) or auditory learners (audio recordings), and students who need more time to grasp concepts. The new format also encouraged group learning among students with online discussion boards, in-class active learning sessions and content reviews.

While students were encouraged to use the Blackboard Learn discussion board to work through difficult topics, it was only used minimally. However, the students stated they frequently used social media platforms such as Facebook forums to discuss the content among themselves. Additionally, several individual topics such as acute decompensated heart failure, hemodynamics and hypovolemic shock and nutrition support in the ICU also showed improved examination scores, while advanced cardiovascular life support (ACLS) and sepsis had similar examination scores. The authors postulate that certain topics, such as ACLS, may be better taught through face-to-face instruction because of the difficulty of explaining complex algorithms in a video recording. The addition of required quizzes after each lecture gave students another assessment of their learning and may have helped improve examination scores. While some examination questions were recycled in subsequent years, most examination questions were updated each year and may account for differences in student performance.

The most common feedback regarding the course delivery was the ability to stop the recording and further research a topic, or take a short break. We chose to release a group of lectures to the students each week as opposed to releasing all the content in the beginning. This was done to prevent student overload from waiting until the last day to complete all lectures, and to closely mimic the flow and structure of a traditional course. Data from Blackboard Learn indicated that a majority of students completed the required quizzes less than 24-48 hours before the due date. The quizzes counted for 10% of the course grade, enough credit that the students took them seriously. Student comments stated they appreciated the quizzes because it kept them focused and on track.

The logistics, time and effort to convert our course to an online hybrid course was time intensive in the

beginning. Faculty and guest lecturers had to learn how to use the recording software, coordinate time to record and edit lectures, and building the course in Blackboard Learn. Since the first year that the hybrid elective course was offered, the faculty members have used a combination of different software platforms to allow lecturers to record on their own time and deliver video recordings to course coordinators via Dropbox. Blackboard Learn was an easy to navigate system to index recordings, lecture files and supplemental readings, in addition to building required online learning assessments after each lecture. Although increased time and effort was required for faculty members to get the course started, the overall faculty time commitment decreased in subsequent years after the online infrastructure was complete and less in-class time was required.

We continue to evaluate the content taught in the elective course and make modifications depending on the needs of the students and what is taught in the core curriculum. Over the past few years, a Hematological Disorders in the ICU lecture and Alcohol Withdrawal lecture were added to the course. Additionally, Ethics in the ICU was added as a standalone lecture in place on an ethics video that was previously shown. We were able to add these topics by reducing the time allotted for several other topics taught in the course from two class hours to one class hour. The newly incorporated topics were not included in the examination performance data because no similar examination questions had been given to the traditional lecture group so no comparisons could be made. The American College of Clinical Pharmacy (ACCP) has created a Pharmacotherapy Didactic Curriculum Toolkit that serves as an excellent guide to colleges in determining content to be taught in therapeutics curriculum.<sup>14</sup> This toolkit may be particularly useful to faculty members when creating electives in different specialties. Future topics for incorporation in our course may include an ICU devices lecture, solid organ transplant in the ICU, and hepatic diseases in the ICU.

There are several limitations to consider with this curricular innovation. First, while some of the lecturers returned and taught in the course all four years, there were several new faculty members and lecturers for the course in 2013 and 2014. The varied teaching styles of these educators may have had an impact on student learning and results. We did not obtain baseline academic performance of the students enrolled in the course for each of the years. Academically stronger or weaker students enrolled in the class in one or more of the years studied may have impacted our results. There is also the possibility that students who were not interested in critical care took the course in 2013 or 2014 simply because it was offered as

a hybrid elective course, and that may have impacted their motivation or performance. Additionally, in 2014, we converted the examination reviews into standalone sessions delivered prior to examinations and that may have improved student performance compared to 2013. Online recall quizzes were also added as a new feature of the hybrid online course, which may have served as an aid or self-assessment for students when preparing for examinations. The online quizzes may have had a positive impact on student performance on examinations, especially as 75% of students responded they were a beneficial learning experience during the focused survey in 2013.

## CONCLUSIONS

Students preferred an online hybrid elective course format over a traditional classroom-based course format. Students taught with the online hybrid course format performed better on examination content compared to students taught via traditional lecture. This condensed, online hybrid course provides an effective example of how colleges of pharmacy may be able to include essential content, like critical care pharmacotherapy, into an already crowded curriculum. Future research will analyze the effect of the elective course on student performance on critical care topics in a required therapeutics course compared to students who did not take the elective.

## ACKNOWLEDGMENTS

The authors acknowledge Dr. David Wallace and Ms. Shari Mauthner for their technological support in recording lectures and providing this course online. Results from this manuscript were presented as a poster presentation at the AACP Annual Meeting in July 2015.

## REFERENCES

1. Halpern NA, Pastores SM. Critical care medicine in the United States 2000-2005: an analysis of bed numbers, occupancy rates, payer mix, and costs. *Crit Care Med*. 2010;38(1):65-71.
2. Society of Critical Care Medicine. Critical care statistics. <http://www.sccm.org/Communications/Pages/CriticalCareStats.aspx>. Accessed July 7, 2014.
3. Cook AM, Weant KA, Gross AK, Ashton JN, Lemon SJ, Winstead PS. Survey of critical care education in US colleges of pharmacy. *Curr Pharm Teach Learn*. 2011;3(4):290-298.
4. ASHP Resident Matching Program. Summary of programs and positions offered and filled for the 2014 match. <https://natmatch.com/ashprmp/stats/2014summpos.html>.
5. Erstad BL. A primer on critical care pharmacy services. *Ann Pharmacother*. 2008;42(12):1871-1881.
6. DiPiro JT, Talber RL, Yee GC, Matzke GR, Wells BG, Posey LM. *Pharmacotherapy: A Pathophysiologic Approach*. 9<sup>th</sup> ed. New York, NY: McGraw-Hill; 2014.
7. Johnson TJ. *Critical Care Pharmacotherapeutics*. 2<sup>nd</sup> ed. Burlington, MA: Jones and Bartlett Learning; 2013.

*American Journal of Pharmaceutical Education 2016; 80 (9) Article 154.*

8. Malcolm DR, Hibbs JL. Incorporating active-learning techniques and competency assessment into a critical care elective course. *Am J Pharm Educ.* 2012;76(7):Article 129.
9. Cook AM, Flynn J, Romanelli F. Descriptive evaluation of a new critical care elective course. *J Pharm Teach.* 2006;13(1):37-47.
10. Moazed F, Cohen ER, Furiasse N, et al. Retention of critical care skills after simulation-based mastery learning. *J Grad Med Educ.* 2013 Sep;5(3):458-463.
11. Zapantis A, Machado C, Nemire R, Leung S. An Elective course in adult acute care medicine using a hybrid delivery system. *Am J Pharm Educ.* 2008;72(5):Article 105.
12. Congdon HB, Nutter DA, Charneski L, Butko P. Impact of a hybrid delivery of education on student academic performance and the student experience. *Am J Pharm Educ.* 2009;73(7): Article 121.
13. Seybert AL, Kane-Gill SL. Elective course in acute care using online learning and patient simulation. *Am J Pharm Educ.* 2011;75(3): Article 54.
14. Slain D, Wong-Berringer A, Blake B, et al. 2009 ACCP Pharmacotherapy Toolkit. <http://www.accp.com/docs/positions/misc/pharmacotherapytoolkit.pdf>. Accessed July 20, 2015.

Appendix 1. Course Schedule

Week 1	
In Class	Monday 6/22 - Course Introduction
Online Lectures	1. Stress Ulcer/DVT Prophylaxis 2. Sepsis (2 hours) 3. Hemodynamics and Hypovolemic Shock 4. Decompensated Heart Failure/Cardiogenic Shock 5. Hematological Disorders in the ICU 6. Acid Base Disorders (1.5 hours)
Online Quizzes	6 quizzes - (Lectures 1-6)
Week 2	
In Class	Skills Lab and Review
In Class	Content Review and Q&A session (optional)
In Class	Exam 1 (Lectures 1-6)
Online Lectures	7. Sedation/Analgesia 8. Delirium 9. Alcohol Withdrawal 10. Mechanical Ventilation/ARDS
Online Quizzes	4 quizzes - Lectures 7-10
Week 3	
In Class	Mechanical Ventilator Demo
Online Lectures	11. Cardiac Arrest 12. Nutrition Support in the ICU (1.5 hours) 13. Neurotrauma 14. PK/PD Issues in CRRT/ICU 15. Ethics in the ICU
Online Quizzes	5 Quizzes - Lectures 11-15
Week 4	
In Class	Skills Lab and Review
In Class	Content Review and Q&A (optional)
In Class	Exam 2 (Lectures 7-15)