Original Publication

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A Clinical Procedures Course for Medical Students

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Citation: Romeo R, Blasiole B, Chalifoux T, et al. A clinical procedures course for medical students.

MedEdPORTAL. 2016;12:10524.
https://doi.org/10.15766/mep_2374-8265.10524

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Abstract

Introduction: Doctors perform many clinical procedures throughout their careers. It is important for students to learn these procedures in a nonthreatening environment. This clinical procedures course introduces students to several basic diagnostic and therapeutic procedures, both invasive and noninvasive. These include managing pediatric and adult airways, starting intravenous lines, inserting arterial and central lines, inserting Foley catheters and nasogastric tubes, and performing lumbar punctures and paracentesis. **Methods:** Small-group teaching is used to achieve these objectives; over the course of 4 weeks, the medical students meet once a week for 4 hours. Each meeting includes teaching and demonstrations of the procedures by faculty instructors and residents. This is followed by practice of the procedures on mannequin simulators and partial task trainers by the students. Feedback is then given to the students by the instructors. **Results:** Based on conversations during the feedback sessions, the students feel that the materials used in the course are helpful in learning these clinical procedures.

Discussion: The medical students feel that the course familiarizes them with clinical procedures they may be asked to perform on patients during their clinical rotations and postgraduate training.

Keywords

Lumbar Puncture, Airway Management, Paracentesis, X-Rays, Central Venous Access, Clinical Procedures, Respiratory Assessment, IV Insertion, Arterial Catheter Placement, Foley Catheter Insertion, Nasogastric Tube Insertion

Educational Objectives

By the end of this course, the learner will be able to:

1. Feel familiar with basic clinical procedures in a laboratory setting and with utilizing universal precautions prior to attempting the procedures on actual patients with appropriate supervision.
2. Assist in performing basic clinical procedures with appropriate supervision on patients during clinical rotations and postgraduate training.
3. Describe the indications, complications, and interpretations associated with the various clinical procedures that have been learned.

Introduction

Doctors perform many clinical procedures throughout their careers, including managing pediatric and adult airways, starting intravenous lines, inserting arterial and central venous lines, inserting Foley catheters and nasogastric tubes, and performing lumbar puncture and paracentesis. It is important to teach these procedures hands-on and in a nonthreatening environment.

This clinical procedures course came about because there were no formal courses at the University Of Pittsburgh School of Medicine that taught medical students how to perform these routine technical procedures, with which all graduating medical students should be familiar. In fact, an article on the clinical

Appendices

- A. Week 1 Resource - Respiratory Assessment, Adult Airway Management, Pediatric Airway Management, and Chest X-Ray.docx
- B. Week 1 Resource - Respiratory Therapy Discussion.pptx
- C. Week 1 Resource - Pediatric Airway Management Discussion.ppt
- D. Week 1 Resource - Student Performance Evaluation.docx
- E. Chest X-Ray Film Resource - Lateral View.pdf
- F. Chest X-Ray Film Resource - PA View.pdf
- G. Chest X-Ray Film Resource - Tension Pneumothorax.jpg
- H. Chest X-Ray Film Resource - Tension Pneumothorax After Pigtail.jpg
- I. Chest X-Ray Film Resource - Pneumonia.jpg
- J. Chest X-Ray Film Resource - Metastatic Disease.jpg
- K. Week 2 Resource - IV Insertion.doc
- L. Week 2 Resource - Student Performance Evaluation.doc
- M. Week 3 Resource - Arterial Catheter Placement and Central Venous Access.doc
- N. Week 3 Resource - Student Performance Evaluation.doc

skills training of US medical students was published in *Academic Medicine* reinforcing this need.¹ In another article, the Medical College of Georgia at Augusta University published a course for teaching entering third-year medical students how to do common bedside procedures.² This was a full, 2-day course in which intravenous line insertion, venipuncture, obtaining an arterial blood gas (ABG) sample, Foley catheter insertion, nasogastric intubation, electrocardiogram interpretation, surgical scrub technique, and basic life-support skills were taught.² Since electrocardiogram interpretation, surgical scrub technique, and basic life-support skills are taught elsewhere in our curriculum, we did not include them in our course. We added adult and pediatric airway management, respiratory therapy, chest X-ray reading, central and arterial line placement, lumbar puncture, and paracentesis. An article by Sanders, Edwards, and Burdenski concluded that many US medical schools are not rigorously teaching and evaluating technical procedures and called attention to this educational need.³ With our clinical procedures course, we have built upon what others have started, and we try to help fulfill that educational need. The course also familiarizes students with the indications, contraindications, complications, and interpretations associated with various clinical procedures.

All the sessions that make up the 4-week course are taught by both faculty and residents from different departments: anesthesiology, emergency medicine, internal medicine, critical care medicine, and urology. Teaching by residents has been recognized as essential to the education of medical students.⁴ In a study by Apter, Metzger, and Glassroth, residents enjoyed teaching and considered it a critical component of their own experience and education.⁴ A study by Jafri and colleagues concluded that residents are an effective supplement to faculty teaching.⁵ Having residents help teach and facilitate also allows the sessions to run very efficiently. To run a course of this magnitude, it takes about eight people per half day (namely, a faculty instructor and resident/fellow facilitators), 3 days a week for 4 weeks.

The small-group approach to this course allows much focused teaching. Throughout this course, partners in small groups are utilized. Cooperative learning in pairs, called dyad training, has been shown to improve efficiency of clinical skills training.⁶ The way the course is set up and taught allows the students to learn how to perform many procedures before having to do them for the first time on patients. The course gets high ratings each year from students, which indicates that they feel it is an important part of their learning.

Methods

The clinical procedures course consists of 4 half-day sessions that are presented weekly. Three sessions per week are scheduled to accommodate a group size of 50 students and a class size of 150 students. From a student's perspective, the total class time for this course is 16 hours (four 4-hour sessions). From a course director's perspective, 384 instructor hours are required for this course (eight instructors per session, 4 hours per day, three sessions per week, for 4 weeks). Therefore, the individual instructor time for this course is 48 hours, reflecting the time commitment for each of eight instructors. Sample schedule and logistics follow.

Week 1: Respiratory Assessment and Therapy, Adult Airway Management, Pediatric Airway Management, and Chest X-Ray

- Tuesday, Wednesday, Thursday, 1:00 pm-5:00 pm:
 - 1:00-2:00: respiratory assessment and therapy.
 - 2:00-3:00: adult airway management.
 - 3:00-4:00: pediatric airway management.
 - 4:00-5:00: chest X-ray.

- O. Week 4 Resource - Lumbar Puncture, Foley Catheter Insertion, Nasogastric Tube Insertion, and Paracentesis .doc
- P. Week 4 Resource - Lumbar Puncture Presentation.ppt
- Q. Week 4 Resource - Nasogastric Tube Insertion and Paracentesis Presentations.pptx
- R. Week 4 Resource - Student Performance Evaluation .doc
- S. Course Evaluation.docx

All appendices are peer reviewed as integral parts of the Original Publication.

Fifty students are put into groups of approximately 12 and rotate on the hour. Two instructors lead each group. One instructor should be a faculty member; the other can be a resident or fellow.

Week 2: IV Placement

- Tuesday, Wednesday, Thursday, 1:00 pm-5:00 pm:
 - 1:00-1:30: instructor demonstration.
 - 1:30-5:00: small-group lab sessions.

Fifty students are put into groups of approximately six. One instructor leads each group. At least one instructor should be a faculty member; the others can be residents or fellows.

Week 3: Introduction to Invasive Hemodynamic Monitoring and Arterial Puncture

- Tuesday, Wednesday, Thursday, 1:00 pm-5:00 pm:
 - 1:00-1:15: student introduction and overview of stations.
 - 1:15-3:15: invasive hemodynamic monitoring (two groups).
 - 3:15-5:00: arterial puncture (two groups).

Fifty students are put into groups of approximately 12 and rotate at different stations from 1:15 to 5:00. Two instructors lead each group. At least one instructor should be a faculty member; the others can be residents or fellows.

Week 4: Diagnostic Lumbar Puncture, Foley Catheter Insertion, Nasogastric Tube Insertion, and Paracentesis

- Tuesday, Wednesday, Thursday, 1:00 pm-5:00 pm:
 - 1:00-2:00: lecture: presentation of topics.
 - 2:00-2:45: lumbar puncture.
 - 2:45-3:30: Foley catheter insertion.
 - 3:30-4:15: nasogastric tube placement.
 - 4:15-5:00: paracentesis.

Fifty students are put into groups of approximately 12 and rotate every 45 minutes. Two instructors lead each group. One instructor should be a faculty member; the other can be a resident or fellow.

The first week consists of four stations: respiratory therapy, adult airway management, pediatric airway management, and chest X-ray (Appendix A). During the first subsession, the students learn about respiratory therapy. This includes assessing the need for supplemental oxygen for a patient and how the oxygen may be delivered (Appendix B). Next, adult mask ventilation and endotracheal intubation are taught and practiced on intubating mannequins after a brief discussion. Then, pediatric mask ventilation and endotracheal intubation are taught and practiced on pediatric intubating mannequins (Appendix C). Finally, chest X-ray interpretation is taught, in which the students learn the basics of reading a normal chest X-ray, then abnormal chest X-rays (Appendices E-J). Four groups of 12 students each go to one of four assigned stations. Each group participates in that station for 1 hour, then rotates to the next station every hour, until all four stations have been done. Students are evaluated on their performance utilizing a checklist pertinent to the objectives of each station (Appendix D).

The second week is IV placement (Appendix K). It incorporates a demonstration of the technique by the instructor. This is followed by a hands-on portion where students are divided into eight groups of three pairs with equipment for peripheral IV venipuncture and catheterization. Students practice on partial task training arms and on each other using strict universal precautions. Students are evaluated on their performance utilizing a checklist pertinent to the objectives of the session (Appendix L).

The third week is an introduction to invasive hemodynamic monitoring and arterial puncture (Appendix M). During the third session, students learn how to draw ABGs and place arterial lines and central venous catheters on partial task trainers. This session incorporates a demonstration by the instructor on the technique of arterial and central venous catheter placement. Indications for obtaining ABGs are discussed as are indications, contraindications, and complications of arterial and central venous catheter placement. Ultrasound has become the standard of care for central line placement. This modality is taught by the instructors, but didactics for ultrasound are outside the scope of this curriculum. Four groups of 12 students each go to one of four assigned stations. Two groups each at two stations participate in learning to draw ABGs and place arterial lines on partial task trainers, while two groups each at two other stations participate in learning to place central venous catheters on partial task trainers including the use of ultrasound. After 2 hours, each group switches so that all the students have participated in each procedure. Students are evaluated on their performance utilizing a checklist pertinent to the objectives of the session (Appendix N).

The fourth week consists of four stations: lumbar puncture, Foley catheter insertion, nasogastric tube insertion, and paracentesis (Appendix O). At the beginning of this session, a presentation of the topics and brief lectures on lumbar puncture, nasogastric tube placement, and paracentesis are given (Appendices P-Q). During the first station, the students use partial task trainers to learn how to do lumbar punctures, obtain opening pressures, collect cerebrospinal fluid, and send for evaluation. They then practice inserting Foley catheters on male and female pelvic task trainers. In addition to learning proper technique from the urologist, complications and troubleshooting are reviewed. Next, the students learn how to insert nasogastric tubes on partial task trainers, with technique and complications being stressed. Lastly, the students learn how to do paracentesis on abdominal partial task trainers. They learn both diagnostic and therapeutic indications.

Students are put in four small groups of 12 and rotate at one of four different stations every 45 minutes over the course of 3 hours. Students are evaluated on their performance utilizing a checklist pertinent to the objectives of each station (Appendix R). Finally, each session is evaluated by the students (Appendix S).

Results

At the end of the course, students assessed it based on its overall organization, pace, integration, and materials. They rated the overall quality on a 5-point Likert scale (1 = *poor*, 5 = *outstanding*). Students used the same scale to rate each individual session component, including the lecture and small groups. Faculty were rated on a similar scale.

The clinical procedures course has been rated very highly each year by the students ($N = 27$). The [Table](#) details the course evaluations for the past 4 years. There are 27 evaluative questions total, and the responses to each have been averaged over 4 years. Overall, the course has been rated a 4.4 out of 5. Of the individual components, the adult airway trainer has been rated the highest.

Table. Student Assessment of Course (*N* = 27)

Question	Rating ^a
The course was well organized.	4.275
The course was appropriately paced.	4.375
The course was well integrated.	4.050
The course materials were helpful.	3.675
Integrated session reflected important aspects of the course.	4.200
Instructors in this course treated me with respect.	4.700
Instructors in this course treated others (staff, students, etc.) with respect.	4.650
Lectures were helpful.	3.700
Small groups: workshops/practice sessions/sessions.	4.650
Individual course components	
Respiratory assessment and therapy, airway management, and chest X-ray	4.200
Vascular access	4.175
Diagnostic lumbar puncture	4.200
Foley catheter insertion	4.175
Nasogastric tube insertion and paracentesis	4.250
Introduction to invasive hemodynamic monitoring and arterial puncture	4.200
WISER (simulation center)	4.425
Third-floor teaching lab	4.175
Adult airway trainer	4.450
Pediatric airway trainer	4.225
Vascular access IV training arm (if used)	4.325
Lumbar puncture (back) task trainer	4.275
Foley catheter insertion task trainer	4.175
Nasogastric tube insertion task trainer	4.225
Paracentesis trainer	4.025
Central venous cannulation trainer	4.300
Arterial line trainer	4.125
Overall quality of course	4.400

^aOn a 5-point Likert scale (1 = *poor*, 5 = *outstanding*).

Discussion

There are challenges to running this course. A faculty member of the medical school is responsible for being an instructor for each session, and instructors should be able to demonstrate proficiency in the area being taught. With four stations being taught in the first week, one station in the second week, two stations in the third week, and four stations in fourth week, 11 faculty instructors are needed in total. In addition, to run each station efficiently, another seven facilitators are needed to keep the facilitator-to-student ratio around one to six. These facilitators can be faculty, fellows, or residents. In addition to manpower challenges, space can be a challenge too. Depending on the session, anywhere from four to eight classrooms or teaching labs may be needed. Initial materials, such as partial task trainers, can be costly, as can the supplies used for the course. Lastly, it may be challenging to carve out the time for the course, which is about 48 hours (4 hours per session, three sessions per week, over the course of 4 weeks).

One of the limitations of this course is that only select procedures are taught. Though we teach several common procedures that medical students should be familiar with upon graduation, there are some that are not taught. However, most are taught elsewhere in the curriculum. Another limitation is that we do not currently teach the medical students how to document the procedures that they perform. This could be an area for improvement. In the past, we have made changes to the curriculum based on learner feedback. An example of this was the addition of ultrasound to the teaching of central line placement before it became a standard of care. As medicine continues to evolve and new procedures emerge, revisions to the course can continue to be made.

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Disclosures

None to report.

Funding/Support

None to report.

Ethical Approval

Reported as not applicable.

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Received: August 12, 2016 | **Accepted:** December 7, 2016 | **Published:** December 31, 2016