Simulation Based Critical Care Curriculum Design

“Educational goals must dictate decisions about the use of simulation technology for teaching and testing”

(A) Identify problem

1. Need to meet LCME Accreditation Standards regarding objectives, teaching, and assessment.
2. Students are assigned to a diverse array of clinical settings (ED, PACU, Peds ICU, SICU, MICU, Neuro ICU, Burn, VA CCU).
3. Patient care responsibilities of house staff and faculty often compete with time for teaching and will likely vary over time.
4. Some settings/preceptors may better facilitate achievement of more sophisticated CCS course objectives (e.g., developing an integrated approach to single or multi-organ compromise).
5. Procedural training is particularly challenging because, in addition to time/resource constraints, there can be additional patient safety concerns.
6. Challenging to acquire objective assessment since evaluations completed by wide array of supervising personnel.
7. Evaluation of critical thinking may require deliberate discussion and debriefing that is not consistently practical in critical care settings.
8. Difficult to ensure formative evaluation and feedback throughout the clerkship.

(B) Goals/objectives: The objectives for this curriculum were developed according to the 2010 LCME Accreditation Standards for Medical Education and the Critical Care Selective Objectives below:

**LCME ED-1-A:** Objectives of medical education program must be defined in outcome-based terms that allow assessment of student progress.

- Use Critical Care Selective Objectives as guiding principles of scenario design. The objectives that are particularly difficult to operationalize and assess in the clinical setting are in bold:
  - Develop an integrated approach to evaluating and discussing the patient with either single or multi-organ compromise.
  - Manage patients with hemodynamic instability admitted for monitoring and treatment of arrhythmias, hypotension or hypertension.
  - Recognize patients with respiratory distress, manifested as an inability to either oxygenate or to ventilate and discuss etiologies of respiratory failure based on different patient populations.
  - Students are expected to achieve the knowledge, skills, attitudes and behaviors to enable them under supervision to demonstrate increasing clinical capabilities as they progress toward residency, specifically to:
    - Observe and participate in procedural opportunities pertinent to each selective such as central and arterial line placement and endotracheal intubation.
    - Act at a resident level when assuming care for new admissions, writing orders and discussing cases directly with fellows and attendings.
  - Select and interpret pertinent clinical information including radiographic, pharmacologic and laboratory data.
  - Participate in clinical skills assessments and simulated patient encounters.
  - Students should demonstrate critical and analytic thinking, awareness of the limitations of their knowledge and skills.
  - Refine interpersonal communication skills with patients, their families and other health professionals in a concise, accurate and respectful manner.
  - Students will be prepared to function effectively in teams and within organizational structures. They will demonstrate the ability to call on system resources to provide optimal care.
Use analysis of experiences to improve performance and continuously update personal clinical knowledge and skills.

**LCME ED-6:** Incorporate the fundamental principles of medicine and its underlying scientific concepts while allowing medical students to acquire skills of critical judgment based on evidence and experience.
- Content will include organ system compromise that incorporates underlying pathophysiological concepts and requires integration of data to make sound clinical decisions.

**LCME ED-2:** The types of clinical experiences that students encounter must be monitored so that gaps can be identified and remedied. The system must ensure that all students have the required experiences.
- Ensure that each student has the opportunity to gain first-hand experience with cases considered fundamental to critical care including ACS, RF, Shock.
- Ensure all students are exposed to central venous catheter placement as this skill will be useful in the majority of post-graduate positions.

**LCME ED-27:** A medical education program must include ongoing assessment activities that ensure that medical students have acquired core knowledge, clinical skills, and behaviors. These assessments should occur early enough in each course to allow sufficient time for remediation.
- Standardized checklist including skills pertinent to evaluation and integration of data, as well as analytical thinking.
- Weekly simulation sessions will allow for feedback on a progressive basis (formative).

Specific goals of simulation curriculum:
1. Reinforce physiology
2. Practice requesting, filtering and integrating relevant data
3. Practice assuming the posture of a resident leader. This includes confident, effective communication while eliciting input from colleagues from other professions (nursing, RT...)
4. Learn basic algorithms for common organ failure (respiratory, circulatory...)
5. Focus on informative debriefing after each scenario to discuss medical, as well as teamwork/leadership topics.

**2011-2012 MAITF: A Simulation-Based Critical Care Curriculum for Medical Students**

**Project Summary**
There is an increased focus on competency based assessment in the training of physicians. Medical simulation offers an opportunity to achieve objectively defined performance standards in an environment that is both safe and provides the realism necessary for learners to practice both technical and non-technical skills. This proposal outlines a longitudinal simulation-based curriculum for fourth year medical students enrolled in a Critical Care Selective. Students will participate in weekly simulation sessions designed to complement the current didactic and clinical experiences. Week one will focus on procedures commonly performed in the intensive care unit, with an opportunity for formal training in sterile technique and the placement of a central venous catheter on a realistic medical model. Weeks two through four will be case-based scenarios on a high-fidelity medical simulator during which students will practice the initial stabilization of an acutely decompensating patient. Emphasis will be placed on both technical skills, such as the assessment of airway, breathing and circulation, as well as non-technical skills, such as effective communication and situational awareness. All activities will be implemented observing the principles of deliberate practice, which ensure clear definition of tasks and informative, timely feedback. Students will be evaluated for teaching and research purposes by both checklist performances of key procedural steps during central venous catheter placement, and global rating scale during the
case-based scenarios. The course will be evaluated by questionnaires to be anonymously completed at the end of each month.

**Purpose of Project**

The purpose of this project is to incorporate a longitudinal simulation-based curriculum into the Critical Care Selective designed to complement the current didactic and clinical experience. This curriculum will offer an innovative approach to (1) Reinforce course learning objectives (2) Provide a safe learning environment for students to practice core critical care procedural skills as well as the management of critically ill patients (3) Provide a forum for formative evaluation and feedback throughout the selective based on objectively defined performance criteria.

**Specific Aims**

The specific aims of this educational project can be divided into three categories: those that reinforce knowledge and understanding of the pathophysiology commonly seen in critical care settings; those that involve the execution of skills necessary for appropriate diagnostic and therapeutic actions; and, finally, those that ensure competency based performance standards and instructive, timely feedback. In each case, the specific aim incorporates goals set forth by both the Critical Care Selective Course Objectives and the Liaison Committee on Medical Education Accreditation Standards, and will be accomplished through medical simulation while incorporating principles of deliberate practice. Although these aims are likely common to many student experiences during clinical training, simulation offers a unique opportunity for students to achieve these objectives in an experiential way.

**Specific Aim #1: To reinforce physiological principles necessary for an integrated diagnostic and therapeutic approach to organ failure in the critical care setting, including the role of commonly performed procedures.**

The foundation for providing suitable critical care is a solid understanding of the pathophysiology of organ failure. Mastery of this knowledge base enables physicians to identify relevant test results, and to integrate these results to derive a plan of action. Although students practice these skills during the basic science years by way of clinical vignettes and problem based learning, and are witness to them during their clinical years as a part of the care team, neither will completely prepare them for their first call to the bedside of a declining patient as an intern. Simulation offers a unique opportunity for students to practice accessing their cognitive framework for organ failure in a setting complete with many of the physical and psychological barriers found in the inpatient setting. Cases will prompt students to formulate organized differential diagnoses with associated treatment algorithms based on available data. In addition, students will learn the indications, contraindications and risk for procedures that are commonly performed in the critical care setting.

**Specific Aim #2: To provide a safe environment to practice the execution of the care plan for a critically ill patient, including both technical and non-technical skills.**

The case based simulations in this educational initiative will ensure that students have the opportunity to practice the technical skills necessary to evaluate and stabilize a patient in the first several minutes of clinical decline prior to arrival of more senior members of the care team. In addition, students will complete a formal, simulation-based training program for central venous catheter placement and sterile technique as this is a procedure common to most residency training programs. Perhaps more valuable for senior medical students is the opportunity to practice non-technical skills as the leap from a learner/observer role as a student to that of a team leader as a resident is sizeable. The case based scenarios afford the opportunity to explicitly consider and practice effective team leadership skills including effective communication and situational awareness.

**Specific Aim #3: Define course learning objectives in a competency based manner that allows for informative, timely feedback.**

Although the Critical Care Selective is generally rated quite favorably in the Curriculum Evaluation performed by graduating seniors, the two lowest rated categories by the Class of 2010 were “evaluation methods clearly explained” and “feedback about my progress was timely and appropriate.” Both the procedural and case-based teaching in this initiative will be operated under the principles of deliberate practice which will ensure identification of specific learning objectives as well as focused, repetitive practice that is guided by informative
feedback. Although under the current proposal, the evaluation in the simulation environment will be formative in nature, as it matures, simulation-based education may contribute to the formal evaluation of student performance.

MAITF 2012-2013: Expansion of a Simulation-Based Critical Care Curriculum for Medical Students

Project Summary

Simulation-based education provides the unique opportunity for trainees to practice both the technical and non-technical skills necessary to deliver optimal patient care while in a safe learning environment. During the 2011-2012 academic year, a simulation-based curriculum for fourth year medical students enrolled in the Critical Care Selective was developed. Due to the success of the pilot program, plans have been made for a substantial expansion of the curriculum for the 2012-2013 academic year with the incorporation of several modifications resulting from the needs assessment completed during year one. Once again, students will participate in small group case-based simulations hosted in the School of Nursing Skills Laboratory and utilizing a high-fidelity patient simulator. During these sessions, students will have the opportunity to lead their care team in the initial stabilization of an acutely decompensating patient. The primary adaptations for the upcoming year include: (1) Expansion of the breadth and depth of simulation experiences (2) Development of a corresponding didactic curriculum (3) Focus on the importance of 'non-technical' skills such as teamwork and decision making. Student progress and program efficacy will be documented with scenario checklists administered both pre and post-training. The course will also be evaluated by questionnaire to be completed at the end of each month by participants.

Purpose of the Project

The purpose of this project is to expand the simulation-based critical care curriculum that was piloted with the fourth year medical students enrolled in the Critical Care Selective during the 2011-2012 academic year. The overall objective of the simulation curriculum is to provide students with the opportunity to practice the skills necessary to direct the care of critically ill patients as described in the course learning objectives. Analysis of the student performance and feedback during the current academic year have enabled the investigators to modify the specific strategies employed according to the learning needs of the students.

(B) Background from 2011-2012 Pilot Study:

Dr. Sharpe and Dr. Diederich worked together to pilot a simulation-based curriculum for medical students in the Critical Care Selective during the 2011-2012 academic year. One of the primary outcomes of this project was a needs assessment regarding both the learners and the resources necessary to develop and sustain a comprehensive simulation-based critical care curriculum. Highlights of the findings relevant to the current proposal include:

- Although the students rated themselves as well-prepared to direct the care of critically ill patients prior to participating in the simulation-based cases, this was not substantiated by student performance during the scenarios. During the debriefing sessions, participants almost universally described their difficulty in making diagnostic and therapeutic decisions while actively assimilating patient data from the case.
- There were greater than anticipated knowledge gaps regarding the pathophysiology and pharmacology underlying the cases, as well as practical aspects of delivering care (ex: devices to administer supplemental oxygen). Significant time was spent on information transfer during debriefings rather than on discussion of non-technical skills such as communication and teamwork as had been anticipated.
- There was a clear need to develop diagnostic reasoning skills. In particular, how to discern the extent of patient history needed, prioritize diagnostic testing and categorize illness in terms of both severity and etiology.
- Opportunities to practice procedural skills were greatly appreciated as student exposure during routine patient care varied greatly based on clinical assignment in the selective.

Specific Aims
As detailed above, the pilot study revealed several areas of need regarding student learning which serve as the specific aims for the current proposal of an expanded simulation-based critical care curriculum during the 2012-2013 academic year.

**Specific Aim #1: Expansion of the breadth and depth of simulation experiences.**

A. Critical Care Scenarios: For the current academic year, two categories of critical illness, respiratory and cardiac failure, were chosen as themes for weekly simulation sessions. The substantial increase in the time allotted for the simulation curriculum next year will afford the opportunity to both enhance the curriculum surrounding the existing topics and to introduce cases involving other types of organ compromise, including the neurologic and metabolic systems. The task of directing the care during scenarios has proven to require a very different skill set than is needed for success in the clinical portion of the clerkship, and adding the opportunity for additional practice for each student will be extremely valuable.

B. Procedural skills: In addition to the training module regarding the placement of central venous catheters that was developed during this academic year, a similar task-based session regarding airway management and endotracheal intubation will be added. Regardless of whether students will ultimately perform these particular tasks in their future career paths, hands-on experience facilitates a meaningful and valuable understanding of the risks and benefits of invasive procedures, as well as the opportunity to practice the leadership skills necessary to guide a care team through a relatively high stakes tasks.

**Specific Aim #2: Development of an accompanying didactic curriculum to ensure consistent, efficient transfer of knowledge regarding pathophysiology of underlying the cases.**

As described above, there were greater than anticipated knowledge gaps regarding the pathophysiology and pharmacology underlying the cases. After being forced to navigate the scenarios in the presence of such knowledge deficits, the students were highly motivated to master the relevant content. In order to capitalize on this educational opportunity, as well as ensure standardization across learners, a didactic curriculum will be developed to complement the simulation experiences and to provide direction for self-study after the sessions.

**Specific Aim #3: Refine the focus on non-technical skills during critical care simulations.**

Although the mastery of course learning objectives regarding critical care topics is a fundamental goal of this curriculum, simulation provides a unique environment to practice what has been described as 'non-technical skills.' The term 'non-technical skills' was first used by the aviation industry to denote the aspects of personnel performance that are relatively independent of profession-specific tasks, but instrumental for efficient and safe job performance (9). These skills classically include situational awareness, decision-making, team work, and leadership. In the context of medical student training, the development of these skills is particularly valuable as they are applicable across the wide range of the future careers upon which students may embark.