

CRITICAL CARE HIGH-FIDELITY COMPUTER SIMULATION (HFCS) PROGRAM

Purpose

The primary objective of the Critical Care High-Fidelity Computer Simulation (HFCS) program is to provide the physician with a lifelike environment in which the concepts of critical illness management & crisis management can be applied. The secondary objective of the HFCS program will be to provide a potential means of assessment of performance in critical illness & crisis management.

Rationale

With the advances in the fundamental understanding of disease in modern medicine, the information required to obtain and maintain proficiency in the practice of medicine continues to increase at a staggering rate. This also makes the clinical application of such knowledge even more difficult; nowhere is this more evident than in Critical Care medicine.

Due to the complexity and severity of the medical problems encountered, assimilation of these skills has been mostly through direct patient contact. With the increasing acuity of illness seen in Intensive Care Unit patients, this poses a problem with residents initially starting in the Intensive Care Unit, or for physicians not routinely caring for critically ill patients. Obtaining and maintaining proficiency in clinical decision-making represents a proverbial two-edged sword: without experience it is impossible to develop proficiency, but inexperienced physicians are at high risk of errors in clinical decision-making.

Because of the complex & dynamic nature of problems seen in Critical Care Medicine, crises often occur. Although medical knowledge & skills are required in treating a critically ill patient during a crisis, it is the application of such knowledge & skills that count most. Thus, until recently, direct patient contact has been the only method in which experience can be acquired in crisis management skills.

Computer Simulation

Advances in computerized simulation have made patient simulation available for physicians. Computer simulation is used as a fundamental training tool in aviation and aerospace industries (1,2). Its use in the medical field it has been used largely restricted to the field of Anesthesia. Initial reports indicated favorable responses from test subjects as an education tool (3). It remains, however, by and large an untested tool in medical education. Recently, computer simulation has been developed for Critical Care medicine scenarios (4); the potential benefit of such a simulation program would appear to be high.

The Laerdal SimMan and Eagle Patient Simulator at the Ottawa Heart Institute are able to provide simulations of both Operating Room (OR) and Intensive Care Unit (ICU) environments. The computer simulator consists of a mannequin patient, monitoring

equipment, and ventilator located in a setting that mimics an ICU environment. A patient's cardiovascular, pulmonary, neurologic and metabolic conditions can be altered; the patient can even talk! Limited physical examination findings can also be reproduced; breath sounds, visible airway, palpable pulses, pupillary responses and eye opening are some of the responses displayed by the mannequin. The Simulator can reproduce complex physiological scenarios commonly observed in ICU patients. Clinical events and physicians' interventions then trigger preprogrammed multi-organ responses. Participants can gain experience in routine and difficult airway management, basic pharmacology and crisis management. Training through patient simulation can be of great benefit to inexperienced physicians and even to seasoned physicians wishing to refresh their skills. In addition, training with the Simulator gives physicians the opportunity to manage life-threatening situations without having to suffer the stress caused by disastrous patient outcome.

Crisis Resource Management

Crisis resource management, or CRM, as described by Gaba (19), involves many components, some of which include problem recognition, crisis response & re-evaluation, and resource management. The simulator sessions are tailored to provide a life-like environment. Specifically, the problems encountered can be changed in severity and new problems can be introduced at various times during the simulator session. In addition, the wide variety of information (monitoring data, bloodwork, EKG's, x-rays, etc.) that are normally available at the bedside during a real-life crisis are available. Finally, the presence of other physicians, nurses and/or respiratory therapists is provided in these simulations. Most importantly, the sessions are videotaped. In this manner, not only can the clinical knowledge & skills demonstrated by the physician be evaluated, but the way in which the crisis was handled (aspects of crisis management) can also be reviewed with the physician afterwards. Therefore, the Simulator appears to be an ideal application for review of crisis management skills as well as a source of acquiring clinical experience in managing critically ill patients.

Target Population

Although the Simulator Program will be offered to all physicians who are interested in taking it, the group of physicians in whom it would be particularly applicable to would include:

1. Residents Prior To ICU Rotations
2. Critical Care Medicine Fellows
3. Internal Medicine Physicians
4. Anesthesiologists
5. Emergency Room Physicians
6. General Surgeons

All trainees in the Critical Care Medicine Fellowship Program are required to participate in Simulator sessions on a semi-annual basis.

Course Prerequisite

The Computer Simulator Program is not intended to replace Adult Cardiac Life Support (ACLS) Course. Rather, the knowledge and skills which are required to effectively manage a case scenario in the Computer Simulator sessions assume that the participant already has the basic techniques which are covered in ACLS. Thus, a prerequisite for the Computer Simulator Program will be certification in the ACLS course.

Simulator Sessions

Physicians not familiar with the Simulator are given a thirty minute session, introducing them to the Simulator environment, and to the design of the Simulator sessions. At the beginning of each simulator session, physicians first receive a brief synopsis of the patient profile consisting of history, physical examination, and routine investigations normally available in ICU patients. Then, the case scenario, which consists of approximately twenty-minute simulations of common ICU clinical events, is initiated. The physical setting of the room, the mannequin's appearance, the physiologic monitoring devices with real-time displays and the presence of support staff ensure that the physician's experience will be realistic.

The initial events & clinical setting (for example, congestive heart failure with acute respiratory failure) are pre-programmed, and can be faithfully reproduced for each physician participating in that specific clinical scenario. In addition, further clinical events (for example, hypotension) can be triggered at predetermined time intervals to reflect the dynamic nature of crises. Further information, such as ancillary investigations (for example, x-rays & bloodwork) are released in a controlled fashion to reflect the life-like time required to obtain such information. Predetermined cues from Simulator support staff, or release of information at a preset time, can assist the physician when problems go unrecognized. Since the amount of information & assistance is controlled, participants can all experience a similar number of clinical events and complete every scenario regardless of their level of expertise.

After the session, physicians and Simulator staff will then review a videotape of the case scenario. Feedback on assessment and management of the clinical events are given, as well as feedback on aspects of crisis management. Simulator sessions involve three to four physicians; therefore a total of three to four case scenarios are covered in each session.

Confidentiality

Prior to participation in the Simulator sessions, participants are required to sign an agreement of non-disclosure. Due to inherently finite number of case scenarios currently available in the Simulator Program, **full confidentiality** of case scenario

content is required. Conversely, all information gathered on physician performance during the Case scenarios will be kept strictly confidential, and at present will not be used in evaluation of performance during residency or for maintenance of certification

Course Evaluation

At present, the purpose of the High-Fidelity Computer Simulation program is not for evaluation of performance. A concurrent pilot study is underway to examine the use of High-Fidelity Computer Simulation as an evaluation tool for crisis management skills. However, at present the sole purpose of the Critical Care High-Fidelity Simulation program is to introduce the participant to the concepts of crisis management and management of the critically ill patient. Sessions will be videotaped both for feedback on performance, and for evaluation of the Simulator as both a teaching tool and a potential tool for future evaluation of performance.

Maintenance of Certification/Continuing Medical Education (CME) Credit

The High-Fidelity Computer Simulation Program has been recognized as a Category III activity from the Royal College of Physicians and Surgeons of Canada MAINPRO program.

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