LOGISTICS OF CONDUCTING A LARGE NUMBER OF INDIVIDUAL SESSIONS WITH A FULL-SCALE PATIENT SIMULATOR AT A SCIENTIFIC MEETING

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ABSTRACT. Objective. To design and implement the logistics of accommodating a large number of participants in individual, hands-on sessions on a full-scale patient simulator during a major scientific meeting or continuing medical education course. **Methods.** We used our method during the 11th World Congress of Anaesthesiologists in Sydney, Australia to facilitate studying the impact of pulse oximetry and capnography on the time taken by anesthesiologists to correctly identify critical incidents on a full-scale patient simulator. Each study participant spent 15 minutes in 4 sections of the study area: the anesthesia and monitoring equipment briefing room, the simulator briefing room, the simulation room and the debriefing room. **Results.** There were 113 participants during five days (15 during instructor training and 25, 23, 24 and 26 on subsequent exhibit days). We were oversubscribed daily. However, there were 9 no-shows during the 4 days of the study, which generated a participant absence rate of 9.2%. The average number of participants over the 4 days of the study was 24.5 per day compared to our capacity of 27 per day. The feedback we obtained from the participants about the simulation experience and the format of the exercise was positive and enthusiastic. **Conclusions.** We have developed a practical and viable method that can be adapted for use at scientific meetings and courses, which improves accessibility of individual, hands-on sessions on full-scale patient simulators to a larger audience than previously attainable. Our method is applicable for continuing medical education courses as well as research purposes in the form of prospective studies during scientific meetings and courses.

KEY WORDS. Logistics, full-scale patient simulator, equipment, monitoring.

INTRODUCTION

A full-scale patient simulator is most beneficial when used in hands-on, individual learning sessions. Prior to the 11th World Congress of Anaesthesiologists (WCA 96) held in Sydney, Australia, in April 1996, use of full-scale patient simulators at major scientific meetings and other continuing medical education (CME) programs had been limited to demonstrations where a large number of attendees watch an instructor or volunteer from the audience interacting with the simulator. Structured, individual, hands-on learning with full-scale patient simulators had not been offered to attendees at major national and international scientific meetings and CME courses. The fundamental problem, related to the novelty of patient simulation, was the lack of a tested and proven method that would allow a large number of participants to experience hands-on, individual sessions

The University of Florida owns and licenses human patient simulator technology. Royalties received by the University of Florida are distributed in part to the inventing team, which includes Dr. Lampotang, Dr. Good, Mr. Carovano and Mr. Hardcastle.

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on a full-scale patient simulator, within the time constraints imposed by the meeting or course structure.

We describe a method that was successfully used at the WCA 96 to facilitate studying the impact of monitoring instruments on the elapsed time before anesthesiologists could correctly identify certain critical incidents (e.g., pulmonary embolus, malignant hyperthermia, pneumothorax, anoxic oxygen supply) that could develop during anesthesia. To obtain an appropriate sample size, it was necessary to have at least 100 conference participants complete a meaningful, individual, hands-on exercise using a full-scale patient simulator, during which each participant was asked to diagnose a particular critical incident. The results of the study will be described in another paper. The purpose of this paper is to describe in detail the method employed to facilitate the study so that it can be reproduced or adapted by other educators and researchers for use in simulator-based exercises at major scientific meetings and CME programs.

The specific objective was to design a method to allow 100 participants to conduct an individual, hands-on session using a full-scale patient simulator, which was necessary for successful completion of the WCA 96 prospective study on capnography and pulse oximetry. Without pilot data available to conduct a power analysis, we pro-actively set a target of 100 participants during the four exhibition days of WCA 96.

METHODS

Floor plan of simulation area

Adequate space is necessary for a simulator-based program. We recommend approximately 1,000 square feet (93 square meters) of floor space, strategically located in high visibility and high traffic areas (e.g., exhibition hall preferably near a food and refreshment service area) to increase general awareness among conference attendees. The simulation area is divided into 6 functional areas: reception desk, staging area, briefing room for anesthesia and monitoring equipment, simulator briefing room, simulation room, and debriefing room. If possible, the reception desk and staging area feature an open floor plan (no walls or barriers) allowing free flow of traffic while the other four areas (775 square feet, 72 square meters) are closed to the general public. A floor plan showing the specific layout used at the WCA is shown in Figure 1. Modular foam board panels (rather than curtains) are used to partition the spaces within the exhibit area. This material provides sufficient noise reduction to prevent sounds generated in one area from disrupting the activities in adjacent areas. Equipment and doors in each room are arranged to facilitate the smooth flow of participants and instructors through the entire simulation area.

A diaphanous curtain is used on a portion of the outer wall of the simulation room (see Figure 1). The curtain reduces visibility such that those passing by the outside of the simulation area can see the general outline of the patient simulator, the participant, and the instructor, but can not identify the specific individuals involved. Thus, members of the simulator team can follow the progress in the simulation room without actually entering, and those passing by the exhibit can see without disrupting the current participant and simulation exercise.

Reception desk

Participants register for a simulator session at the reception desk. Prospective participants are given a specific appointment time to return to the simulation area. The time is written on an appointment card and given to the participant along with a demographics questionnaire to be completed prior to returning. At the time of registration, the participants are instructed to report to the reception desk 5 minutes prior to their appointed session. Participants are also informed that if they do not show up by their appointed time, their session will be reassigned to another participant on an alternate list. Each morning, the participants and their appointment time are posted on a marker board next to the reception desk.

The reception area contains a desk, 3 chairs, a marker board, pre-printed sign-up sheets, questionnaires, and appointment cards. A meeting program book available at the reception desk was helpful for the participants to identify the times when they would be available.

Staging area

When participants return to the simulator exhibit 5 minutes prior to their appointment time, they report to the reception desk. At this point, it is verified that the demographic questionnaire is properly completed. If not, the participant is asked to complete it before entering the equipment briefing room. If the previous participant has not yet cleared the equipment briefing room, the participant is directed to the staging area; those people on an alternate sign-up list also wait in the staging area.

At the WCA 96, two computers with interactive educational software programs loaded and running

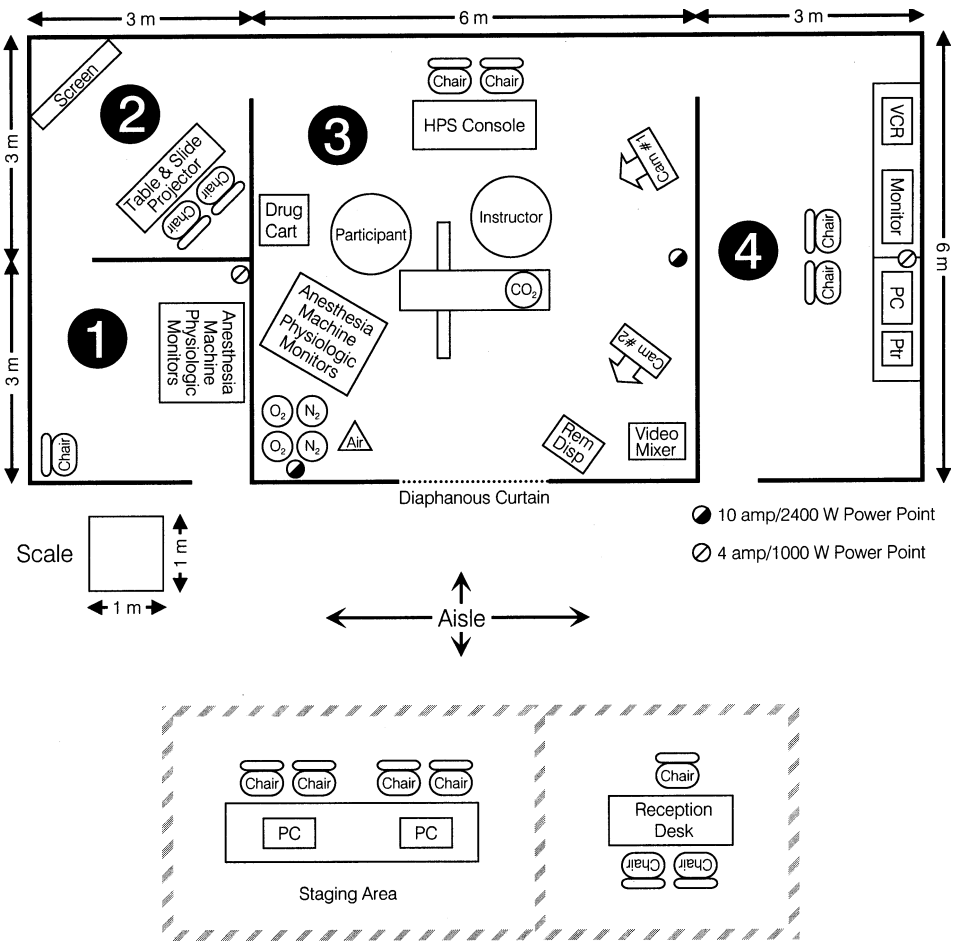

Fig. 1. The floor plan of the simulation area at the WCA 96 where our method was implemented. The remote display ("Rem Disp") is a monitor that displays exactly the same data as the physiologic monitor on top of the anesthesia machine. Camera #2 is used for a close-up shot of the remote display which is superimposed, via the video mixer, over a general view of the anesthetic field, captured by camera #1. Ptr = printer.

were available for participant use in the staging area. One program was TEECHER™, a computer based trainer (CBT) on transesophageal echocardiography. The other program was a CBT developed by Ohmeda, Inc. that demonstrates the function of an anesthesia machine. The CBTs provided the participants with a constructive learning experience while they waited for their simulator session to begin.

The staging area contains 2 desks, 4 chairs, and 2 computers with relevant educational software.

Equipment briefing room (Figure 1, room #1)

Participants can not be expected to manage a simulated case and critical incident if they are not familiar with the life support equipment and monitoring instruments being used. For the simulator-based study at the WCA, we used an Ohmeda Excel anesthesia machine and a SpaceLabs multi-parameter physiologic monitor. Thus, in the equipment briefing room, participants received a 15 minute hands-on orientation to these devices, which was provided by representatives of Ohmeda and SpaceLabs, respectively. Because a thorough orientation to all functions and capabilities of the anesthesia machine and physiologic monitor was not possible in 15 minutes, the instruction and hands-on exercises in the equipment briefing room focused on those skills that were necessary to correctly diagnose the planned critical incidents. For example, orientation to the anesthesia machine focused on setting mechanical ventilation parameters and alarm settings, and switching back and forth between bag and mechanical ventilation modes.

The equipment briefing room contained an Ohmeda Excel anesthesia machine, a pre-printed handout detailing the exercises to be performed by the participant

on the anesthesia machine, a SpaceLabs physiological monitor, a chair, and a clock. The equipment in the equipment briefing room must be exact replicas of the equipment in the simulation room.

Simulator briefing room (Figure 1, room #2)

Caring for a simulated patient is similar, but not identical, to caring for a real patient. Accordingly, in the simulator briefing room, participants receive a short didactic overview of the human patient simulator, using 35-mm color slides. Emphasis is placed on the clinical signs and symptoms (for example, palpable pulses, breath sounds, and twitch response to peripheral nerve stimulation) that can be examined by the participant, and how therapeutic interventions, such as intravenous fluid boluses, are accomplished with the simulated patient.

During the last 5 minutes in the simulator briefing room, participants read a written description of the patient and the progress of the case up to the point they are to assume responsibility for the patient. For the WCA 96, the written case stem explains that the anesthesia provider who started the anesthetic developed abdominal cramps and diarrhea and must quickly leave the operating room. This case "set up" allows many meeting participants to be challenged with a critical incident in a realistic fashion without having to go through the more time consuming induction of anesthesia and early phases of maintenance anesthesia. After reading the case stem, the participants are given the opportunity to ask any questions they might have about the simulator in general or about their specific patient.

The simulation briefing room contains a slide projector, a projection screen, a set of 35-mm a desk, 2 chairs, color slides of the simulator, a check list to ensure that all relevant aspects of the simulator are addressed, a laser pointer, printouts of the case stem, and a clock.

Simulation room (Figure 1, room #3)

The simulation room is where the individual, hands-on sessions on the full-scale patient simulator are actually conducted. As each participant exits the simulator briefing room and enters the simulation room, they are joined by a clinical instructor. Wireless microphones are attached to the participant and the instructor so that their dialogue is audible on the videotape recording of the simulation session. Participants are asked to vocalize their thoughts and decision-making processes.

After introductions, the instructor first asks if the participant has any questions about the patient described in the written case stem. Next, the instructor orients the participant to the patient simulator and the case that is already in progress. To do this, the participant is asked to review a prepared anesthesia record and to auscultate the simulated patient's breath sounds. The participant may take up to 3 minutes for this orientation and to ask any questions about the physical set up of the patient simulator, the anesthesia delivery equipment, or the case in progress. The instructor manages the simulation session so that, within 5 minutes of entering the simulation room, the participant must assume care of the simulated patient.

Once the participant assumes care of the simulated patient, the simulator operator initiates the critical event scenario, and videotaping simultaneously begins. There were 4 possible critical incidents for the WCA 96 simulator program: pneumothorax, pulmonary embolism, malignant hyperthermia, and anoxic oxygen supply. The participant is challenged to diagnose the problem and demonstrate appropriate differential diagnosis skills. The participant is not required to treat the condition once it is correctly identified but may do so if time allows. These actions are recorded on videotape and by the simulator's data logging feature. The simulator technician copies the vital signs data file generated by the simulator to a 3.5-inch computer diskette at the conclusion of each simulator session.

Each participant is allowed up to 10 minutes to diagnose the problem. If the problem has not been correctly diagnosed within 8 minutes of the participant assuming care of the patient, the instructor begins to provide clues to help the participant. We feel it is important that all participants learn the nature of the critical incident before they leave the simulator room, so that no patient dies and every participant experiences a positive encounter. Thus, it is very important for the instructor to observe the participant's approach to solving the clinical problem, and if necessary, to provide appropriate guidance, once the 8-minute mark is reached.

Our rationale for helping the participants make the correct diagnosis is that participants in simulator exercises learn through trial and error. If they leave the simulation room without understanding the correct diagnosis, we feel that they do not learn as much as they could, if, in contrast, they are cued to the correct diagnosis while the clinical situation is still being enacted on the simulator. During the debriefing with the videotape, there is no opportunity to re-test, for example, a missed unilateral lung sound and chest movement during unilateral pneumothorax.

The physical layout of the simulation room is shown in Figure 1. Each participant's management of the critical incident simulation is videotaped to allow mean-

ingful review and feedback later in the debriefing room, and as a data analysis tool if a study is being conducted. Two video cameras and a video mixer are used to superimpose a close-up shot of physiologic data displayed on the monitoring equipment on top of a wide angle view of the participant and clinical area. Time synchronization between the clock used in the simulator's data logger and the videotape time stamp is achieved by starting the pre-determined scenario at the same time as the start of videotaping.

At the WCA 96, the simulation area contained a METI full-scale patient simulator, an Excel anesthesia machine, a SpaceLabs physiological monitor, H-cylinders of O_2 and N_2, an E-cylinder of CO_2, a compressed air hose supplied by the convention center, 2 video cameras, a video mixing station, a drug supply cart, an 8-foot table, 2 chairs, printed copies of the case stem, an anesthesia record matching the case stem, a pre-randomized sequence of scenarios for the study, 120 videotapes, 120 3.5-inch computer diskettes, and a clock. Gas consumption was approximately 0.5 H-cylinder of O_2, 0.5 H-cylinder of air, and 0.5 H-cylinder of N_2 per day, and 1 E-cylinder of CO_2 for 5 days.

We used N_2, instead of N_2O, because there was no convenient way to scavenge the waste anesthetic gases in the convention center. For the same reason, we did not use halogenated volatile anesthetics. The nitrogen gas flowed through the N_2O flowmeter of the unmodified Excel anesthesia machine.

Debriefing room (Figure 1, room #4)

After the hands-on simulator session is concluded, the instructor collects the 3.5-inch computer diskette, which contains the patient's vital signs recorded during the simulation exercise, the videotape of the exercise, and the completed demographic questionnaire and escorts the participant to the debriefing station. The computer diskette is inserted into the diskette drive of a personal computer connected to a printer. A Microsoft Excel macro prints a graphic display of the recorded physiologic data as trend plots. The instructor plays back the video tape for the participant, and comments on the decision-making processes and actions taken. At the conclusion of the debriefing session, the instructor places the videotape, diskette, vital signs graphic printout, and completed demographic questionnaire in a large envelope, seals it, and writes the confidential number assigned to the participant on the outside of the envelope. The envelope is placed in a box for storage.

The debriefing area contains a desk, 2 chairs, a notebook computer with a 3.5-inch diskette drive, Microsoft Excel software, and an Excel macro to automatically print a graphic plot of the vital signs logged by the simulator, a videocassette recorder, a color television, a high speed laser printer, 2 reams of printer paper, 120 10-in × 13-in envelopes, boxes to store the filled envelopes, and a clock.

Personnel

The logistics to run simulator exercises all day for multiple successive days requires a significant number of personnel to assure smooth operation. We recommend a minimum of 2 complete operational teams to allow the teams to alternate working and rest periods. Each operational team consists of at least 9 persons: a manager who oversees the entire simulation area and ensures the exercises are on schedule, a receptionist to manage the reception and staging areas, at least one equipment specialist to provide an in-service on the equipment, a simulator applications engineer to provide the introduction to the simulator, a clinical instructor for the simulation room, a simulator technician and an audio-video technician for the simulation room, a clinical instructor for debriefing, and a clinical instructor on break. Thus, the minimum personnel required is 18 for 2 operational teams, with a minimum of three clinical instructors per team. This number may be reduced to 16 if the clinical instructor on break performs double duty as the manager.

Training of simulator instructors

Typically, at least 3 clinical instructors are needed at all times, thus, the ability to quickly train many clinicians as simulator instructors is an important component of the method. Clinicians with teaching experience can become adept as simulator instructors with a 3-hour training session. First, a 1-hour didactic overview is provided, which reviews the format of the simulator exercise and participant flow through the simulation area. Next, each trainee completes the simulation program as a participant and subsequently as a clinical instructor. This familiarizes the trainee with the simulation exercise from the perspective of the participant and also gives them a chance to practice their role as instructor. The data collected while using the trainees as the participants can also be included as participant data for simulator based studies, which we did at the WCA 96. Immediately following instructor training, a schedule for providing continuous instructor coverage is made, before the instructors leave the simulation area.

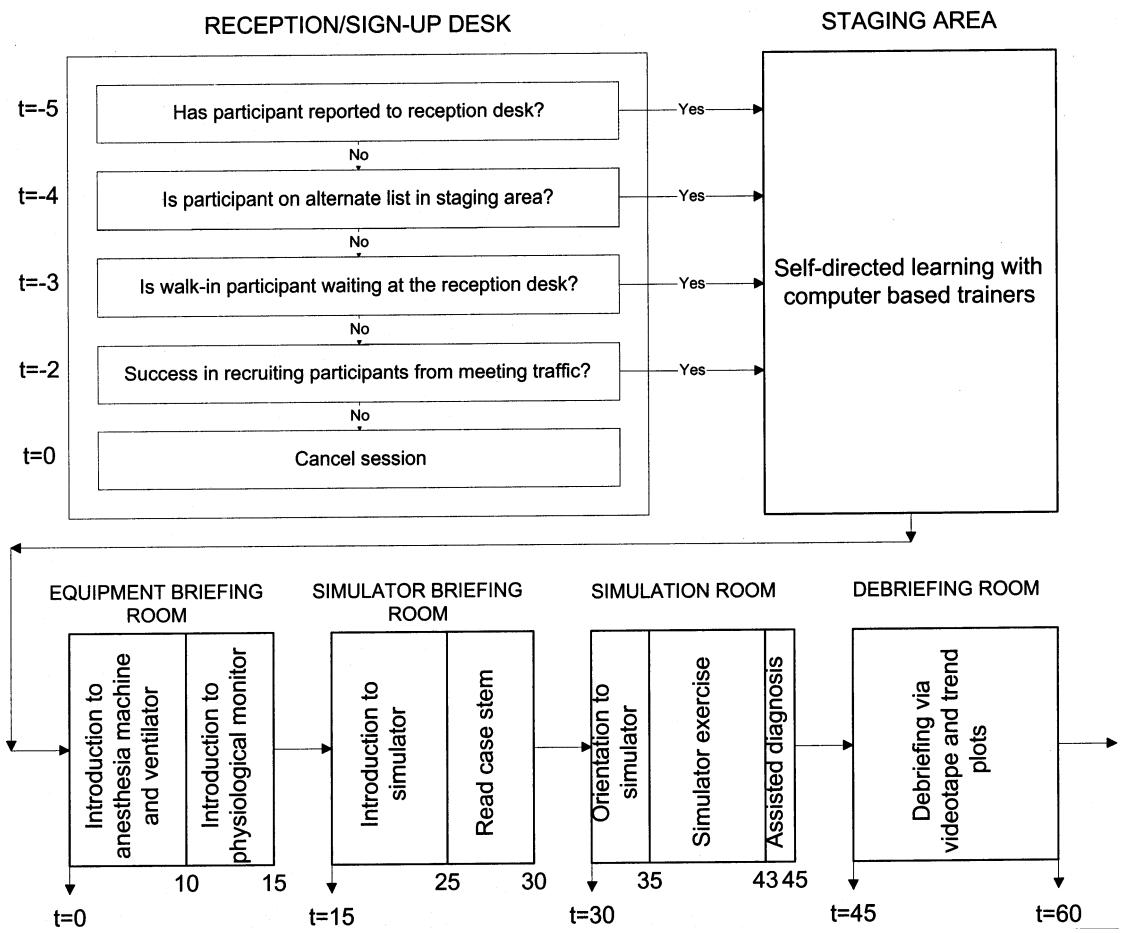

Fig. 2. A schematic of the logistics for the simulator-based exercises. Participants enter the equipment briefing room every quarter hour and leave the study area 60 minutes later. At the WCA 96, the first participant arrived at 8:30 am and the last morning participant at 11:45 am. After a lunch break, the first afternoon participant enters the equipment briefing room at 1:00 pm and the last one enters at 4.00 pm, for a daily total of 27 participants (14 in the morning and 13 in the afternoon). At t = *35, the participant must have assumed care of the patient. At* t = *43, the instructor starts to actively assist the participant in arriving at the correct diagnosis, if the participant has not already identified the incident.*

Scheduling

The on-time arrival of participants is critical to the smooth operation of our method. With a new participant scheduled to enter the simulator area at 15 minute intervals (Figure 2), late arrivals delay the start of subsequent participants. Despite efforts to stress the importance of punctual arrival, tardiness will still occur. Consequently, we require participants to report to the reception desk 5 minutes prior to their appointment. If the exercises are booked, we maintain an alternate participant list and ask interested people to continue checking at the reception desk on the quarter hour for openings created by absentees or late arrivals. If a participant does not arrive 5 minutes before the appointment time, we accept an alternate participant. If the alternate participant is not in the reception area, then we take those who check every quarter hour as instructed. Alternatively, we invite qualified individuals that are touring the exhibit area to participate.

RESULTS

At the WCA 96, our method operated smoothly and 113 participants had individual hands-on sessions on a full-scale patient simulator in 5 days, 15 during instructor training, and 98 during the 4 days of the study. Fifteen instructors were trained but 2 were not able to work because of scheduling conflicts. During the 4 days of the actual study, we had 98 participants fill 110 slots. Eighty-six participants were on time and we used 12 alternates. We had 9 no shows, 1 empty slot that was not booked, 1 registered person could not wait when we

were running slightly behind schedule, and 1 session had to be dropped when we realized that the participant could not speak English. An extra session was worked into the lunch break during days 2 and 4, which provided some flexibility in re-registering participants who arrived late.

Participants rated the simulator exercise and debriefing session highly. One anesthesiologist thanked us for allowing him to experience his first malignant hyperthermia crisis. There was minimal concern from the participants about confidentiality. Interest was stronger than we anticipated indicating a high demand for individual hands-on sessions on full-scale patient simulators. Word-of-mouth advertising was surprisingly effective. Past participants recruited their colleagues to participate in the study. Our sign-up sheet for the 4 days of simulator exercises was full by the end of the second day. We started an alternate list and asked interested parties to keep checking at the reception desk on the quarter hour for openings. Late arrivals were initially rescheduled, however, when the sign-up sheet was full, they were placed on an alternate list and also asked to keep checking by the reception desk on the quarter hour.

DISCUSSION

Initial simulator-based CME courses held at the University of Florida lasted 2 days and were limited to 12–16 participants to ensure an acceptable amount of hands-on interaction with the simulator for each participant. The Anesthesia Crisis Resource Management courses developed by Howard et al [1] also limit the number of participants and typically last 1–2 days.

Practitioners attending a major scientific meeting, such as the annual meeting of the American Society of Anesthesiologists or the World Congress of Anaesthesiologists, do not have large blocks of time to dedicate to a simulator-based session. Our method takes into account the busy schedule of meeting attendees by requiring only an hour of the participant's time while accommodating a large number of individual participants (approximately 25/day).

In adapting our method presented here to a specific meeting or CME course, we recommend a 7-step process:

1. Define learning objectives and/or study objectives
2. Select meeting or location for full-scale patient simulator sessions
3. Analyze expected composition of audience or participant pool
4. Establish minimum amount of time required for a meaningful, hands-on, individual session with the patient simulator
5. Establish minimum number of participants required (statistical significance for a study, break-even for a course) and verify that the required number can be attained within the format of the meeting or course
6. Rehearse and fine-tune the logistics as well as the simulation scenarios until all aspects are adequately covered and all personnel know their roles exactly
7. If the actual simulator sessions will occur at a different site than where the logistics is being developed, coordinate in minute detail with the actual study site

WCA 96 was in many ways a worst case scenario. Factors to consider and problems we had to overcome in designing our method are described below. We have grouped them in four main categories: simulation, meeting/study, national/geographic, and motivation.

Simulation

Inherently, the best learning experience on a full-scale patient simulator is provided in a one-on-one, hands-on format. This is the most severe constraint in that it limits the number of participants. In the future, multiple patient simulators might be used concurrently to increase throughput. Lack of familiarity with patient simulators is addressed by a didactic orientation session to the patient simulator prior to the actual simulator session. The need for numerous qualified simulator instructors was met by training local anesthesiologists to become simulator instructors, on site, a day prior to the study.

Meeting/study

The participants at the WCA 96 were from various national backgrounds, with varying degrees of familiarity with monitoring equipment. This variance must be established via a demographic questionnaire that each participant must complete so that it can be factored into the study. Participants at major scientific meetings usually have numerous time commitments; consequently, an appropriate and realistic goal is that each participant will spend roughly one hour in the simulator exercise area.

National/geographic

For the WCA 96, the electrical power supply, gas connectors, gas supply pressures (60 instead of 50 psig), and videotape format (PAL instead of NTSC) were different from formats and conventions used in the United States. Consideration must be given to electrical power requirements (220 V/50 Hz vs. 120 V/60 Hz), and to connectors for compressed gas supplies. We found it helpful to send exhibit coordinators actual samples of the gas connectors to ensure that the correct gas connectors were available for the patient simulator and other life support equipment (i.e., anesthesia machines, mechanical ventilators).

Motivation

Participants are motivated in the simulator-based exercises because (1) they are able to experience rare, complex and often life-threatening situations, (2) they are provided immediate feedback through debriefing using videotape playback and review of graphical plots of the patient's vital signs. Still, some participants may be concerned about "performing" or demonstrating their skills in front of peers. The learning potential of the full-scale patient simulator session must be well publicized to help participants overcome their initial fears.

We also gained other valuable insights when using our method at the WCA 96. The flier publicizing the simulator exercises that we distributed during the registration period did not work. While we were pleasantly surprised to find the drop box full of filled-out fliers after the first day, we quickly realized that there was no way to contact people who had responded and requested a particular time and day for their participation. In the end, the flier actually created confusion and we do not recommend using one to schedule participants. A flier should be used solely for publicizing the study and providing directions to the reception desk. Ideally, publicity for the simulator sessions should be included in the general meeting or course registration package.

On the first day, several participants were actually waiting in the staging area, without the receptionist being aware of it, which resulted in alternate participants being accepted. Consequently, after the first day, all participants were specifically requested to report to the reception desk upon arriving for their scheduled appointment time.

To avoid repeating the lecture on the simulator, we recommend that the introduction to the simulator be delivered via an 8–10 minute videotape, with a simulator applications engineer available to answer any questions from the participants. For a study, a videotape also has the advantage of presenting exactly the same material to all participants, so that all participants have the same baseline knowledge, independent of the styles of the different presenters.

Because of the didactic nature of the briefing on the simulator, another possibility is to have all participants for the day (or half day) meet for a group presentation of the simulator at the beginning of the day (or half-day). This group session might also provide the opportunity for the participants to confirm or modify their appointment times. However, a group session would be more for the convenience of the person presenting the simulator briefing than to increase throughput because the areas requiring one-on-one interaction, like the simulation and debriefing areas, remain the limiting factors. The convenience factor for the presenter of the group sessions has to be weighed against the inconvenience for the participants to report to the study area twice during a busy meeting as well as how to handle participants who miss the group session and show up for their simulator exercise.

Conceptually our method could be extended to cover simultaneous use of multiple full-scale patient simulators. We anticipate that the major challenge in adapting our method to multiple simulators will be personnel and space. Also, our method may be adapted for non-simulator based exercises, for example, anesthesia machine pre-use check, or evaluation and teaching of new equipment, techniques, or drugs.

Our commercial partners provided valuable assistance in implementing our method. An unexpected bonus for our commercial partners was that they were guaranteed that at least 100 anesthesiologists would spend 15 minutes in the equipment briefing room, becoming familiar with their equipment.

Our experience indicates that it is possible to conduct individual, simulator-based exercises and studies at scientific meetings and obtain large audience participation. We look forward to other researchers adapting and refining our method.

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REFERENCE

1. Howard SK, Gaba DM, Fish KJ, Yang G, Sarnquist FH: Anesthesia crisis resource management training: teaching anesthesiologists to handle critical incidents. Aviat Space Environ Med 1992; 63: 763–770