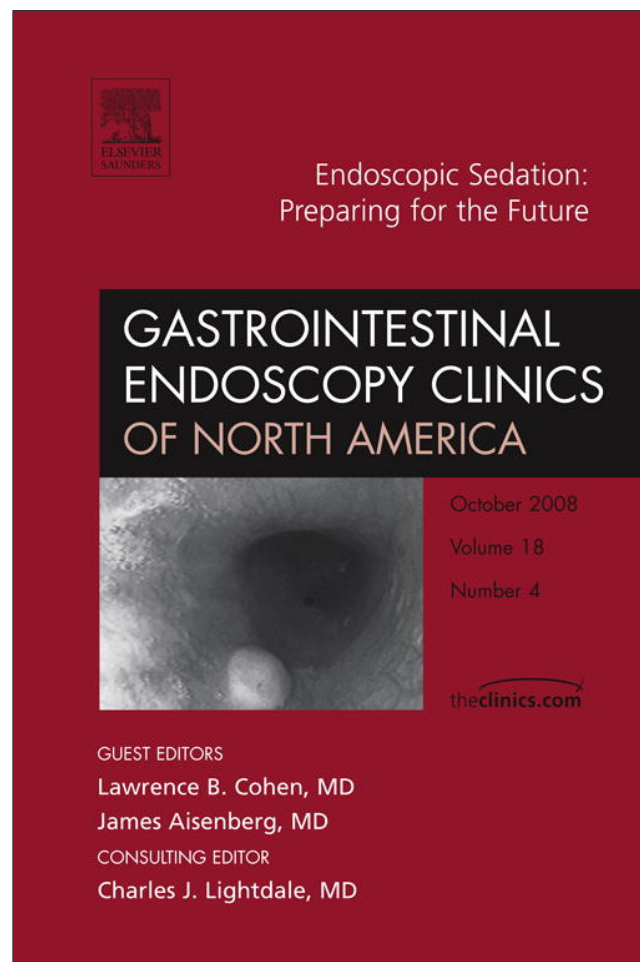


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Human Patient Simulation and its Role in Endoscopic Sedation Training

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KEYWORDS

• Patient simulation • Endoscopic sedation • Procedural sedation

Endoscopic sedation has an inherent potential to cause serious adverse events due to respiratory and circulatory depression. To improve the safety of patients undergoing endoscopy, guidelines for appropriate use of sedation and analgesia have been developed by several professional societies including the American Society for Gastrointestinal Endoscopy¹⁻³ and the American Society of Anesthesiologists (ASA).⁴ The Joint Commission (formerly the Joint Commission on Accreditation of Healthcare Organizations) and other accrediting agencies have developed standards, based largely on these guidelines, establishing minimum requirements for the practice of procedural sedation. These standards stipulate that a physician credentialed to administer “anesthesia” shall possess “appropriate education, training and experience.”⁵ What constitutes appropriate education and training is, however, left to the discretion of each institution. Accordingly, the content and form of sedation education for trainees and practicing endoscopists differ from one institution to another. Although there are no sufficient data to indicate how many institutions and gastroenterology training programs in the United States have formalized training programs in endoscopic sedation, few endoscopists in the United States receive formalized training in endoscopic sedation and in most instances, sedation training occurs *pari passu* with the teaching of endoscopic skills during gastroenterology fellowship.

Training in patient monitoring and sedation should encompass both didactic and practical elements. The didactic portion may be in the form of dedicated seminars or conferences, weekend symposia, or online web-based learning. The practical

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component should include both one-on-one mentoring in the endoscopy unit and competency-based training for the development of skills necessary for critical event management. In other fields of medicine such as anesthesiology, full-scale simulation has become very useful for this purpose. This article reviews the potential role of patient simulation in sedation education and training. A core training curriculum designed to provide the endoscopist with competency in endoscopic sedation, patient monitoring, and the management of adverse events is also presented.

THE ROLE OF SIMULATION IN MEDICAL EDUCATION

The use of patient simulation to educate and evaluate providers of sedation (traditionally anesthesiology residents) has become increasingly accepted. Although anesthesiologists took the initiative in incorporating simulation into their culture, its use in education and evaluation has been widely embraced during the last 2 decades by both medical schools and post-graduate training programs. The American Board of Anesthesiology now requires simulator-based education to fulfill maintenance of certification in anesthesia requirements,⁶ and the Accreditation Council for Graduate Medical Education has recognized simulation as a useful assessment tool.⁷ The Israeli Board of Anesthesiology Examination Committee has given primacy to simulation as an element in credentialing and certifying anesthesiologists.⁸ Indeed, the role of simulation appears to be evolving from that of an educational adjunct to an additionally useful tool in the assurance of clinical competence. Because the provision of moderate sedation by endoscopists essentially asserts their role as anesthesia providers, it follows that being trained in similar fashion would be beneficial. Hence, simulator-based education and evaluation is uniquely suited to this limited scope of anesthesia-based practice.

History and Classification of Medical Simulation

Although an exhaustive review of the history of medical simulation is beyond the scope of this work, a brief overview is in order. Cooper and Taqueti⁹ give a comprehensive survey of simulation and note that because the field is arguably in its infancy, few accepted conventions exist. Some basic terms with which the endoscopist should be familiar are listed in **Table 1**. These definitions provide a broad framework with which to describe the various types of simulators available in medical education today and encompass a wide array of human (eg, standardized patients) and manufactured (eg, manikins) simulation techniques. A more extensive system of classification has been described by Cumin and Merry.¹⁰

Table 1	
Common definitions in simulation	
Term	Definition
Simulator	Any object or representation of the full or part task to be replicated
Simulation	Application of simulator to training and/or assessment
Immersive simulation	Recreation of actual environment in which tasks are to be performed (eg, OR, ICU)
Part-task simulation	Technologies which replicate only a portion of a process or system
Fidelity	The nearness to "true-life" achieved by simulation

Data from Cooper JB, Taqueti VR. A brief history of the development of mannequin simulators for clinical education and training. *Qual Safe Health Care* 2004;13(Suppl 1):i11-8.

Inspired by the aviation industry, the first manikin-based medical simulators were introduced in the early 1960s. Resusci Anne, designed by Asmund Laerdal, was developed during this time to teach mouth-to-mouth resuscitation. The concept of basic life support training using a manikin-based simulator soon grew out of this simple design as Laerdal partnered with Peter Safar, a Baltimore anesthesiologist, to enhance his simulator's capabilities and realism.¹¹ The model underwent further significant improvement in the 1990s when more anatomically correct airway features were added and the model was renamed SimMan, which is still commercially available.¹²

Computer-driven simulators were first developed in the mid-1960s with Sim One, a full-scale manikin with a chest capable of rise-and-fall action during respiration, blinking eyes, and a jaw which could open and close.¹³ A single Sim One was manufactured and was eventually lost to obscurity largely because it was ahead of its time, although residents trained on the simulator acquired airway management skills quicker than their colleagues. The Harvey cardiology manikin was also developed in the 1960s but unlike the Sim One, it has had sustainable use to the present day. This simulator is capable of producing a wide array of cardiac disease scenarios, has been researched and validated extensively, and has evolved over time to include multimedia programs that enhance its fidelity.^{14–16}

The development of mathematical modeling programs for human physiology and drug pharmacodynamics and pharmacokinetics led to the development of modern manikin- and screen-based simulators. Various evolutions of these mathematically driven simulators have been developed at Stanford and the University of Florida, Gainesville, and are described elsewhere.^{9,17} Today the Human Patient Simulator (HPS), based on the Gainesville simulator and now manufactured by Medical Education Technologies Inc. (METI) is the prototypical full-scale, mathematical-model-driven product. This simulator can be used to stage full-scale simulations whereby realistic monitoring, physiologic response to drugs, and high-fidelity pathologic conditions can be encountered by participants. Key features of the HPS are listed in **Box 1**.¹⁸

A simple classification system of simulator types uses 3 categories: part-task trainers, computer-driven manikins, and virtual reality (VR) simulators on a continuum from low to high fidelity.¹⁹ Part-task trainers represent anatomic parts for teaching and/or evaluating skills (eg, plastic airways for intubation) and are generally passive, noncomputerized models. However, more advanced part-task trainers have been

Box 1**Features of the HPS by METI**

1. Pupils that automatically dilate and constrict in response to light
2. Thumb twitch in response to a peripheral nerve stimulator
3. Automatic recognition and response to administered intravenous and inhaled drugs and drug dosages
4. Variable lung compliance and airway resistance
5. Real-time oxygen consumption and carbon dioxide production
6. Automatic response to cardiovascular conditions including ischemia, needle decompression of a tension pneumothorax, chest tube drainage, and pericardiocentesis
7. Automatic control of urine output.

Data from Medical Education Technologies, Inc., Sarasota, FL. Available at: www.meti.com.

designed, such as the Endoscopy AccuTouch System by Immersion Medical. This is a computer-driven tool used to simulate flexible bronchoscopy and upper- and lower-gastrointestinal endoscopy. These simulators also include cursory responses to noxious stimuli, including audible sounds of discomfort from the simulated patient, increased heart rate and blood pressure along with the ability to respond to medications commonly used for sedation.

Computer-driven manikins or realistic patient simulators not only possess anatomically correct features, but also respond to stimuli and administration of medications through mathematical models. Such manikins are ideally suited for immersive simulation in which entire teams of health care providers can train to perform tasks, manage potentially deadly scenarios, and improve teamwork skills, including leadership, communication, delegation, and prioritization.^{20–23} Full-immersion VR is the newest and next generation of simulation where users can interact with all of the elements of the simulated environment. Although visual, auditory, and haptic (touch and pressure) feedback are all available in VR simulations, this technology is still in its infancy and much work needs to be done to fully incorporate VR technology into the field of medical simulation.

General Uses and Benefits of Simulated Patients

The growing interest in medical simulation for education and assessment of physicians has been fueled by many of the same factors that led to the use of simulation in the aviation and nuclear industries.²⁴ The importance of simulation is evident in aviation, where commercial pilots take their first flight only after a rigorous simulation program. The extensive use of simulation in the aviation industry has not been driven by evidence, but by intuition and common sense. To date, there is but a small body of evidence that simulator training improves health care education, practice, and patient safety, but, Gaba²⁵ argues, "...no industry in which human lives depend on skilled performance has waited for unequivocal proof of the benefits of simulation before embracing it." Certainly, adopting simulation for the training in moderate sedation seems sensible.

An educational imperative is one obvious utility of simulation. Simulation is learner-centered in that the participant's education receives the highest priority. There exist no competing patient needs and therefore the participant is afforded a unique opportunity to perform tasks without the looming stress of medical error. Medical clerkships and post-graduate training rely on apprentice-based, chance encounters with patients where learning time is limited and not standardized. Simulation eliminates these limitations and in doing so, benefits teachers too by allowing for an optimal learning environment and a predesigned curriculum that emphasizes points deemed germane by the instructor. Also, presentation of uncommon but critical situations in which a rapid intervention is required is possible.¹⁷ This offers the learner the benefit of experience with a particular disease state in a safe environment rather than a purely "textbook" knowledge of the subject.

Immersive simulation, in particular, allows for assessment and education that extends beyond simple cognitive measures. A participant or a team of participants can be evaluated and trained in domains of clinical knowledge, communication and teamwork, and procedural and technical skills in 1 environment and in 1 simulation session. An expert in the domain(s) of interest can then debrief the participant(s).²⁶ Debriefings are vital, as one can learn from mishaps that occurred during a scenario and also speak openly about perceived and actual errors and limitations without fear of liability, blame, or guilt. Errors are deliberately allowed to occur and reach their end, whereas in real life a more capable clinician would necessarily be called. In this

way, participants can see the results of their choices. Patient safety and medical errors have come to the forefront of health care since the Institute of Medicine released “To Err is Human: Building a Safer Health System in 2000.”²⁷ The effective integration of simulation into medical education and assessment can address this modern health care challenge.

In addition to the more obvious and intended benefits of simulation, the ethical benefits are also pronounced. Patients entrust health care providers with their well-being and enter into a relationship in which they believe their providers to be expertly trained. It follows that being trained in simulated scenarios before a real patient encounter reduces a patient’s exposure to less seasoned professionals. Thus, patients theoretically receive a higher quality of care than they might otherwise get from those trained in apprentice-based systems where the adage of “see one, do one, teach one” may, in fact, overestimate the experience the provider has attained. As alluded to previously, other high-risk fields such as aviation and the nuclear power industry have safely integrated simulation into their personnel training programs and competency evaluations.^{28,29}

A CORE CURRICULUM IN ENDOSCOPIC SEDATION

The Continuum of Sedation

The trainee should have a clear understanding of the ASA continuum of depth of sedation, be able to distinguish moderate from deep sedation, and recognize the physiologic implications associated with the respective levels of sedation (**Box 2**).^{1–3} Moderate sedation, the level of sedation generally targeted by endoscopists, is defined by purposeful responsiveness to verbal or light tactile stimuli. Ventilation, airway, and circulation are maintained at this level of sedation. The patient’s level of sedation should be assessed periodically throughout the endoscopic examination, especially when determining the need for additional sedation.

Box 2

Components of a training program for moderate sedation

1. Understanding of the continuum of sedation and the ASA guidelines
2. Knowledge of methods used for obtaining informed consent for sedation and the ability to counsel patients on risks, benefits, and alternatives
3. Skills for completing a medical history and physical examination, including airway assessment
4. Pharmacology of planned sedatives, antagonists, and drugs used for emergencies.
5. Understanding of the benefits and risks of supplemental oxygen
6. Management of upper airway obstruction, including the ability to use an oral or nasal airway and bag-mask ventilation.
7. Monitoring of physiologic variables, including blood pressure, respiratory rate, pulse oximetry, ECG, arrhythmia analysis, sedation depth, and capnography, if appropriate
8. Awareness of the importance of continuous use of appropriately set audible alarms
9. Documentation of medication administration, physiologic variables, and sedation depth using a formatted record.
10. Providing advanced cardiac life support (ACLS), if an ACLS provider is not immediately available.

Because sedation is a continuum, it is possible for a patient targeted for one level of sedation to reach a deeper stage of sedation. Accordingly, the endoscopist should possess the training to rescue a patient who reaches a level of sedation deeper than that which was planned. The endoscopist targeting moderate sedation should be able to establish airway patency and provide positive pressure ventilation. All endoscopists should be certified in ACLS.

Patient Evaluation

The preprocedure evaluation should identify those patients considered as high risk for procedural sedation. This would include the uncooperative patient, the difficult-to-sedate patient (including those with history of alcohol or substance abuse and history of inadequate sedation during prior endoscopy), and patients with serious comorbid illness. It is appropriate to refer such patients to an anesthesia specialist rather than administer moderate sedation. The trainee should understand the ASA physical status classification and record the level before sedation is initiated.

A focused history and physical examination is required before endoscopy. The history should identify significant medical illness (cardiac, pulmonary, renal, and hepatic) to permit appropriate triage of the patient. Female patients of childbearing age must be queried regarding the possibility of pregnancy, and a pre-sedation pregnancy test should be ordered if a patient is uncertain of her pregnancy status. A list of current medications and allergies (medication, food, and latex) should be elicited. A physical examination should include heart, lungs, and airway assessment, including assignment of a Mallampati score. The trainee should be familiar with the ASA guidelines on fasting.³⁰

Patient education should be considered part of the preprocedure encounter. This includes a discussion of the sedation plan as well as discharge instructions. It is also appropriate at this time to confirm that an escort will be available to accompany the patient home after completion of the procedure. The trainee should have a thorough understanding of the process of informed consent and be capable of discussing the indications, benefits, risks, and alternatives.³¹

Pharmacology of Sedation Drugs

The trainee should have a thorough knowledge of the pharmacology of all drugs used for endoscopic sedation within his or her institution.^{1,3} This includes the mechanism of action, dosing schema, time of onset and peak effect, duration of effect, metabolism, pharmacodynamic variability, side effects, and drug interactions. The pharmacologic principles of ceiling effect, stacking effect, and drug synergy and their clinical significance should be understood by all endoscopists. In addition, they should understand the appropriate use of pharmacologic antagonists of benzodiazepines and opioids.

A number of adjunctive agents, including diphenhydramine, prochlorperazine, ketamine, droperidol, nitrous oxide, and tramadol have been used to supplement benzodiazepines and opioids for hard-to-sedate patients. It is recommended that an endoscopist understand the pharmacology and acquire first-hand clinical experience with 1 or more of these agents.

All endoscopists should possess a basic understanding of the pharmacokinetic and pharmacodynamic properties of propofol and its clinical utility during procedural sedation. The endoscopist contemplating the implementation of a propofol sedation protocol within his or her unit will require more specialized training.

Patient Monitoring

Monitoring is intended to measure and record deviations from normal physiologic levels, warning of a potential adverse event.^{3,4} Monitoring includes both visual assessment of the patient and the measurement of physiologic variables. Accordingly, both the endoscopist and the endoscopy nurse must possess a basic understanding of pulmonary and cardiac physiology in order to be capable of interpreting and responding appropriately to physiologic changes. Visual assessment provides feedback regarding the depth of sedation, respiration, sweating, and skin color. Circulation is monitored through the measurement of heart rate and rhythm, blood pressure, and arterial oxygenation. Respiration is evaluated by the effort and frequency of breathing and oxygenation by pulse oximetry. The trainee should understand the difference between oxygenation and ventilation. Capnography provides real-time feedback on end-tidal carbon dioxide and expired carbon dioxide versus time waveform that is useful for assessing the adequacy of ventilation.

The trainee should recognize that all monitors have limitations. Pulse oximetry probes may become detached, or spurious data may result from movement. The role of an experienced observer is paramount when the findings of physiologic monitoring devices are discordant. All monitors should have audible alarms and appropriate limits should be established and maintained. The information available from clinical observation and monitors must be accurately and contemporaneously recorded.

The routine use of supplemental oxygen during endoscopy is controversial.^{32,33} The trainee should understand the benefits and potential disadvantages of supplemental oxygen use during routine endoscopy, and a decision regarding its use should be made based on an analysis of the literature.

The trainee should understand the importance of postprocedure monitoring, recognizing that most complications of sedation occur during either the first 8 to 10 minutes of a procedure or immediately after its completion. Postsedation monitoring is designed to ensure that physiologic functions return to baseline before discharge. Postsedation monitoring and discharge policies are required by all accrediting agencies. The modified Aldrete discharge scoring system evaluates 5 physiologic parameters: activity, respiration, oxygen saturation, blood pressure, and consciousness. Verbal and written instructions outlining diet, activity, medication, and follow-up evaluation should be provided to all patients.

Emergency Management

Respiratory complications, the most serious risk of procedural sedation, occur for 1 of 2 reasons: (1) upper airway obstruction due to tongue base, epiglottis, and/or soft palate and (2) ventilatory depression.³⁴ Endoscopists must be able to recognize the signs and symptoms of both forms of respiratory failure and possess the skills necessary to provide the appropriate intervention. The signs of upper airway obstruction include increased respiratory effort, sternal retraction, inspiratory stridor, hypoxemia, and absence of breath sounds. Treatment modalities that may restore effective ventilation include auditory/tactile stimulation, head tilt, chin lift, jaw thrust, adjunctive airway device, administration of reversal agents, and bag-mask ventilation. Laryngospasm, with upper airway obstruction due to spasm of the laryngeal musculature, should be suspected if bag-mask ventilation is unable to provide adequate oxygenation. Endoscopists administering sedation medications should be clinically competent to manage airway emergencies. There are several sources for additional training in airway management including a DVD on airway management produced by the American

Heart Association and a hands-on training course in airway management sponsored by Airway Management Education Center (www.theairwaysite.com).

Hypotension and cardiac arrhythmias (bradyarrhythmias and tachyarrhythmias) are the most commonly reported circulatory disturbances during endoscopy. The trainee with certification in ACLS will possess the necessary training and treatment protocols for the management of most cardiac disorders encountered during endoscopy. The endoscopist should also be able to recognize and treat anaphylactic reactions including those associated with latex allergy.

Deep Sedation Training

The requirements of a program designed to provide training in the use of propofol, in addition to that discussed for moderate sedation, should include a thorough understanding of the pharmacology of propofol and advanced airway skills.^{2,3} At a minimum, the practitioner should possess the skills necessary to provide bag-mask ventilation and the appropriate use of a supraglottic airway device. Personnel wishing to incorporate a propofol sedation program in their endoscopy suite should adopt a protocol for propofol use that has an established track record of safety and effectiveness in the hands of a nonanesthesiologist.³⁵⁻³⁷ Trainees should begin by observing an experienced propofol sedation team perform at least 5 cases using the same sedation protocol. This may be followed by a period of mentorship during which the trainees administer propofol sedation under the supervision of a qualified instructor.

Quality Assurance Program

The demonstration of competency in endoscopic sedation is assessed through direct one-on-one observation of performance-based skills (using a checklist to document successful performance of each item on the list), objective criteria (written examination), and subjective opinion of the endoscopy-training director. Currently, no quality indicators of endoscopic sedation have been adequately validated. Nonetheless, specific outcome measures of endoscopic sedation have been useful for continuous quality improvement processes. Examples of some indicators used in the sedation setting include documentation of presedation evaluation, postsedation monitoring, use of sedation discharge scale, unplanned hospital transfer, and assessment of level of consciousness throughout the examination, cardiopulmonary complications, and unplanned termination of procedure. Patient satisfaction surveys also provide useful data on the success of endoscopic sedation.

SIMULATION IN ENDOSCOPY AND SEDATION TRAINING

Simulation in Endoscopy Training

The use of simulation in the field of gastroenterology is not novel. In fact, simulated proctosigmoidoscopy was described as early as 1969.³⁸ Computer-based endoscopic retrograde cholangiopancreatography, endoscopy, and colonoscopy simulators are commercially available and used as part of many curricula in gastroenterology fellowships throughout the world. It has been suggested that the use of such simulation shortens the initial learning curve for these procedures. This is of great importance to the field in light of evidence suggesting that patients indicate dissatisfaction and suffer an increased frequency of adverse events when procedures are performed by trainees, especially early in the training period.³⁹ Furthermore, fellow involvement in endoscopic procedures leads to longer procedure time and subsequent financial loss. Although evidence is still accumulating, 2 large reviews of extant data suggest that

simulation-based training serves a valuable role in the field of gastroenterology, specifically with regard to training residents and fellows in endoscopic skills.^{38,40}

Simulation in Sedation Training

The use of simulation to train anesthesia residents has been well documented. Similarly, gastroenterologists and fellows may be trained and assessed in the provision of moderate sedation using simulation technology. Depending on the resources of a particular institution, a full-scale “endosuite” can be reproduced.

The application of simulation technology for training in sedation/analgesia has recently been reported. Farnsworth and colleagues⁴¹ assessed the results of a 90-minute teaching program using an anesthesia simulator with 20 nurses working in units of a hospital where conscious sedation was performed. The program was successful in meeting its goals, which included an improved knowledge of the subject (sedation/analgesia), satisfactory performance on a clinical crisis test scenario, and satisfaction with the learning program.

During the fourth annual Conference on Endoscopic Sedation, the authors offered an optional 4-hour training session that included the use of a full-scale patient simulator (METI). This program was sponsored jointly by the departments of medicine and anesthesiology of the Mount Sinai School of Medicine. The schedule for this conference was as follows: introduction = 10 minutes, pretest = 30 minutes, didactic presentation = 60 minutes, HPS (critical event demonstrations) = 30 minutes, HPS (clinical scenarios, hands-on) = 80 minutes, and post-test/program evaluation = 30 minutes.⁴²

After the pretest, an endoscopist and a staff anesthesiologist presented an overview of the basic principles of sedation training, including a brief discussion of the HPS, preprocedure patient assessment, physiologic monitoring, pharmacologic profile of sedative and analgesic drugs (including reversal agents), continuum of sedation and analgesia, and methods of rescue. This was then followed by simulator-based demonstrations of supraglottic airway devices, proper technique of mask ventilation, and management scenarios (difficult-to-sedate patient; cardiopulmonary event during endoscopy, upper airway obstruction due to laryngospasm, oversedation). Fifteen participants then had an opportunity to rotate through 2 stations where clinical scenarios were simulated and trainees provided “hands-on management” for various critical events. The trainee was responsible for ordering sedation medication, monitoring the patient, identifying the disorder, and initiating appropriate corrective actions. During this time, the anesthesiologist observed and assisted as necessary. A post-test examination, consisting of the same questions on the pretest but arranged in a different order, was designed to quantitate their learning experience during the session. Participants completed a satisfaction survey at the end of the session.

The laboratory was maximally enrolled (9 nurses, 6 physicians). Fifteen paired tests were analyzed. The mean total test score increased from 20.3 (67.6%) to 22.8 (76.0%) ($P < .05$). Overall, the course was quite well received by the attendees. Based on the results of the course evaluations, satisfaction among attendees scored 3.9 or higher (scale 0–4; 4 = excellent) for clinical scenarios, effectiveness of hands-on experience, length of program, authenticity of simulation experience, recognition and management of sedation-related complications, improving understanding of moderate sedation, and overall assessment.

The Future of Simulation in Sedation Training

Clearly, the potential combinations of scenarios achievable in the simulated environment are inexhaustive and range from the basic and common to the complex and

rare. Although basic knowledge and cursory facility with airway management, ACLS protocols, and the ability to recognize the need to call for help are easily taught and practiced in these environments, complex, rare, and critical events are just as easily reproduced for learning and practice. It is important to note that, whereas the actual scenario is crucial for the learner, the debriefing session with an expert in sedation and airway management is considered a critical component to the learning experience. Misses and near misses can be discussed and opportunities for improvement and further study/practice suggested. The simultaneous training of an additional participant with an endoscopy simulator makes the scenario more “true to life” and maximizes instructional time for endoscopists and their trainees.

While the benefits of simulation-based technology seem obvious, numerous limitations still exist that restrict its broad and rapid expansion. Because this form of training is currently extremely expensive and labor intensive compared with other forms of training and education, the availability of such resources is still limited. Cost continues to be a major obstacle to greater adoption of this teaching modality. The start-up cost of a HPS and associated equipment is significant (more than \$200,000). Additional costs of operation include faculty time for an anesthesia instructor and a simulator technician. Simulator-based courses are likely to cost more per participant than traditional continuing medical education lecture-based courses. In addition, the number of students who can be educated simultaneously using this technology is limited, and the cost to educate each student can be quite high. Although the expense of such a training program can be sizable, it may ultimately be cost-effective by allowing trainees and practitioners to work more safely and efficiently.

Although many societies including the ASA and the American College of Surgeons have started to certify specialty-specific simulator programs and centers, their availability to outside specialties and their geographic distribution may be limited. In addition to the cost of participating in the simulator-based activity, those wishing to receive simulator-based training will also probably need to absorb the expense of travel and accommodation as well as the loss of wages during the training period. Teaching institutions are currently the main sites of simulation, but independent simulation training centers may develop as the need or the public demand for such training occurs, making the economics of center development favorable.

Aside from the logistic issues discussed earlier, simulation education, training, and assessment also have other limitations. Although the simulated environment can predict the level of training based on performance, there are few data to support a transfer from what is learned and observed in this environment to the actual clinical arena.⁴³⁻⁴⁵ Many participants in simulated environments may not take the scenario seriously and therefore may perform below their capabilities, as they are not “stressed” enough to perform optimally. Alternatively, the participants may perform at or better than their capacity if they are not as stressed as they might be in an actual critical situation. In addition, the participants are aware that an event is likely to occur because they are in a simulator, therefore they become hypervigilant and wait for the event to occur. These weaknesses aside, the common sense element of training individuals in a safe, simulated environment appears obvious.

SUMMARY

Our initial experience with the human simulation laboratory indicates that endoscopy nurses and physicians are receptive to this method of sedation training. Although much work remains to be done in the field of simulation, including an assessment of educational content, the number of training sessions needed to achieve competency,

and the frequency of re-training, its role in training and the continued education of endoscopists in the practice of moderate sedation appears essential.

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